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GENDER, HUMAN CAPITAL AND GROWTH: EVIDENCE FROM SIX LATIN AMERICAN COUNTRIES

by

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RÉSUMÉ

Ce document fait la synthèse des recherches menées par Donald J. Robbins à la demande du Centre de Développement. Il examine la structure et les déterminants des progrès rapides obtenus en matière d'éducation dans six pays latino-américains (Argentine, Chili, Colombie, Costa Rica, Mexique et Uruguay). Tous illustrent les bouleversements radicaux que connaissent actuellement la croissance, la démographie et l'enseignement dans la plupart des pays de la planète. Selon l'auteur, la hausse de la production par habitant, *via* les incitations pour les femmes à entrer sur le marché du travail et la diminution consécutive de la taille des familles, est l'un des facteurs clés de l'amélioration du niveau d'éducation.

Ces constatations mettent en exergue le rôle joué par les femmes dans les décisions micro-économiques quotidiennes des ménages, et l'importance de leurs conséquences économiques et sociales. C'est le cas par exemple des décisions concernant la participation au marché du travail et le passage d'une vision « quantitative » de la famille (familles nombreuses) à une vision plus « qualitative » (moins d'enfants et plus d'investissement dans la santé et l'éducation). Ces décisions expliquent pour une grande part la hausse de la productivité marginale de la main-d'œuvre dans une proportion notable du monde en développement.

SUMMARY

This Technical Paper reports on a body of research conducted for the OECD Development Centre by Donald J. Robbins. It examines the patterns and determinants of rapidly rising educational attainment in six Latin American countries — Argentina, Chile, Colombia, Costa Rica, Mexico and Uruguay — all of which illustrate the sweeping transformations in growth, demographics and education now occurring in much of the world. It finds that rising per capita output, through a mechanism which induces women to join the labour force and interacts with falling family size, acts as the key factor leading to mounting educational achievement.

This in fact highlights the role of women in basic household microeconomic decisions with powerful economic and social effects — decisions about female labour-force participation and family shifts from notions of "quantity" (large families) to those of "quality" (fewer children, with more investment in health and education). It carries important implications for explaining the rising marginal productivity of labour in a sizeable slice of the developing world.

PREFACE

For some time, the Development Centre has been concerned with the social effects of globalisation in developing economies. As the integration of the world economy continues apace, it becomes more and more urgent to seek ways in which developing countries can participate in the process and reap benefits from it, while protecting their populations from negative side effects.

To this end, the Centre is undertaking research on foreign direct investment and income distribution, and on labour markets, education and developing economies. This Technical Paper forms part of the latter research, looking specifically at the interaction between gender, human capital and growth in six Latin American countries: Argentina, Chile, Colombia, Costa Rica, Mexico and Uruguay. It finds that rising educational achievement is causally linked to rising per capita output. Moreover, it concludes that as women join the labour force there is a tendency towards fewer children and higher family investment in education and health, leading to a decline in quantity and an increase in the quality of the workforce.

This finding is important, for it begins to explain part of the dynamics which will allow developing countries to participate more actively in the world economy. It shows that the participation of women in the work force is not only a socio-political objective, but economically desirable.

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I. INTRODUCTION

Educational expansion, the key phenomenon explored in this study, appears in many developing countries. Figure 1 illustrates its rapid pace in nine of them, in Latin America and Asia. It plots the ratio of university-educated equivalents to primary-educated equivalents, or "relative supply", in their adult populations[1]. All show a striking pattern of rapid, unabated increases in educational attainment. Relative supply for the group rose at an average annual rate of 5 per cent[2], and typically it at least doubled over the fifteen year period from 1975 to 1990[3].

With these rapid increases, education levels in many developing countries have come to rival those of more developed nations, and middle-income Latin American countries have generally performed even better than countries in other regions. Figure 2 illustrates both points. In Bogota, Colombia, the share of university-educated people in the adult population more than doubled from 1976 to 1994, rising from 8 per cent to 19 per cent, to levels comparable with those of the OECD countries, which had raised their shares from 7 per cent in 1960 to 18 per cent in 1985. East and South Asia both had more modest gains in 1960-85, from 2 per cent to 6 per cent in the former and from practically zero to 3 per cent in the latter. In Bogota, the share of those with completed secondary education also doubled, from 10 per cent to 23 per cent — still substantially below OECD levels but rising faster, with both levels and rates of increase exceeding those in East and South Asia[4].

This study argues that understanding the striking growth of educational attainment becomes critical for comprehension of many central economic and social issues in countries where such growth occurs (and where it does not). The perspective stresses real wages, economic growth, income distribution and patterns of global trade. Most of these themes get developed in much greater depth later on; they all merit some introductory comments here, to bring the perspective itself into focus.

Real Wages

The level of average real wages results from changes in productivity and in the productive inputs, namely physical capital and human capital, of which schooling is a key part. Higher average real wages in developing countries often arise largely from increases in the average level of schooling. In Chile, for example, most of the nearly 50 per cent gain in urban real wages from 1960 to 1990 came from more education: the marginal effect of rising schooling levels actually would have boosted real wages by 80 per cent, had not other changes mitigated it. In Colombia, rising educational levels contributed 25 per cent at the margin to a nearly 40 per cent gain in average urban real wages from 1976 to 1989. In Chinese Taipei, where average real wages rose by 90 per cent (1978-92), rising educational levels had a marginal effect of 14 per cent (Robbins and Menendez, 1996).

Economic Growth

Human capital and formal education also relate closely to rates of economic growth. Using cross-country data, Barro (1991) found the growth rate of per capita GDP positively related to initial levels of enrolment rates. Similar findings by others include Benhabib and Spiegel (1994), and Barro and Sala-i-Martin (1995). These results accord with the models of Lucas (1988), Jones and Manuelli (1990) and Rebelo (1991), which emphasise the role of human capital in the growth of total factor productivity and per capita income.

Income Distribution

Changes in the determinants of the distribution of earnings separate into two broad groups: changes in the distribution of the productive attributes of persons, of which formal schooling is a central ingredient, and changes in the wage structure or returns to these productive attributes. Understanding the first requires knowledge of the determinants of individuals' investments in education. The supply of human capital directly affects the wage-structure component. Changes in it feed back upon the price of, or returns to, human capital.[5 6] Whether the converse is always as important, i.e. whether changes in returns to schooling affect educational attainment, is a major theme of this study.

Trade and Human Capital

Much recent research has examined "trade and wages", or how globalisation and trade liberalisation affect the structure of wages and, ultimately, changes in wage distribution. These studies have focused almost exclusively on the determinants of wage structure, with only indirect concern for education levels or distribution, largely to verify the predictions of trade theory regarding trade opening and wage structure. They have sought specifically to test the Stolper-Samuelson theorem applied to models with two types of labour. It predicts that trade liberalisation will raise the wages of more educated workers relative to those of the less educated in skill-rich countries (the "North"), while lowering relative wages in skill-poor countries (the "South").

These studies (by trade economists) typically have chosen to ignore shifts in the domestic level and distribution of education, measured in this paper as "relative supply". The basis for dismissing relative supply shifts when examining wage structure is the argument that most countries — even the United States — are so small relative to world markets that shifts in their relative supplies will hardly ripple the global ocean of relative labour supply (the Rybzinski Theorem, see note 6).

Labour economists have taken an opposite view. Their more "partial equilibrium" approach, rooted in empirical knowledge of the labour market, has encountered heavy criticism for ignoring the Rybzinski trade theorem. It has emphasised the role of relative supply as central in wage determination but, in studies of trade and wages, it has not explicitly considered human capital or formal education as determined endogenously within the trade process. Instead, such studies have usually incorporated relative supply shifts only as controls that would allow them to identify shifts in the relative demand for skills that may derive from trade opening or globalisation.

Besides arguing that domestic labour-supply shifts can be ignored, trade theory has generally shunned the issue of human capital determination. Much of the theory is based on exogenous factor endowments, notably of capital, land, skilled workers and unskilled labour; only a handful of models examine skill determination as endogenous, and they assume that human capital is an increasing function of the returns to human capital alone (Findlay and Kierzowski, 1983; Findlay, 1995; Davis and Reeves, 1997).

Is this simple formulation of human capital realistic? Perhaps not. Both theory and casual examination of data for some developing countries suggest that the returns to education may not be the key to understanding its attainment. Figures 3 and 4 graph relative supply and relative wages lagged five and ten years for several such countries. Relative wages proxy returns to schooling very closely. The figures give little suggestion that changes in relative wages in these countries have had major impacts upon relative supply.

Recent human capital theory also suggests that educational attainment may involve far more than the returns to schooling. Earlier models, here called Simple Human Capital (SHC) theory, viewed education as an investment determined principally by returns to education. An alternative approach, an Extended Human Capital (EHC) model, emerged from the observation that families

largely self-finance their children's education, given the absence or imperfection of credit markets for individual educational investments. This puts educational decisions squarely within the nexus of other family consumption and investment decisions, introducing other factors into the determination of educational attainment. They include the prices of consumption goods, net returns to education, the direct and indirect costs of raising children and family income.

The EHC model provides a framework that can explain the pattern of rising educational attainment or relative supply, even with current or lagged returns to education falling. This study uses the framework to seek empirical evidence of the explanation, notwithstanding very limited information, especially for developing countries, on what alternative factors or prices vary over time and give rise to increasing educational attainment. The first tasks, taken up in the next section, involve *i)* a review of the inextricably interwoven economic theories of human capital and fertility, focusing on the EHC model and its potential for the purposes at hand, along with a summary of shortcomings of the extant empirical literature; and *ii)* a description of the methodology used for the main work of the study. The stage will thus be set for an exposition of the empirical findings.

NOTES

1. For persons with more than primary-complete and less than university education, this measure employs the "Linear Skills Synthesis" framework (Welch, 1969) to estimate how much university-equivalent and primary-equivalent education they possess (see also Robbins, 1995).
2. Regressing log relative supply onto time, time-squared and country dummies yields a coefficient on time of 0.048 (t-statistic = 5), and 0 on time-squared (adjusted r-squared = 0.87). Excluding Malaysia, the estimated coefficient on time fell to 0.04.
3. The roughly 15-year periods vary among countries, depending on data availability. For individual countries, the percentage increases in relative supply were as follows: 115.8 per cent (Argentina, 1976-90), 65 per cent (Chile, 1976-90), 82.3 per cent (Colombia, 1976-89), 87.4 per cent (Costa Rica, 1976-90), 1 508.1 per cent (Malaysia, 1973-89), 46.8 per cent (Mexico, 1987-1993), 68.1 per cent (Philippines, 1978-88), 110 per cent (Taiwan, 1978-90) and 29.9 per cent (Uruguay, 1984-90).
4. Evidence from the other six major Colombian cities is consistent with the figures for Bogota, although their educational attainment levels are slightly lower. See Robbins (1998*c*).
5. Robbins (1996) presents evidence of the first order impact of shifts of (relative) supply of education human capital upon relative wages, even for countries with diversified trade.
6. An aside regarding human capital supply and wages in the presence of trade: in theory, the relationship between shifts in the domestic supply of human capital and domestic wages may be broken for small trading countries satisfying the Hecksher-Ohlin-Samuelson conditions (the Rybzinski Theorem). Domestic supply shifts would be overwhelmed by global supply, so that they do not lead to changes in domestic relative wages. Robbins (1996), however, finds evidence to the contrary.

II. THE DETERMINANTS OF EDUCATIONAL ATTAINMENT: CONCEPTUAL FOUNDATIONS AND EMPIRICAL METHODOLOGY

Theory and Evidence

Contemporary understanding of the determinants of education levels emerged initially from the human capital models of Becker (1964) and Mincer (1974), who developed what this study calls the SHC model. Upon this base, the theory broadened to embrace a wide range of family behaviour, fertility in particular, in the EHC model.

The SHC model postulates that education is an investment good whose principal costs include the direct cost of education and the opportunity cost of foregone earnings while in school. People invest in "s" years of education until the expected return on this investment equals the market interest rate. Because the supply of educated persons affects the returns to education, in equilibrium persons may have different levels of education[1]. Adding diversity in personal endowments of ability and parental wealth, and hence possibly in the costs of funds, leads to a diversity of optimal education levels and outcomes. Crucially in this model, people may borrow freely to finance their education, which produces the equality between returns to education and the interest rate. Parental income does not affect the demand for education.

The EHC model (also known as the Household Model of production and consumption) challenges a central assumption of the SHC, that a perfect financial market exists in which to finance desired educational levels. It assumes instead that future education does not constitute good loan collateral, so that a failure occurs in the financial market for education (summarised in Becker, 1995, Chapters 5-7). To the degree that parents finance their children's education, their income and wealth enter into the demand function for education as constraints in the family's intertemporal budget. If parents are altruistic and value the future consumption of their children, they will value the children's' health and future earnings capacity, or child "quality" for short, in a joint calculus with their valuation of the number of children they raise, or child "quantity". Most of this study emphasises the educational component of child "quality".

The EHC model thus studies the family's behaviour, where the satisfaction (utility function) of the parents depends upon both the number and quality of their children, along with the consumption of other goods. The basic EHC model is essentially the standard consumer demand model, with a crucial twist. As a consequence of incorporating quantity and quality, the budget constraint faced by the family includes an interaction term involving both. This interaction reflects a peculiarity for family demand that has immense implications for demography and education: very small changes in the relative price of quantity versus quality will lead to dramatic substitutions between them (technically, the elasticity of quantity or quality to their relative price is extremely high, although they are not close substitutes as consumption "goods"). The model predicts that small but continual increases in the price of child quantity relative to child quality — or, as families might more readily see it, decreases in the price of quality relative to quantity — will lead to very strong, secular increases in child quality and decreases in family size.

The price of child quality can include a variety of factors, notably costs of education and the inverse of the returns to education (a negative price). The price of child quantity can include the fixed costs of bearing and raising each child, the (negative) price of children's earnings, particularly in agriculture or in urban informal-sector work, and the opportunity costs of the mother, notably foregone labour-market earnings.

The EHC model leads to a system of demand equations

$$q = f(n, p_{n.}, P_Q, P_{az}, Y) \quad (1)$$

$$n = g(q, p_{n.}, P_Q, P_{az}, Y) \quad (2)$$

$$z = h(n, q, p_{n.}, P_Q, P_{az}, Y) \quad (3)$$

where,

q is optimal quality (years of education, here),

n is optimal quantity, or family size,

z represents optimal levels of other consumption goods.

The Merging of Demographics and Human Capital Theory

Early economic theory had a poor track record in predicting population growth and real wages. In recent years the discipline has done far better. In his famously pessimistic analysis, Malthus predicted continued subsistence-level poverty for the majority of the population because, based on biological principles, any economic gain would literally be "eaten up" by ensuing population growth. This explosive population response to economic growth would continually force the average level of per capita output — or the real wage — back to subsistence levels.

In contrast to Malthus's dramatic but inaccurate theory, the *apparently* separate strand of economic theory modelling individuals' decisions to educate themselves, the SHC model, has predicted reality more closely. A vast empirical literature has verified that education is indeed one of the major determinants of persons' earnings, that returns to education respond to its supply, and that educational choice is in large part an investment decision. Yet the SHC theory, while correct in many respects, could not fully explain some aspects of the educational investment decision. The broader EHC theory that superseded it, and that links fertility and human capital formation, completed the replacement of Malthusian biological principles with economic ones; it became the cornerstone for understanding the demographic transition.

The "demographic transition" refers to a widely observed shift from typically small populations with high birth and death rates to much larger populations with low birth and death rates, small family sizes and low net population growth, often accompanied by rising educational levels. It began with a fall in mortality rates due to advances in medical science and the dissemination of basic sanitation infrastructure and practices. Contrary to Malthusian expectations, falling mortality rates led to lower fertility rates[2], although greater numbers of surviving, desired children initially raised population growth[3]. Birth rates eventually fell faster than mortality rates, however, leading to falling population growth, smaller families and rising educational levels.

What led to this transition? The EHC model, and related but more detailed models of fertility, have had wide use as explanations. Fertility fell initially, the argument runs, because families aimed for *net* child-survival rates; as mortality dropped and the probability of a given child reaching adulthood rose, the desired number of births shrank. Yet decreasing mortality alone would not lead to less population growth. That arose from a change in the relative price of quantity versus quality in children, consistent with the EHC model, where small increases in this relative price induce a big substitution from large families with and low per-child quality, to small families with high quality per child. As with any investment facing fixed up-front costs, the longer the horizon over which the investment will bear fruit, the more profitable it is. Thus, falling mortality and longer expected life spans, which raised the expected returns on investment in human capital, further encouraged this substitution towards more education per child.

Changes in the Relative Price of Quantity versus Quality of Children

Becker and Mincer put forth various possible reasons why the relative price of quantity to quality may rise over time. Their central hypothesis is that the net price of child quantity rises with urbanisation. This occurs largely because rural children offset their fixed costs by working on the farm, while children in the city have fewer work opportunities, so that urbanisation induces a progressive rise in the national average relative price of quantity versus quality and the ensuing demographic transition.

As a secondary cause, Becker and Mincer (e.g. Mincer, 1995*a*) suggest that secular increases in the opportunity cost of time also contribute to falling population growth:

> "In addition to costs due to urban living, . . . the opportunity cost of time in raising children is another factor that leads to declines in population growth and the ultimate completion of the demographic transition . . . . (Mincer, 1995*a*).

Other components of relative prices could also drive the demographic transition, such as secular increases in the returns to education.

Comments on the Opportunity Costs of Women

To the extent that the rising opportunity cost of time may induce demographic transition, female labour-force participation rates ought to rise, along with shrinking family size and rising education per child. But will an increase in the opportunity cost of time necessarily lead to this outcome? Alone, it is not sufficient to induce transition or even a change in quality per child. Following Becker (1964) and Mincer (1995*b*), if the demand for household-intensive goods rises rapidly with income (i.e. if it is income-elastic), or if household productivity growth exceeds market productivity growth, then rising opportunity costs may fail to engender transition. Empirically, however, child quantity has a low income elasticity and child quality a high one, while market productivity tends to rise faster than household productivity (Schultz, 1981; Mincer, 1995*a*).

In a different formulation, Cigno (1991) shows that an increase in the female wage typically raises the relative price of quantity versus quality of children, and that the attendant substitution effects from quantity towards quality will tend to dominate income effects. This occurs because the value of the mother's time is a large part of the cost of child quantity, and because her earnings will often be a small part of total family income. By contrast, a rise in the father's opportunity costs will lower the relative price of quantity versus quality. A rise in the father's wage alone will both induce substitution towards larger families and lower per-child quality and generate large, dominating income effects. If fathers' opportunity costs rise, both quantity and quality are likely to rise, and quality per child is likely to fall.

These asymmetric effects of mothers' versus fathers' wage changes make it clear that a symmetric rise in the real wage for both men and women will generate countervailing substitution effects and reinforcing income effects, so that the income effects are likely to dominate. The symmetric rise in wages generates opposite substitution effects that may roughly cancel out; but the income effects work together to raise family size, without a clear change in quality per child. Thus, under Cigno's framework, for opportunity costs to generate demographic transition, the mother's wage must rise more rapidly than the father's — say, from a decrease in gender discrimination.

The Becker-Mincer arguments regarding income elasticities and productivity growth become compatible if one converts the mother's wage into a net market versus household wage. Assuming a constant sex-wage or "gender" differential, the rate of increase in the father's wage will tend to equal that of the mother's. Then, if labour's market productivity rises faster than its household productivity, this tends to raise the net opportunity costs of mothers faster than that of fathers.

While a simplified version of the Becker-Mincer EHC model suggests symmetric price effects, asymmetric effects may commonly occur. In the simplified EHC model with different prices making up the overall relative price of quantity versus quality, changes in those prices have symmetric effects. Any price change leading to a change in the overall relative price will affect both the quantity and quality of children demanded in a symmetric fashion. In more precise or explicit models of household behaviour, however, individual prices act asymmetrically; changes in some prices may have larger effects upon quantity or quality. For example, in Cigno (1991), changes in subsidies for children affect only the price of child quantity and tend to affect quantity more than quality. Depending upon how prices enter, therefore, price changes may affect quantity and quality symmetrically, or act more directly upon one or the other. This point has relevance, for example, in the Argentine case discussed later, where rates of return to schooling changed but opportunity costs for women held largely constant, inducing a large change in quality with little change in quantity.

The Nature and Underlying Causes of the Changing Relative Price of Child Quantity and Child Quality

While the EHC model provides a rich framework for understanding population dynamics and human capital accumulation, it should be clear from the foregoing that it can show many paths toward rising educational attainment and demographic transition. Transition unambiguously requires a secular rise in the relative price of quantity versus quality. Yet the notion of a single relative price obscures that the prices of quantity and quality really consist of many potential sub-prices — for quantity, the foregone earnings of children, perhaps associated with urbanisation, the direct costs of giving birth to, clothing and feeding them, the opportunity costs of mothers, etc.; and for quality the direct costs of education, the returns to it (a negative price), and so on. Thus, a secularly changing relative price may arise from changes in a wide variety of component prices. To understand the underlying causes of changes in educational attainment and accompanying demographics, one must identify the particular price changes driving the process.

Although Mincer and Becker have tended to emphasise urbanisation as the economic force leading to a secularly rising price of quantity versus quality, much of the evidence on the underlying price changes driving demographic transition for both developed and developing countries is anecdotal or non-dynamic. Different forces may lie behind different episodes of transition, particularly at different points in history.

Studies of educational attainment in the early 1980s were often simple analyses of aggregate time-series data and, while they did include time-varying factors, such analyses have encountered scepticism. These studies also suffer from severe colinearity, aggregation bias, the use of poor proxies and weak information on underlying variables.

Subsequent work has tended towards increasingly sophisticated exercises employing individual-level microdata for single cross-sections; but such data sets are ill-equipped to examine directly the actual dynamic process driving change, because they largely exclude time-varying prices, such as the returns to schooling and government spending on education, that potentially explain the dynamic transition. The only time variation within cross-section studies of these sorts is across cohorts within the single sampled year. A small subset of these studies (e.g. King, 1987) included returns to schooling that varied across cohorts within the sample. This approach is limited, however, because the range of ages in a given cross-section is fairly narrow and hence the variation in returns to schooling tends to be small. The frequent absence of earlier cross-sectional data meant that returns for all schooling were often unavailable for all cohorts in the cross-sectional sample.

The predominant single cross-sectional studies also often suffer from use of data on persons with incomplete spells of education or, when completed spells are used, from unreliable, retrospective data. Many, motivated by the desire to include family background variables, examine

the educational attainment of persons still studying; but the variable of real interest is the *completed* level of schooling, which goes unmeasured. A few studies employ completed spells of schooling by looking at adults in the sample. In addition to typically excluding time-varying variables, these studies do not measure family characteristics directly, but reconstruct them through highly subjective, retrospective questions (e.g. Parish and Willis, 1993).

Empirical Strategy, Data and Methodology

Empirical Strategy

The next section examines the determinants of educational attainment in six countries, Argentina, Chile, Colombia, Costa Rica, Mexico and Uruguay, within the conceptual framework of the EHC model. Each of these six studies has exactly the same form as the others: an extended graphical analysis of key variables that may serve as such determinants, followed by regression analyses to pin down the associations and, last, interpretative comments. All six attempt to address the three central problems of previous studies, namely:

— the absence of time-varying prices affecting educational attainment;

— the use of incomplete spells of education; and

— the use of completed educational spells but with only retrospective information on family characteristics.

Pooled multiple cross-sections for each country incorporate the time-varying factors and avoid analysis of individual cross-sections. Such data typically embrace individuals across longer periods and thus enable introducing measures of returns to education and public educational expenditures, which generally varied significantly over the study periods.

Most studies that use incomplete educational attainment do so because information on individuals comes from household data sets. In them, persons who have completed their education often no longer live with their parents, rendering direct information on the relevant parental households unavailable except through retrospective questions. To address this problem, the focus rests in large part on recent school leavers with completed education, who still live with their original families. This is feasible because in the countries examined, the vast majority of recent school leavers remains with the original families for several years. The practical definition considers as “recent” school leavers or graduates those who left school within the four years of the survey date, with due care taken to explore the robustness of the results to avoid sample-selection bias.

The Data

For each country the data represent a combination of multiple cross-sectional household surveys and macrovariables. The household surveys contain information on individuals and identify the members of households. They yield information on sex, age, educational attainment, earnings and relationship to family structure for each individual. By linking information across household members, variables could be formed summarising individuals’ family characteristics, such as family size, parents’ education and ages, etc. Some variables were estimated, such as potential labour market earnings, or opportunity costs of the mother.

The macrodata came from two sources. Time series on public educational expenditures, available in most cases, could go directly into the analysis without reworking. Returns to education for each year were estimated from individual household data, with many different measures employed to check for statistical robustness. The analyses turned out to be highly consistent across measures, and three calculated returns measures were retained: the returns of secondary over primary, of university over secondary and of university over primary education.

Key Variables

The principal variables and their definitions are:

s *Completed years of schooling* (completed educational attainment), for recent graduates as defined above, is the principal variable of interest, the dependent variable to be explained.

n *Number of children in the family.* Completed-family size was estimated as the average number of children of women aged 35 to 40, an age when most children still remain in the family but have been born. Because of attrition and unborn children, this will somewhat underestimate total completed-family size, but it serves as a reasonable measure of changes in family size over time.

Y_h *Head of household's income from work.* This variable measures all income from labour by the head of household. In the econometric work, it reflects the largely exogenous component of family income, as suggested by examination of hours worked and participation. Total family income is highly *en*dogenous, because spousal labour-force participation, family size and children's education are jointly, endogenously determined.

S_p *Average parental education.* While individual parents' education was studied carefully, they were very highly correlated within families and their average summarises nearly all the information on both. This facilitates the econometric study of children of families with both one and two parents.

W_f *Females' opportunity costs.* This variable reflects the market value of women's time at prime child-bearing age. It was calculated by estimating Heckman-corrected earnings functions for women, then matching the year of the estimated earnings function to correspond to age 30 and evaluating that particular year's earnings function for the schooling of the particular woman at that age. Thus, for the i-th woman surveyed in year t, aged 45, with schooling of s_i, her estimated opportunity costs at prime child-bearing age would be:

$$w_{i,t} = \alpha_{t-15} + \beta_{t-15} * s_i + \delta_{t-15} * 30\text{-}s\text{-}6 ,$$

where w is log wage, the subscripts on the parameters refer to estimated parameters for year t-15, when the woman was 30, and where 30-s-6 is a proxy for her labour force experience when 30 years old. The actual estimate included a quadratic in schooling.

$r_{j,k}$ *Rates of return to schooling*: This is the rate of return to j years of schooling compared to k years of schooling, with three rates of return calculated, as noted above. For survey years, both average and median wages were calculated for persons aged 35 to 40 by educational level (primary-complete, secondary-complete and tertiary-complete), whence the rate of return was calculated in standard fashion[4 5].

g_s *Public spending on education per unit of GDP and per capita*, in constant local currency.

Structure of the Country Studies

The empirical analysis for each country in the next section consists of three sequential components: a graphical examination of the time series of averages of variables; statistical estimation (regression analysis) of the causes of educational attainment; and empirical synthesis and interpretation. The data were prepared by taking averages of the key variables listed above (and others, although not all are reported) for each year, then forming time series of these averages. The first part of each country analysis looks at the patterns of these time series.

The ensuing statistical analysis uses the individual-level data for recent school leavers, pooled across all available years. It estimates the determinants of their demand for the education they have completed (in "educational attainment functions"), which corresponds to estimating

equation (1) above. The basic technique involves regressing educational attainment of individuals onto their personal and family characteristics, as well as the time-varying macrovariables. Related techniques examine the robustness of the results and correct for potential simultaneity bias.

This formal econometric analysis seeks to identify factors which may affect educational attainment by measuring how it is associated with changes in variables across individuals and families. It is often safe to ascribe a causal interpretation to such associations, but sometimes it is not; judgements must enter, based on all the information available, econometric and otherwise. For example, the estimates tended to indicate that increases in the head of household's labour income associated with higher educational attainment. This does not necessarily mean, however, that average head-of-household income rose over time, or that in the actual historical experience of the country this factor importantly affected the average changes of educational attainment over time. Thus, each country analysis incorporates a discussion which interprets the historical experience in the light of *both* the econometric estimates and the patterns of the time series of the key variables.

The remainder of this section describes in somewhat greater detail the statistical estimation of the educational attainment functions and then moves on to explain the technique used to correct for possible bias in the estimates because child quantity is jointly determined with child quality, or educational attainment. The educational attainment functions corresponding to equation (1) above were specified in general terms as follows:

$$s_{i,t} = \alpha 0 + \alpha_1 Age_{i,t} + \alpha_2 SEX + \alpha_3 N_{i,t} + \alpha_4 Yh_{i,t} + \alpha_5 Wf_{i,t} + \alpha_6 Sp_{i,t} + \alpha_7 Rup_{(t-L)} + \alpha_8 Rus_{(t-L)}) + \alpha_9 Rsp_{(t-L)} + e_{i,t} \quad (4a)$$

and

$$s_{i,t} = \alpha 0 + \alpha_1 Age_{i,t} + \alpha_2 SEX + \alpha_3 N_{i,t} + \alpha_4 Y_{h,t} + \alpha_5 W_{f,t} + \alpha_6 Sp_{i,t} + \alpha_7 Rup_{(t-L)} + \alpha_8 Rus_{t-L} + \alpha_9 Rsp_{t-L} + e_{i,t} + \alpha_{10} gupop_{t-L} + \alpha_{11} gspop_{t-L} + \alpha_{12} gppop_{t-L} + v_{i,t}, \quad (4b)$$

where the subscripts i and t refer to the i-th person in year t and the variables, discussed previously, are:

s	Years of completed schooling
Age	Age of individual
Sex	A dummy variable for sex: 1 = male, 0 = female.
N	Family size
Yh	Head of households income from work
Wf	Mother's opportunity costs at age 30
Sp	Average parental education
Rmn	Rate of return to schooling: m versus n years of schooling
gmpop	Government spending on education type m, per capita,

and L is the number of years the variable is lagged. Because recent graduates have a wide range of ages, and age and educational attainment are strongly correlated, the estimates control for the age of the individual, but do not report the estimated coefficients.

There is a potential simultaneity problem implicit in equations (1) to (3), where the optimal level of children's education is a function of the number of children, which in turn is a function of education. This formulation sees the entire process as a one-period, simultaneous decision. Consider a simple two-period model, however, where children are born and reared in the first period and educated in the second. In the first period, families choose both expected family size and children's educational levels, based on their expected incomes and the prices of quality and

quantity, and they bear their children. In the second period, if family income falls short of period-one expectations, then the desired level of consumption will fall. Barring infanticide, however, the number of children will remain constant across the two periods and hence be exogenous. The family will adjust the desired educational levels of their children downward in response to the income shortfall. If period-two income exceeds expectations, families will desire more children and higher educational levels for those children: hence family size, n, will be endogenous.

The data considered for recent graduates correspond roughly to period two of this model. As proxies for variations of family income around period-one expectations, the analysis used the residuals from estimated earnings functions for head-of-household labour income (employed and self-employed) for particular families — and only that income, because total family income is strongly endogenous. Partitioning the data based on these residuals corrected for simultaneity. The estimation of equation (1), then, involves partitioning the data and estimating for families that are unlucky in the second period, as proxied by negative residuals from the estimated earnings functions. The presentations give estimates from both the unpartitioned and the partitioned data.

NOTES

1. Unless non-linearities are assumed, the optimal level of education is not unique in equilibrium.

2. The lag between falling mortality and falling fertility has become shorter over time, likely due to more readily accessible knowledge of fertility control methods and technology.

3. For falling mortality rates to lead to falling fertility rates, the elasticity of demand for the number of children to the cost of producing a surviving child, π, must be low: $|\varepsilon_{v,\pi}| < 1$. See Schultz (1981), Mincer (1995*a*).

4. When comparing educational levels b and a, where level a is completed at age t, retirement occurs at age T, b takes 5 years and the earnings outcomes are w_a and w_b, then the rate of return is that r which solves:

$$\int_{t}^{T} w_a * e^{-rt}\, dt \quad = \quad \int_{t+5}^{T} w_b * e^{-rt}\, dt\,.$$

5. One point is worth emphasising: using “relative wages” for the entire population is not a meaningful proxy for calculating rates of return and, indeed, it has little use. Factor prices (wages) must correct or control for the age composition of the population. Relative wages for the entire population do not do this and will often differ substantially in level and pattern over time from similar calculations which control for age.

III. THE COUNTRY STUDIES

This section, the core of the study, embarks on a detailed empirical search for the determinants of educational attainment in the six subject countries of Latin America. It follows closely the principles, overall data strategy and structure for analysis laid out in the second part of Section II, to which the reader may find it useful to refer from time to time. The sequence of analysis is identical for each country. Graphical presentations serve for the examinations of time series of the variables, starting with the outcome variables of interest, educational attainment measures and the endogenous variable in the EHC model, number of children, then moving to a look at the variables which may function as causes of the quality (education) and quantity (family size) outcomes. With the main trends in the variables thus identified for each country, results of the regression analyses appear, with interpretation and some concluding remarks that tie together all the evidence for each country's story.

The material, which contains a plethora of charts and tables, poses presentational problems. The large number of necessary graphical aids and tables, when inserted in the usual way near the text which they illuminate, gets in the way of the story and even seems tedious. For these reasons — and at the admitted cost of some inconvenience to the reader — all of the figures and tables for this and the other sections have been collected in a Statistical Annex at the end of the document. They are numbered sequentially for the document as a whole.

Argentina

Data

The principal data come from the annual household surveys of INDEX, Argentina's National Statistical Institute, from 1974 to 1994. Conducted for Greater Buenos Aires, these surveys include data on earnings, hours worked, education, age, sex, labour force status, and income by source for individuals; they relate individuals to one another by household. Sample size per survey averages around 12 000. The number of recent graduates per survey averages about 500, of whom some 80 per cent live with their parents. To generate the time series for returns to education, annual returns were estimated for the sub-population of employed individuals over 15 years old, using a standard earnings-function framework.

Educational Outcomes and Family Size

Figure 5 shows that educational attainment rose until 1990 and then fell slightly. One variable measures mean educational levels of recent graduates to reflect flows into the potential labour force. The second, much broader, covers the entire population over 15 years of age and measures relative supply, the ratio of university to primary and secondary graduates; it reveals the education of the stock of workers in the potential labour force. Both measures rose quickly through time. Relative supply increased from 0.2 to 0.5 until 1992 and then fell a bit. The mean education of recent graduates rose from nine years to 11.5 years, falling slightly after 1990. This series follows a somewhat erratic path, suggesting year-to-year sampling error, while the more stable curve for relative supply reflects the much larger samples.

The EHC model posits a close relationship between demographic change and educational attainment, with rising educational attainment typically accompanied by falling family size, in response to a falling relative price of the quality versus the quantity of children. Nevertheless, as Figure 6 shows, virtually no change in family size occurred in Argentina during the period covered by the data, notwithstanding that educational attainment rose. The number of children averaged just over two.

Candidates to Explain Educational Attainment Outcomes

Returns to Education. The university/primary measure of the rate of return to education rose in the late 1970s and then held roughly constant or fell until 1994 (Figure 7). Secondary/primary returns rose in the late 1970s but fell thereafter. University/secondary returns, however, did rise on average over the whole period, and hence constitute a potential explanation for rising educational attainment while family size remained stable.

Head of Household's Real Income. The EHC model predicts that exogenous increases in household income will raise consumption of all normal goods, including the number and education of children. Reflecting Argentina's tempestuous economic times from 1974-94, head-of-household income varied dramatically from year to year, from 0.6 to 1.3 times its mean (Figure 8), but it showed little trend. The index used in the figure is calculated from actual annual income divided by its mean for all years.

Per capita GDP Growth and Females' Opportunity Costs. The opportunity cost of women's time enters as a key ingredient in the relative price of quality versus quantity. To capture it, the analysis used annual data to estimate women's wages, conditional upon their age and education and employing Heckman correction for selectivity bias related to labour-force participation. Figure 9 presents the mean annual estimates through time, along with GDP per capita. Female opportunity costs will often covary positively with GDP per capita, because the demand that supports rising wages for women derives from higher aggregate demand per person. Because labour supply is endogenous and responsive to changes in aggregate labour demand, however, actual wage changes may deviate from per capita GDP. This appears to have occurred in Argentina after 1979. Female opportunity costs held quite constant in 1980-90, even as per capita GDP fell from 1.1 to 0.65 times its overall mean. They showed a sharp drop only in 1990. Thus estimated opportunity costs would not seem able to explain the secular rise in educational attainment.

Figure 10 shows female labour-force participation rates. Participation stayed flat until 1985, rose from 1986 to 1992, then fell slightly. The rise is puzzling. It might reflect an "added-worker" response to falling family income, i.e. women went to work to augment those declining incomes. Head-of-household income contracted in 1980-81, recovered and then tumbled sharply from 1984-90. From this and the preceding evidence, Argentina's experience apparently does not reflect the classic process of demographic change, with rising opportunity costs luring women into the market place and leading to smaller families with higher-quality children.

Public Spending on Education. Expenditure figures were available for Argentina from 1980 until 1992 for primary and secondary schooling combined, and for higher education. Figure 11 reveals that public spending on each of these groups as a share of the total hardly changed over the period, and Figure 12 shows the total as essentially trendless, with wide swings. Thus, much contribution to rising educational attainment from the public purse seems quite unlikely.

The Educational Attainment Functions

Looking at the time series has revealed that educational attainment rose strongly in Argentina over the 20 years to 1994. Yet demographic transition did not occur: family size remained nearly constant, with no evidence of changes in females' opportunity costs. Female labour-force participation rose, curiously, between 1985 and 1990, but stayed flat before then; taking lags into account it could not have had much impact on educational attainment. The only likely explanation which remains is a rise in returns to university education as compared to secondary schooling. Let us turn now to the econometric analysis to see what it can make of all this.

The estimated educational attainment functions cover two broad groups. The first is unpartitioned, includes all recent graduates and is not controlled for endogeneity of family size. The second is controlled, through partitioning of the data. (See the closing paragraphs of Section II for a description and justification of this technique.) Each of these two broad groups was estimated

with many specifications. Two sets of specifications appear here (one for the unpartitioned and one for the partitioned group), each estimated with both OLS and the Iteratively Reweighted Least Squares (IRLS) technique, which is robust. The first set of specifications is simplified, with only short lags in returns to education and without variables for government spending on education. These estimates have the advantage of eliminating the fewest observations. All estimates reported are semi-log specifications, where the dependant variable is the level of completed education and right-hand variables are logged, except for age, which is in levels. Log-log specifications were also estimated with similar qualitative results, but generally poorer overall fits.

Table 1 presents the regressions for the simple specifications for all recent graduates (the unpartitioned group). The estimated coefficients on head-of-household income tend to be negative and often significant. Those on parental education are positive and highly significant. Those on mothers' opportunity costs vary in sign but tend to be negative and are sometimes significant. Coefficients on returns to education here are lagged five years. They are positive and statistically significant for university/primary and for university/secondary returns without trends, but insignificant when trends are included. Coefficients on secondary/primary returns are negative and significant. Those on the sex dummy (male = 1) are positive and significant throughout.

Table 2 presents estimates for the same specifications, for the partitioned sub-population with second-period incomes below estimated expected levels. The results turn out quite differently from those for the unpartitioned population. Estimated coefficients on head-of-household income become consistently positive and statistically significant. They range from 0.64 to 1.1, with t-statistics from 4.9 to 7.6. The estimated coefficients on mothers' opportunity costs also turn consistently positive and statistically significant. Both results are robust across specifications and much more plausible than those in the unpartitioned regressions.

The coefficients on returns to education also differ. For university/primary returns they turn negative and tend to be insignificant. For university/secondary returns, however, they stay positive and significant in the IRLS estimates without trend, but adding a trend lowers the t-value to 1.2. Secondary/primary returns coefficients, as before, are negative and significant. The estimated coefficients on the sex dummy drop close to zero and become highly insignificant.

Table 3 presents the estimates for the unpartitioned regressions, with government expenditures on university education as a share of total government educational spending added as another independent variable. Estimated coefficients on this variable are negative and significant. The pattern of estimated coefficients otherwise resembles that in Table 1, although the coefficients on returns to university/secondary education turn negative.

Finally, Table 4 presents the results for the same specifications as in Table 3 for the partitioned data. The changes that emerged in comparing Tables 1 and 2 appear again. Coefficients on head-of-household income and mothers' opportunity costs turn positive and very significant, while those on the sex dummy become small and statistically insignificant. For equations with returns to education lagged five years, coefficients on university/primary returns to education are positive and significant, while those on the other two returns measures are negative and significant. For returns lagged ten years, only the coefficients on secondary/primary returns, in the equations without trend, are positive and significant.

Interpretation

What sort of evaluation can emerge from the regression results, in light of what the data series have already revealed — or not revealed? The partitioned estimates that correct for simultaneity bias yield positive, statistically significant and robust estimates for both head-of-household income and female opportunity costs. While important in their own right, do these findings explain the observed increase in educational attainment? Consideration of the time-series data on these variables suggests otherwise. Head-of-household income, very volatile through time, showed no rising trend over 1974-90. The opportunity costs of women held nearly constant through 1994,

except for a sharp, one-year drop in 1990. Moreover, government expenditures on education clearly played no role: the shares of the different levels of schooling in total spending on education hardly moved, and per capita spending on education showed much volatility but did not increase through time. The estimated impact of government expenditures on educational attainment comes up negative, but that clearly is a statistical artefact.

While the estimated impact of returns to education on educational attainment looks hard to interpret, the clue to an answer lies here. Returns for university/primary and secondary/primary education do not rise over time, so one can rule them out *a priori*, even though the university/primary series, lagged five years, does have a positive correlation (0.2) with mean educational attainment. University/secondary returns hold more promise. With a five-year lag, this series has a positive correlation with the attainment series (0.5) *and* these returns rose with time. Figure 13 reveals the connection. Both series (rescaled to overlap) show considerable year-to-year sampling error, and the volatility of the time-series estimates likely is responsible for the lack of robustness of the estimated impacts in the educational attainment functions. Yet their common movement shows up unmistakably. For Argentina, the most likely cause of rising educational attainment arose from the increase in returns to university education over those from secondary education.

Chile

The Data

This section draws on highly comparable household annual surveys conducted by the University of Chile for Greater Santiago over the period 1960-92. They include data on earnings, hours worked, education, age, sex, labour-force status and income by source for individuals, and they relate individuals by household. Sample size per survey averages 12 000 persons. An average of 700 recent graduates appears each year, of whom approximately 80 per cent still live with their families.

Educational Outcomes and Family Size

Educational attainment grew dramatically in Chile (Figure 14). Mean schooling of recent graduates rose from nine years in 1960 to 13 years in 1992; relative supply rose from 0.1 to 0.4. Both series stagnated or even fell in the early 1960s, but climbed rapidly from the late 1960s to 1972 or 1973. In 1974, the year following the *coup d'etat* that placed the military regime of Agusto Pinochet in power, both measures dropped, but they quickly resumed their rapid rise up until 1990.

Family size rose until 1967 but then began a vertiginous decline that extended until 1992, save for a rise in 1974 (Figure 15). The average number of children for women aged 35 to 40 increased from 2.7 in 1960 to 3.2 in 1967, and then slid to about 2.25 by 1992. No question exists: the inverse relationship between number of children and child education posited in the EHC model appears with power in Chile, as Figure 16 makes strikingly evident.

Candidates to Explain Educational Outcomes

Returns to Education. Measures of returns to schooling followed different paths (Figure 17). University/primary returns stayed largely flat, while secondary/primary returns tended to fall. University/secondary returns trended upward in the long run, however, climbing in the 1960s, dropping back until 1974 and then steadily rising to 1991. Thus, while the first two series cannot explain the trend increase in educational attainment, the third may have played a large role.

Head-of-Household Income. This series, the same sort of index as for Argentina and the other countries, has two striking features in Chile: its volatility and the absence of a clear trend

(Figure 18). Peaks at about the same level occurred in 1970, 1980 and 1994. With no trend increase, it becomes an unlikely candidate for explaining the increase in educational attainment. Moreover, any trend changes in this factor would likely affect family size and children's education in the same direction, which Figure 16 clearly belied. Nevertheless, head-of-household incomes may have played some part in affecting the distribution of educational attainment, which the regression results may uncover.

Per Capita GDP Growth and Females' Opportunity Costs. While GDP per capita and estimated opportunity costs for women are strongly, positively correlated (0.53), as expected, females' opportunity costs do not rise over time, while GDP per capita rises dramatically (Figure 19). This is curious, unless either technological change is very highly skill-saving so that per capita economic growth generates no increased demand for labour, or the supply of labour is rising quickly over time. Was the supply of female labour so elastic that women's wages held constant although aggregate labour demand rose? If the supply response derives from women entering the labour force, one would expect female labour-force participation to rise roughly in tandem with GDP per capita. Figure 20 plots both series, which do indeed track one another closely, particularly after 1970. In 1970-74, participation rates plummeted from nearly 40 per cent to 30 per cent, while per capita GDP plunged by 20 per cent. After 1974 and up until 1995, participation rates made up the ground and more while per capita GDP doubled.

This striking elasticity of female labour-force participation explains the absence of a rising trend in the real earnings of both women and men despite rising per capita GDP (Figure 21). While the patterns of real earnings are nearly identical, men's real earnings have far larger variance, from 0.6 to 1.4 times their overall mean, while those of women vary from 0.9 to 1.1 times their overall mean. This reflects the inelasticity of men's participation decisions, while the elastic supply of women held down real wages of both as per capita GDP rose.

Under these circumstances women's *ex post* wage does not fully reflect their opportunity cost which, with roughly constant male participation rates, gets driven by per capita GDP. It does appear that changes in per capita GDP explain those in female labour-force participation, and in turn the changes in family size and educational attainment.

Public Spending on Education. In 1970-80, public spending on education simultaneously rose and got redistributed towards university education and away from primary education, while the opposite occurred after 1980. Total public spending per person (Figure 22) doubled from 1970 to 1982, fell by a third between 1982 and 1990, then rebounded in 1991 and 1992. Per capita spending on university education more than doubled from 1970-80, after which it began a steep descent (Figure 23). Per capita spending on primary and secondary education held nearly constant over the period 1970-75, rose until 1982, declined in 1983 and then remained roughly unchanged. The share numbers in Figure 24 confirm that public spending on education shifted in favour of university students from 1970-75, whence the universities lost ground while the share of primary education rose. Secondary education more or less retained its share over the entire period.

The Educational Attainment Functions

The sequence of presentation here matches exactly that in the preceding section on Argentina — and those for the other countries as well. In the regressions for the simple specifications for all recent graduates, the unpartitioned group (Table 5), the estimated coefficients on parental education come up consistently positive and statistically significant, which is true for all the countries studied. Those on head-of-household income also are positive and significant, and average about 0.5. Thus, if head of household income doubles, educational attainment increases by half a year. This translates into very large distributional effects because, in 1990 for example, the 90th percentile of heads of household earned six times the average and eleven times as much as the 25th percentile heads of household. Estimated coefficients on mothers' opportunity costs are positive and significant

too, but quite small, averaging about 0.03. Returns to schooling (lagged five years) are positive and significant for university/secondary and secondary/primary education. The coefficient on the sex dummy (for male) is insignificant and small.

Table 6 reports the same specifications as Table 5 for the partitioned regressions. The estimated coefficients on head-of-household income become much larger. Those on returns to schooling are also less statistically significant, and typically insignificant with a trend term.

Table 7 presents unpartitioned estimates for specifications including longer lags and government spending on education. Estimated coefficients on head-of-household income are little changed, but the estimated effects of women's opportunity costs, which continue positive and statistically significant, now become much larger, ranging from 0.3 to nearly 0.7. This implies that a doubling of women's opportunity costs would raise educational attainment by 0.3 to 0.7 years. These estimates likely understate the quantitative impact, because the magnitude of these effects is confounded by the considerations raised earlier. Using per capita GDP instead of women's opportunity costs in a similar log-log specification yields an elasticity of educational attainment to per capita GDP of 36 per cent[1]. Estimated coefficients on returns to education are positive and statistically significant for university/secondary and university/primary education, with five-year lags. With ten-year lags, only university/primary returns stay positive. Estimated returns to the shares of government spending on university and secondary education are negative, which is not surprising, as these variables trend downward after 1980 while average educational attainment rises quickly; it is highly unlikely that any negative causality exists.

Table 8 reports the estimates for the same specifications as Table 7, for the partitioned data. The principal difference is that estimated coefficients on head-of-household income become much larger and now average 0.9. This suggests that estimates of the impact of head of household income are biased considerably downward in the equations which do not attempt to correct for simultaneity bias. It underlines the enormous influence that head-of-household income has upon educational attainment and hence the reproduction of inequality of education and income across generations.

Interpretation

Growth in per capita GDP and perhaps rising returns to university relative to secondary education drove Chile's increase in educational attainment from 1970 to 1990. Demographic change tightly paralleled changes in educational attainment from 1960 onwards. It relates closely to changes in per capita GDP and the opportunity costs of women. An elastic labour-supply response by women kept real wages for both men and women relatively constant, but the *ex ante* demand for labour clearly shifted outward due to the output growth. The induced increases in female labour-force participation led to rapidly shrinking family sizes and rising average educational attainment levels.

Because real head-of-household income did not rise over time, changes in it had no importance for the trend changes in educational attainment. Real head-of-household income did have an exceedingly strong impact on educational attainment in the cross-section, however. The dispersion of parental income across households translates into dispersion of educational attainments of their children and leads to the reproduction of inequality in earnings across generations. The large, positive estimated impact of head-of-household income also supports the premise of the EHC model that the financial market for education is highly imperfect, a binding constraint upon family investment in children's education.

The evidence does not suggest that variations in government expenditures on education played an important role in changes in educational attainment, at least compared to other factors[2]. Per capita GDP growth and changing returns to university versus secondary education had far

more importance in guiding the behaviour of families and educational attainment. Government spending probably did, however, have important impacts on the distribution of educational attainment by social class, given the effects of income constraints on family financing of education.

Colombia (Bogota)

The Colombian National Statistical Institute (DANE) has produced highly comparable household annual surveys for Greater Bogota, covering 1976-94. These surveys include data on earnings, hours worked, education, age, sex, labour-force status and income by source for individuals, and, like the others used so far, relate individuals by household. Sample size per survey ranges from nine to 19 000 persons. Each year sees an average of 600 recent graduates, of whom approximately 96 per cent still live with their families.

Educational Outcomes and Family Size

Educational attainment and relative supply grew rapidly until 1989 (Figure 25). Average educational attainment grew from 9.7 to 11.5 years of schooling just in the short period from 1976 to 1989, after which it dropped back to 11 years. Relative supply doubled from 0.2 to 0.4 over 1976-89 and stayed relatively flat afterwards. Family size declined steeply (Figure 26). After a brief rise in 1976-78, the average number of children of women aged 35 to 40 plunged by more than one child per family, from 2.8 in 1978 to 1.7 in 1994.

Candidates to Explain Educational Attainment Outcomes

Returns to Education fell over most of 1976-86, then rose somewhat but never exceeded previous highs, usually not even reaching them (Figure 27). Given that returns to education affect educational attainment outcomes with at least a five-year lag, the relevant returns fell while attainment rose, so they cannot explain the attainment gains.

Head-of-Household Income climbed by 33 per cent between 1976 and 1983, from 0.9 to 1.2 times its overall mean, and then more or less flattened out (Figure 28). After 1983, it varied by an average of 1.1 times the overall mean. Figure 29 demonstrates the close correspondence between head-of-household income and educational attainment.

Per Capita GDP Growth and Females' Opportunity Costs. For Bogota, the correspondence between these two variables stayed very close, both in changes and — unlike Chile — in levels, except after 1985, when per capita GDP continued to rise while female opportunity costs sagged until 1992 (Figure 30). Estimated opportunity costs rose 10 per cent over the whole period, while per capita GDP gained 40 per cent. Steadily rising rates of female labour-force participation accompanied these gains (Figure 31). They grew from less then 30 per cent to 50 per cent. The pace of the increase accelerated slightly after 1985, closely paralleling and even exceeding per capita GDP gains: the participation rate rose by 2.8 per cent a year, on average, as against 1.5 per cent for per capita GDP.

Public Spending on Education. Figures 32, 33 and 34 detail public outlays for schools and their distribution in Colombia from 1970 to 1991. Total expenditure per capita held relatively constant until 1983, then climbed by 25 per cent to 1985, held those levels fairly well for the rest of the decade and then dropped in 1991. Its distribution also changed. From 1975 to 1981, spending on primary education fell while that for secondary schools rose. In 1979-80, funds going to university education jumped significantly to levels since sustained and sometimes exceeded. Thus, concurrent increases in educational spending and its redistribution to higher education could well explain part of the increase in educational attainment over 1976-90.

The Educational Attainment Functions

Table 9 reports results for the unpartitioned regressions without government educational spending, and both with returns to schooling lagged five years and without returns to schooling. Asterisks beside equation numbers indicate control for a time trend, as in all the tables. The estimated coefficients on head-of-household income are positive and statistically significant in all the equations. These results are quite robust, with t-statistics varying from 6.9 to 7.9, and quite stable, varying from 0.157 to 2.08. The estimated coefficients on the sex dummy are negative, statistically significant and robust, ranging from -0.18 to -2.2, with t-statistics from -5.3 to -6.3. The sex dummy equals one for males, so these results indicate that females averaged more education than males. Females' opportunity costs had positive, statistically significant and robust coefficients, which varied narrowly near 0.73, suggesting that a doubling of mothers' opportunity costs would raise educational attainment by 0.73 years. The estimated coefficients on the returns to education are insignificant for all specifications; recall that returns to schooling were falling or flat while educational attainment rose. The estimates appear quite stable across specifications. Adjusted r-squares are stable near 0.87. Inclusion of a trend term or estimation using IRLS barely alters the estimated coefficients.

Tables 10 to 12 show that the results for Colombia remain almost identical across specifications, with and without partitioning. As for all the countries, parental education has positive and statistically significant coefficients but, different from most of them, the estimated coefficients on family size are small and often insignificant, and the coefficient on the sex dummy is negative and statistically significant; other things equal, girls complete slightly more education than boys. Coefficients on mothers' opportunity costs are positive and statistically significant, and average 0.7. Those on returns to schooling remain statistically insignificant or negative throughout. Those on government expenditures lagged five years tended towards insignificance for the share of public expenditures on university education; with ten-year lags those on secondary education's share emerged as sometimes negative and significant.

Additional specifications yielded similar results. For example, regressions which dropped secondary/primary-education returns, retaining educational spending variables in the specifications for Tables 11 and 12, without a time trend, yielded positive and statistically significant coefficients on university/secondary returns lagged five years and the share of public education spending on secondary education — but with inclusion of a trend term these coefficients became highly insignificant.

All the results remained robust to inclusion of separate variables measuring each parent's education and per capita GDP. With per capita GDP included, the pattern of estimates remained the same while the coefficient on per capita GDP came up positive and statistically significant. That finding accords with the interpretation that the estimated female opportunity cost series under-estimated the trend in those costs, due to the high elasticity of female labour-force supply to women's *ex ante* wages. This supply response held down women's measured *ex post* wages. Adding per capita GDP to the analysis provided additional information about the underlying outward shifts in aggregate labour demand that drove this process.

Interpretation

A combination of rising head-of-household income and female opportunity costs pushed educational attainment in Bogota, and rising per capita GDP pushed both of them. The dramatic fall in family size suggests that female opportunity costs may have predominated, because under the EHC model one would expect rising head-of-household income to tend to increase family size. Changes in returns to education had less importance in this process, except as they may have affected head-of-household income and women's opportunity costs.

The fall in educational attainment after 1990 appears to reflect declines in both of the key variables, a finding somewhat at variance with the EHC model because the female labour-force participation rate continued to rise. Perhaps the levelling-off or drop in wages in this period reflected an unusually high elasticity of female labour supply which outstripped rising aggregate labour demand as per capita GDP expanded.

Costa Rica

The Data

The principal data come from annual household surveys conducted at the national level and gathering the same data as those used elsewhere. Sample size per survey averaged 25 000 persons. The analysis covered a total of about 1 800 recent graduates in their families, but households could be identified for only a subset of years: 1976-78 and 1987-90. Thus. in the econometric analysis. the impact of returns to education and government spending on education could not be estimated; the influence of other factors, notably head-of-household income, parental education and the opportunity costs of mothers, did yield to estimation.

Educational Outcomes and Family Size

Recent graduates in Costa Rica have low levels of education compared to the other countries in this study. They averaged about seven years of schooling in 1976-90 (Figure 35), compared to 10.2 in Argentina, 11.9 in Chile, 11 in Colombia, 9.2 in Mexico and 10.3 in Uruguay. Relative supply grew throughout the period, but its rate of increase fell and little change occurred between 1989 and 1990. Educational attainment of recent school leavers rose by 0.6 years over the entire period, but only in consequence of a big leap in 1978-79. Costa Rica is unique among the countries studied in that educational attainment fell discernibly after 1979, with a modest uptick in 1990 that may signal a trend reversal. Relative supply is calculated using the stock of the active labour force, while educational attainment covers the marginal entrants. It appears, therefore, that educational attainment contributed initially to a rise in relative supply in the late 1970s, after which declining educational attainment helped to slow the rise of relative supply. The continued rise in relative supply, albeit at a slowing rate, despite downward-trending educational levels of new entrants to the active population, probably occurred because persons retiring had even lower educational levels than the new entrants.

In Figure 36, all three measures of the number of children per adult woman indicate a sharp fall, from roughly four children in 1976 to 2.8 in 1990. Thus, contrary to the standard pattern of demographic transition, Costa Rica experienced simultaneous declines in family size and educational attainment. Further analysis will show whether this country still fits the EHC model.

Potential Explanations for Educational Attainment

A steep drop in per capita GDP, virtually a collapse, conditioned events in Costa Rica after 1979. Its effects will appear in many of the other time series, so it is well to establish here how per capita GDP moved (Figure 37). Twenty years of uninterrupted growth ended in 1979, after which the international debt crisis and recession took hold. After a healthy rise of nearly 14 per cent in 1976-79, per capita GDP plunged by 20 per cent between 1979 and 1982. Growth resumed after 1984, but output per capita still had not regained its 1979 peak in 1990. The series for returns to education, head-of-household income, female opportunity costs, female participation rates and total government spending on education all felt the effects.

Rates of Return to Education and Relative Wages largely fell through 1983 and rose gradually or held flat thereafter (Figure 38 which, unfortunately, has no scales). University/secondary rates

of return represent an exception; they began to climb somewhat earlier and more rapidly, particularly after 1987 and the onset of trade liberalisation. Between 1985 and 1992, they rose by 50 per cent (from 0.1 to 0.15), but these increases did not translate into rising educational attainment, which fell during the 1980s. *Head-of-Household Income* also declined sharply in the 1980s, from about 1.5 times its overall mean to 0.9 times the mean, before rising slightly in 1990 (Figure 39).

Female Labour-Force Participation showed similar declines (Figure 40). The participation rate had risen from about 25 per cent to 28 per cent in 1977-79; it began dropping in 1980. Although not shown in Figure 40 because the numbers are not in the data collection available here, it rose sharply during the 1981 recession, but then quickly subsided (Gindling and Berry, 1992). Figure 40 confirms that it fell back to around its 1977 level in 1987, and then began to rise again. It also shows how female participation positively covaries with *Female Opportunity Costs*, but note that the 1980s decline in the latter was very small, from about 3 per cent above to 2 per cent below its mean. Nevertheless, both participation rates and opportunity costs were highly procyclical.

Public Spending on Education did not escape the recession of the early 1980s, and per capita spending on education tracked (but with greater amplitude) movements in per capita output over the whole period studied. The total rose nearly 40 per cent over 1975-80, then plummeted to well below its 1975 level in the ensuing two years as severe recession and economic stabilisation measures took hold. Thereafter, it rose very slightly, reaching about its 1975 level in 1988. Figure 41 displays an index of constant-valued total public education spending. Public educational spending per capita by educational level and the share of spending by levels appear in Figures 42 and 43. Huge shifts favoured university education in 1975-82 and again in 1988; its share doubled, to 50 per cent. Nevertheless, the overall drop in total public education spending dominated: the level of per capita spending on university education declined by over 30 per cent in 1980-82, whence it stayed almost flat until a rise in 1988 brought it back more or less to its 1980 level..

The Educational Attainment Functions

Because of the data difficulties for Costa Rica, it was possible to estimate only a subset of the specifications estimated for other countries in this study. Estimation of the impacts of returns to education and public education spending on educational attainment had generally to be left out, but the data did yield enough material to estimate the effects of individual and family-level variables.

Table 13 reports typical regression results for the unpartitioned regressions without government educational spending and both with returns to schooling lagged five years and without them. The only variables for which estimated coefficients are statistically significant are parental education and mothers' opportunity costs. The coefficients on opportunity costs range widely, from 0.071 to 1.88, with t-statistics averaging about nine. The higher estimated values occur when rates of return to schooling are controlled for. Returns to schooling, however, usually got dropped due to colinearity in the regressions, resulting from the very small number of survey years for which the functions could be estimated.

Table 14 presents the same specifications for the partitioned sub-population. Estimated coefficients on head-of-household income are negative and sometimes statistically significant, particularly for the IRLS estimates with controls (for trend and/or rates of return to schooling). This is somewhat puzzling and likely a spurious result.

Tables 15 and 16 report the regressions for unpartitioned and partitioned samples with an attempt to add longer lags to rate-of-return and government educational spending variables. Little new emerges. In both the unpartitioned and partitioned regressions, the estimated coefficients on head-of-household income tend toward statistical insignificance. The coefficients on mothers' opportunity costs are very large and highly significant. Where not dropped, estimated coefficients on the share of public educational spending on secondary/primary returns are negative and statistically significant, but note the very small sample sizes: only 160 to 284 observations remain after partitioning and using lagged time-series variables.

Interpretation

In Costa Rica, educational attainment fell between 1980 and 1990. The recession lowered returns to schooling, per capita public education spending, heads of households' real income and female opportunity costs. While the individual effects of these variables cannot be ascertained, they all likely contributed in some degree to falling educational attainment. The drop in family size likely arose mostly from the sharp decline in real incomes. The short but sharp rise in female labour force participation in the early 1980s could also have induced lower birth rates that continued even after economic recovery and a fall in female labour force participation. Educational attainment probably will resume pre-1980s growth as output rises. Resurgent output after 1985 did begin to reverse the negative trends of the key variables. Moreover, the accompanying trade liberalisation appears here as elsewhere to have raised returns to schooling (Robbins, 1996*c*, Gindling and Robbins, 1998).

The statistical analysis supports the central role of female opportunity costs in determining educational attainment. Parental education also serves as an important predictor, as in all specifications and countries. It is less clear what quantitative impact changes in female opportunity costs have on educational attainment. The highly significant estimated effects vary sharply between about 0.1 and 1.8, depending upon whether a time-trend is included and whether the estimates come from the partitioned or unpartitioned data. Partitioning to correct for potential simultaneity raised the estimated coefficients on mothers' opportunity costs to roughly ten, which is implausibly high. In contrast to other countries in this study, the estimated impact of head-of-household income tends to be insignificantly different from zero. It remains unclear whether this lack of importance is real or a result of data limitations. It might reflect the less extreme inequality in the distribution of income in Costa Rica than elsewhere in Latin America, so that changes in income across families play a lesser role.

According to the EHC model, each of the explanatory-variable declines that tracked the output contraction should have depressed educational attainment. The results thus conform with the model in that sense. Yet what of family size? The archtypical pattern of demographic transition involves an inverse relation between family size and educational attainment, not the positive correlation uncovered here. Does this contradict the EHC model? Two factors make clear that the answer is "no". First, real incomes fell sharply after 1980. Because family size is a "normal" good, rising (falling) with increases (decreases) in income, declining real incomes would naturally exert downward pressures on family size. Second, the big increase in female labour-force participation during the 1981 recession may have had, if not a permanent effect on family size, at least one that continued even after the economy recovered and female labour-force participation rates fell back again — a "hysteresis" effect of the short spurt in female participation on long-run birth rates.

Mexico

The Data

The data for Mexico come from annual household surveys with national coverage for 1988-93. They match in coverage those used for the other countries studied here. Sample size per survey varied from 95 000 to 211 000. The number of recent graduates ranged from 10 000 to 23 800 per survey. Data on public educational expenditures were not available.

Educational Outcomes and Family Size

Educational attainment grew handsomely over the relatively brief period covered by the data, and relative supply rose even faster (Figure 44), probably because workers leaving the labour force had far less education than those entering it during these years. From 1988 up until 1993,

the mean education of recent graduates rose by about 9 per cent, from nine years to 9.8 years of schooling, while relative supply jumped 60 per cent, from 0.25 to nearly 0.4. Family size declined, as expected, after 1988 (Figure 45).

Potential Explanations for Educational Attainment

Returns to Schooling. University/secondary returns roughly doubled, the university/primary measure rose more slowly and secondary/primary returns changed hardly at all on balance, dipping after 1987 but recovering by 1992 (Figure 46).

Head-of-Household Income rose throughout the period, particularly in 1988-89 and 1992-93. Its behaviour closely followed that of educational attainment (Figure 47).

Female Labour-Force Participation rates barely moved in 1987-88, declined slightly in 1989 and then began a steady rise through 1993 — by about 10 per cent, from 32 per cent to 36 per cent (Figure 48).

Women's Opportunity Costs, by contrast, rose through 1990 and remained relatively constant thereafter (Figure 49).This constancy of estimated opportunity costs, based on *ex post* wages, may have arisen from a higher labour supply as the female participation rate increased. Head-of-household income flattened in this period, although not by quite as much as females' opportunity costs, which is what one would expect with rising female labour-force participation and high, but not infinite elasticities of substitution between male and female workers. In any event, a confluence of educational attainment with rising per capita GDP, female opportunity costs and female labour-force participation shows up clearly, as shown in Figure 50, which pulls together relative supply, GDP per capita, female labour-force participation and female opportunity costs (rescaled to overlap but, unfortunately, with no scales on the vertical axes to show measurement units).

The Educational Attainment Functions and Interpretation

Given the rather truncated breadth of data for Mexico in comparison with the countries studied so far, less opportunity existed to experiment with different specifications of the educational attainment functions. The results, which nevertheless are straightforward, appear in just two tables, each with two specifications — one without and one with a time trend. Table 17 presents regressions using the unpartitioned data and Table 18 those with the partitioned data.

The findings, which bolster impressions gained from the preceding examination of the data time series, accord solidly with expectations from the EHC model and reveal the classic demographic transition as well underway in Mexico. The coefficients on family size, head-of-household income, parental education and mothers' opportunity costs all have the expected signs and t-statistics, which leave no doubt as to their statistical significance, in both tables. The positive sign of the coefficient on the sex dummy suggests that young women entering the labour pool have somewhat less education than young men doing so. Regressions using the partitioned data have somewhat higher (but not startling) coefficients on head-of-household income than those based on unpartitioned data, an expected result because partitioning was intended to correct for the bias created when family incomes as children mature fail to meet expectations held when families are young.

Aside from parental education, which operates as a strong determinant of children's educational attainment in all countries, mothers' opportunity costs have strong coefficients, equal to about one in both specifications and both tables. They exert the major influence. Mexican parents respond rationally and powerfully to the economic inducements of rising per capita GDP and buoyant real wages (which measure the opportunity costs) by limiting family size, entering mothers into gainful employment and investing in better-educated, higher-quality children.

Uruguay

The Data

The principal data employed for Uruguay come from nationwide household surveys taken from 1984 to 1995, with the same characteristics as those for the other countries. Sample size per survey averaged 25 000 persons, with an average of 1 600 recent graduates per year, of whom approximately 85 per cent still lived in their families (for most years about 95 per cent did so). Restricting the analysis to years with only very high percentages of recent graduates living at home yielded nearly identical results.

Educational Outcomes and Family Size

Educational attainment grew 5 per cent over the period, from a mean of 10.2 years to one of 10.7 years (Figure 51) — a much slower pace than in most of the other countries studied. The estimated linear nominal growth rate of mean schooling among recent graduates was only 0.024 years of schooling per year, compared to 0.11 in Argentina, 0.14 in Chile, 0.07 in Colombia, 0.008 in Costa Rica and 0.11 in Mexico (the linear rate understates the point-to-point increase in Uruguay because the gains accelerated towards the end of the period). Relative supply in the entire active population rose gradually. The number of children per family fell significantly, from 2.4 children to about 1.8 children, and the drop was most pronounced in the last few years (Figure 52). Thus, the patterns of family size and educational attainment accord with the inverse relationship posited in the EHC model.

Candidates for Explaining Educational Attainment

Returns to Education. Uruguay has low returns to education compared to many other countries. University/primary returns averaged 3.5 per cent, as against an average of 6.5 per cent for all six countries studied. Secondary/primary returns averaged 6 per cent in Uruguay and university/secondary returns 3.7 per cent. The different returns measures followed rather different paths (Figure 53). University/primary and secondary/primary returns held relatively flat, while university/secondary returns varied a good deal more; broadly, they fell to around zero through 1990, then rose significantly.

Head-of-household Income grew fast through 1992, then became more volatile with no clear trend (Figure 54). Its growth might explain the increase in educational attainment, especially if, as makes sense, it affects educational outcomes with a lag.

Per Capita GDP Growth and Women's Opportunity Costs climbed steeply (Figure 55). Likely as a result, female labour-force participation rose steadily and quickly, from an already high initial level of 47 per cent to about 55 per cent (Figure 56). Compared to the other countries studied, Uruguayan women have entered the labour force in strength. Their mean participation rate in the study period hit 52 per cent, versus 36 per cent in the other five countries. Nevertheless, the elasticity of their participation response appeared smaller than in some of the countries studied, where high elasticities apparently erased wage increases measured *ex post*. The estimated contemporary elasticity of female labour-force participation to per capita GDP in Uruguay was 0.62 versus 1.8, 0.97 and 2.0 in Colombia, Costa Rica and Mexico, respectively. Across countries, higher participation elasticities associate with lower elasticities of estimated female wages to per capita GDP (the correlation is -0.48 excluding Mexico, for which there are few observations). It is less clear what determines the *levels* of participation elasticities. Perhaps higher initial participation rates hold the key. If so, one would expect a negative correlation between these variables; it exists, but is low (-0.11).

Public Spending on Education. Total public spending on education per person rose from 1984 to 1988, declined until 1991, then climbed sharply to 1993 (Figure 57). It tended towards correlation with educational attainment. The period as a whole saw a redistribution of spending from primary to secondary and especially to university education (Figures 58 and 59). The universities' share mounted from roughly 23 per cent to 28 per cent, while the primary schools lost ground, from 51 per cent to about 47 per cent. In terms of constant-value spending per capita, university education gained dramatically; its index in Figure 59 rose from about 82 in 1984 to nearly 120 in 1994. It looks plausible that rising government spending on education — both in total and through redistribution towards university education — drove at least in part the increase in educational attainment. Nevertheless, public spending on education in Uruguay during the period remained quite low compared to the other five countries analysed. It averaged 1.2 per cent of GDP as against 3.7 per cent for the other five. It is possible that, precisely because very low educational spending acted as a binding constraint on attainment, increases in it had large impacts on educational outcomes.

The Educational Attainment Functions

Table 19 presents regressions for the "simple" specifications for all recent graduates (the unpartitioned group). As usual, the estimated coefficients on parental education are large and strongly significant statistically. Those on head-of-household income also are positive and statistically significant, averaging about 0.23; if head-of-household income doubles, educational attainment increases by about a quarter of a year. The insignificant coefficient on the sex dummy conveys little or no information on differences in educational outcomes by sex. Females' opportunity costs have consistently positive and significant coefficients, but those on family size and returns to education are mostly insignificant.

For the partitioned sample with the same specifications (Table 20), the estimated coefficients on head-of-household income become much larger, about 0.7. This change may indicate a simultaneity problem in the unpartitioned equations (which the partitioning corrects) but, because the estimated coefficients on family size do not change much from the unpartitioned estimates, it probably reflects concavity in the positive relationship between the educational outcome and head-of-household income, with the impact of income on educational attainment larger in the lower-income partition.

Table 21 presents results for the second set of specifications and the unpartitioned sample. Because of the short time series available, returns to university/primary education were dropped. Estimated coefficients on university/secondary and secondary/primary returns come up weakly positive, and that on the share of government spending on secondary education tends to be positive. With the second group of specifications for the partitioned sample (Table 22), the estimated coefficients on head-of-household income grow even larger, those on university/secondary returns are essentially zero, those on secondary/primary returns tend towards positive and the government spending variables typically have positive coefficients.

Interpretation

The Uruguayan case conforms closely to the EHC model and shows essentially the same patterns as Chile, Colombia and Mexico. Female labour-force participation, estimated female opportunity costs and per capita GDP all behaved consistently with the EHC model, particularly with the interpretation put forth for several other countries: that rising per capita GDP raised the opportunity costs of women, which induced higher female participation rates, lower family sizes and higher per-child quality in the form of higher education. Educational attainment of recent graduates rose, particularly after 1992. This corresponded to a rise in per capita GDP beginning in 1984. Returns to education started to climb in 1990. Wages (returns) of university-trained workers outpaced those of primary and secondary school leavers, although Uruguay had very low returns

to education in absolute terms. Consistent with the rise in output, females' opportunity costs and returns to schooling trended up, family size tended to contract and the female participation rate rose rapidly and steadily. The estimation results largely follow those for the other countries. Parental education, head-of-household income and women's opportunity costs all have large, positive estimated coefficients. Rates of return to schooling tended to correlate positively with educational attainment, although the very short time-series render the estimates very fragile. Estimated effects of government spending on education tended towards positive, subject to the same caveat.

The regressions produced ambiguous results on family size, difficult to interpret. One factor colouring the outcome may simply have reflected that Uruguay had relatively small families right from the start of the period. Trend changes in family size did tend to mirror changes in educational attainment, yet much noise appears in the year-to-year changes in the number of children and the overall change in family size was quite modest compared to the other countries.

Somewhat differently from the results for the other countries, returns to education and government spending on education sometimes track educational attainment positively. While the short time series available for Uruguay render the estimates at best suggestive, they may be consistent with the main interpretation for other countries, where high variations in those variables could not explain the changes in educational attainment: that both returns to education and government spending on it were sufficiently high not to exert binding constraints on individuals' and familes' educational attainment decisions. Uruguay may represent a polar case. There, very low public spending and returns may indeed have constituted constraints; but they did rise, especially for university training, and the marginal impacts of the increases, especially in public educational supply, may have loomed larger than elsewhere because they eased the constraints.

NOTES

1. This result is not robust to inclusion of a time trend, however, which is not surprising given the smooth trend which per capita GDP followed. Since the causal story is a medium to long-term one with long periodicity, it is inappropriate to move to detrended series, first-differenced equations or more sophisticated time-series methods to focus on eliminating the trend and examining the covariance of short-term innovations in the underlying series.
2. This is subject to the caveat that the econometric estimates may be limited by colinearity of returns to education with other variables and each other, although this did not appear to be a major obstacle.

IV. PULLING THE COUNTRY STUDIES TOGETHER

This discussion interprets and generalises the key findings of the preceding section in a cross-country context, to focus on why average educational attainment rose over time and identify the underlying causes behind the demographic transition. It finds that changes in female opportunity costs acted as the primary cause of rising average educational attainment, the associated rising female participation rates and falling family size. Growth in per capita GDP provided the impetus behind rising opportunity costs of women's time.

The mechanism works simply enough. GDP growth links strongly to changes in *ex ante* wages which, if quantifiable, would directly measure opportunity costs. As it rises they do so as well, luring increasing numbers of women into the labour force. One can easily see why women who choose to enter the labour force would also choose to limit family size. Then, on the assumption that families see higher-quality children (here measured by educational attainment, abstracting from factors like child health) as maximising long-run family welfare, or that parents simply are normally altruistic regarding their children, they invest in education, which both fewer children and the additional income provided by the mother make more affordable. The key to the process is a price change: the price of child quality falls relative to that of child quantity. Opportunity costs play a large role in it.

Argentina's experience shows some apparent deviations from the dominant patterns. While broadly consistent with the EHC model, it suggests asymmetry in the affects of changes in returns to schooling and changes in female opportunity costs on household consumption and behaviour. Changing returns to schooling may affect educational attainment without affecting family size, while changing female opportunity costs strongly affect both.

The section ends on a matter of great importance, although it is not the focus of this work, namely the variance of educational attainment outcomes across persons. It finds very strong evidence that inequality of parental income translates into inequality of educational attainment by social class and hence reproduces it across generations, due to imperfections in the credit markets to finance individuals' education.

Outcomes And Causes — The Time Series of Key Variables

Average educational attainment holds the key interest. Figure 60 plots average years of schooling for recent graduates, the current flow of persons out of educational systems. Attainment rose in all countries save Costa Rica and Uruguay. Recent school leavers had the highest levels in Chile, followed by Colombia, Argentina and Uruguay, with evidence of a slowdown or even fall in the growth in average attainment towards the end of the study periods in Colombia, Chile and perhaps Argentina.

Demographic transformation typically associates with a rising trend in educational attainment (e.g. Becker, 1995; Mincer, 1995*a*). Figure 61 shows that family size fell in all the study countries except Argentina[1]. Rising educational levels accompanied this fall in family size in Chile, Colombia, Mexico and, much more modestly, Uruguay[2]. Thus, rising educational attainment appears to be part of broad demographic transition in three or four of the five reliable cases. In Argentina, educational attainment rose while family size hardly changed. Female labour-force participation stayed roughly flat through 1985, rose, then dropped slightly in 1993-94.

Figure 62 (which omits Costa Rica for greater clarity) shows that declining family size always associates with rising female labour-force participation, again excepting Argentina where family size held roughly constant. The strong correspondence points to women's opportunity costs, the incentive to join the labour force, as a link to the forces behind educational attainment and demographic transition.

Possible Determinants of Rising Educational Attainment

The evidence establishes that rising educational attainment in the countries studied often formed part of a general demographic transition. In the EHC model, this suggests that the relative price of education — the criterion for child quality here — fell relative to the price of the number of children. Yet it does not reveal which price changes, or pressures that would induce such changes, drove this process, and how they associate with broader economic forces. Three principal candidates can be rejected or relegated to minor roles: returns to education, the exogenous component of family income, and the patterns of government spending on education.

Returns to Education. The simple time-series data provide little evidence that returns to education played this role in the countries and periods studied (Figure 63). On average, returns to schooling did not rise. The average level of returns is highest in Chile and Colombia, followed by Costa Rica, then Mexico, Argentina and Uruguay. To the extent that returns to schooling may explain rising educational attainment, the relevant returns are those for university over secondary education, which did rise in some countries some of the time. Even here, however, the supporting evidence is weak. These returns tended to rise with trend in Argentina, Chile and Mexico, but not in Colombia, Costa Rica or Uruguay. The simple correlations of current educational attainment of recent graduates and returns to university over secondary education were positive but small for Argentina (0.16), strongly positive for Chile (0.73), negative and large for Colombia (-0.53) and Uruguay (-0.77) and moderately negative for Costa Rica (-0.22)[3].

Why might changes in rates of return have had small impacts on educational attainment? Theory suggests that the effect of rates of return on educational demand is highest when the rates are low and diminishes as they rise[4]; but many of these countries have high rates of return. Schooling in these countries appears as a good investment, and changes in rates of return are not likely to have altered that very much. In such circumstances, other constraints, such as income levels, may have a more direct impact on educational attainment.

Head-of-Household Income. In Argentina and Chile, head-of-household income was very volatile and followed no trend; it cannot explain rising educational attainment, much less falling family size and rising female participation rates (Figure 64). In Colombia, it climbed through 1985, but then flattened out. It also rose in Mexico and perhaps in Uruguay, although with great volatility in 1992-95. Rising head-of-household income should generate both rising family size and educational attainment. In Colombia until 1985, in Uruguay and in Mexico, its rise cannot explain falling family size.

Public Educational Spending. In all of the countries, unlagged educational spending moved every way and established no solid upward trends; minitrends emerged from time to time in some countries, but had little connection with concurrent educational attainment. Lagged five years and plotted against the mean education of recent graduates, the numbers still do not predict the levels of educational attainment well but, particularly in Chile and Colombia, a suggestion emerges that the concavity of the educational attainment curves matches the public educational spending patterns (Figure 65). The log of educational attainment and the log of lagged public educational spending show positive correlation in Chile (0.67) and Colombia (0.44), but the coefficients are zero or negative for Costa Rica and zero for Argentina and Uruguay. Public spending may sometimes have affected educational attainment, but it was not the principal force behind it.

Educational Attainment Estimates

Estimated coefficients for a core group of three variables — parental education, head-of-household income and female opportunity costs — emerged as highly robust across specifications and countries. All of them were consistently positive, economically large and statistically significant. Table 23 summarises these estimates. Note that the evidence on head-of-household income strongly supports imperfection in the market for financing individuals' education, a crucial stipulation of the EHC model. In the absence of this condition, family income would not act as a binding constraint on educational attainment.

The estimated coefficients on returns to education and government spending were mixed and far less robust. Those on the returns to university over secondary education tended to be somewhat positive and significant in some cases, notably Argentina, Chile, and Colombia, although they were not robust to the inclusion of a trend term. These weak, sometimes negative estimated relationships accord with the absence of clear covariation, or negative covariation, of the means of these variables and mean educational attainment through time. Negative estimated coefficients clearly do not imply causality, and the general weakness in the relationships accords with rates of return high enough to be largely non-binding while other factors, such as the women's opportunity costs, were binding, followed strong trends and drove educational attainment trends.

The estimated coefficients on government expenditures varied widely across specifications within and among countries; they provide no support for the sensitivity of educational attainment to changes in these variables. Estimated coefficients tended to negative values in Argentina, Chile and Costa Rica, to show high variability with some tendency towards positive values for Colombia, and to be positive for Uruguay.

This absence of measurable impact of government spending on educational attainment in most cases may emerge from a variety of different factors and is hard to interpret. It may reflect an econometric problem of too few observations and colinearity with returns to schooling. Public spending may have affected quality and/or quantity (capacity) of education, with quality changes perhaps not always leading to higher individual demand for education. Public educational spending may simply have been inefficient, so that variations in it did not lead to changes in either capacity or quality. Perhaps the level of capacity did not present a binding constraint, so that variations in it had small measurable impacts on educational attainment, while demographic factors played a much more important role.

Given that the time-series pattern of public educational spending correlates at best very weakly with educational attainment outcomes, however, it would appear that the problem is not simply econometric. The positive estimated coefficients on this variable for Uruguay, where the level of spending was far below the average for the other countries, provides some credence to the interpretation that public education spending was not sufficiently meagre to act as binding for most of these countries.

An Interim Summary

It is time to pause for breath and reiterate the evidence and arguments so far about what does *not* explain educational attainment. Both the time-series and the micro-econometric evidence suggest that head-of-household income, returns to education and public spending on education do not throw much light on the dominant pattern of rising educational levels, falling family size and rising female participation rates.

— Head-of-household income did not typically rise with trend and, when it did, theory predicts the contra-factual rise in family size. The micro-econometric evidence of large, positive, statistically significant coefficients on it imply that over the cross-section this variable has great importance — after all, it is the chief component of most families' incomes — but the absence of trend suggests it did not cause rising educational attainment.

— Returns to university and secondary over primary education tended to fall over much of the period Even lagged university/secondary returns correlated positively and strongly with educational attainment in only one country; a few cases produced tendencies towards positive coefficients, but these estimates were not robust to inclusion of a trend term. The correlations of lagged public education spending and educational attainment also came up positive in only a few instances, and the spending variables did not typically rise with trend. Thus, while some evidence emerges that returns to education and government educational expenditures may exert pressures on educational attainment, these variables do not have the strength to explain rising educational attainment.

Women's Opportunity Costs, Female Participation Rates And Growth. One of the strongest, most consistent findings from the educational attainment estimates involved the positive estimated coefficients on women's opportunity costs. Their time series tended to rise with time, and their movements track female participation rates, except in Argentina. Simple regressions also validate these relations. Regressing the log of female labour-force participation in the cross-country time-series data (without Argentina) on log opportunity costs and country dummy variables, produces an estimated coefficient of 1.01 (t-statistic = 4.5); the same regression in first differences yields an estimated coefficient of 0.32 (t-statistic = 2.3).

Women's opportunity costs calculated from observed wages — whether or not corrected as here for sample selection — will systematically understate true opportunity costs as long as women's participation responds to labour demand shifts. The *ex ante* wage that generates the demand shift, or the shift itself, holding female labour-force participation constant, would represent the appropriate measure. The observed wage will reflect the supply or participation response by women and will typically understate the *ex ante* wage that lures them into the market. The more elastic the supply response, the greater the downward bias. In the extreme case of an infinitely elastic short-run supply response, the observed wage remains unchanged even with large demand shifts. This happened in Chile from 1975 to 1990 and in Colombia after 1985; rising female labour-force participation held real wages roughly constant despite rapidly rising per capita GDP, although they were volatile in the very short run.

Output per person in the active labour force likely provides the impetus behind rising female participation rates. On average, its rises or falls imply nearly proportional movements in the per capita demand for labour. While the degree of proportionality will modulate depending on whether skill-biased demand shifts accompany the output shifts, per capita labour demand still will rise and fall closely with per capita output. If aggregate supply were fixed, wages would rise and fall to match. If male participation rates remain more or less constant, as they commonly do, the demand shifts will act largely on female participation. Thus, the *ex ante* opportunity costs of women will be approximately proportional to per capita output. *Ex post,* however, the female supply response will dampen observed wage changes and, if female labour supply is infinitely elastic, they will remain constant. Most important and regardless of the pattern of observed wages, the female participation rate will tend to be a rising function of per capita GDP[5].

In sum, observed wages poorly capture women's opportunity costs, particularly in this dynamic setting. One would like to measure *ex ante* wages, or demand itself, holding labour supply constant. Per capita GDP likely will measure demand for women's labour well, however, because, in the EHC model, its growth drives changes in women's participation rates (see Box for an algebraic demonstration). It follows from this formulation that alternate measures of women's opportunity costs are per capita output or participation-weighted estimated female wages, a sort of employment-probability-weighted wage measure. The latter, corrected for selectivity bias, also captures variations in factors such as labour market discrimination. This study uses it, and it tends to rise with time as expected. Consistent with the prediction of the simple model linking participation, wages and per capita output, the *ex post* participation-weighted wage approximates a linear function of output. (the correlation ranges from 0.85 to 0.95 for all but Argentina, where it also is high after the volatile wage series is smoothed).

The evidence also confirms the prediction of the simple model that the rate of change in female labour-force participation is a linear function of that of per capita GDP. Regressing the log participation rate on log per capita GDP and country dummy variables, the estimated elasticity of female participation to GDP becomes 0.45 (t-statistic = 5.6). This is not only a long-run relation. After first differencing, the resulting coefficient on per capita GDP is still 0.32 (t-statistic = 2.6), suggesting not only that per capita GDP drives female participation rates even in the short run, but also that they quickly respond even to its short-run volatility.

Figure 66 visually sums it all up, plotting the two measures of female opportunity costs, per capita GDP and participation-weighted-estimated wages, along with the mean educational attainment of recent graduates. It shows the strong correspondence among these variables.

A Simple Algebraic Exposition of the Demand for Women's Labour

Labour Demand

Let aggregate output be a Cobb-Douglas function of labour and capital.

$$Q = L^a K^b$$

Aggregate labour demand is then:

$$w = a(Q/L)$$

or $$L^D = a\,(Q/w).$$

Labour Supply

Aggregate labour supply equals the male and female potential labour forces , Nm and Nf, times their respective participation rates, Pm and Pf:

$$L^S = Nf \cdot Pf + Nm \cdot Pm$$

To simplify the exposition, assume that Pm is constant and write labour supply in terms of female labour supply alone. Dropping the subscript on Nf:

$$L^S = N \cdot Pf.$$

And the female labour-force participation rate is a rising function of the real wage:

$$Pf = Pf(w)\ ,\ dPf/dw > 0.$$

For simplicity, assume Pf is linear in w (as, say, local approximation to a logistic function specification):

$$Pf = b \cdot w.$$

In equilibrium, labour supply equals labour demand, so that:

$$a(Q/w) = N \cdot Pf(w).$$

Substituting for Pf(w) and solving for the equilibrium wage and participation rate, we see that the equilibrium wage and the equilibrium female labour-force participation rate are both increasing, concave functions of per capita output, q (≡Q/N):

$$w^* = (a/b)^{½} \cdot q^{½}$$

$$Pf^* = b\,w^* = (a \cdot b)^{½} \cdot q^{½},$$

or, the rate change of the female participation rate is linear in the rate of growth of per capita output:

$$\hat{Pf}^* = ½ \cdot (\hat{Q} - \hat{N}) = ½(\hat{q})\ .$$

Note that in equilibrium the product of the observed wage and participation rate is directly proportional to per capita output[6]:

$$w^* \cdot Pf^* = (a/b)\,q.$$

Cross-country Macro-econometric Evidence

The foregoing sections conclude that average educational attainment got driven principally by growth in per capita GDP; secondarily, it tended, but very weakly, to rise with increases in returns to schooling and per capita public spending on education. Time-series econometric evidence supports these conclusions, but two factors limit the sophistication appropriate for time-series techniques in this context, and lead to only suggestive conclusions. First, with few observations, techniques such as co-integration are inappropriate (Hakkio and Rush, 1991). Second, while much of time-series econometrics tries to render the data stationary, elimination of the underlying trends may be inappropriate; when the underlying phenomena have long-duration periodicity and relate to changes in levels, then the story actually lies in the trends. Stripping the data to only the deviations around trends may eliminate it.

Both groups of considerations apply here. The time series are relatively short, and average educational attainment results from a long-gestation process. In light of these considerations, two basic groups of regressions were run for the country macro time-series, pooled across countries: log-log specifications with country dummy variables, and the same regressions in first differences without the dummy. The exercises regressed average educational attainment in country j in time t onto different combinations of returns-to-schooling variables (lagged five years), per capita GDP (current and lagged), per capita public spending on education (current and lagged five years) and family size.

In the regressions in log-levels, the estimated coefficients on GDP, educational expenditure and university/secondary returns all usually came up positive. A typical regression yielded estimated coefficients of 0.31 on current GDP (t-statistic = 4.1), 0.23 on lagged GDP (t-statistic = 2.9) and 0.04 on lagged university/secondary returns (t-statistic = 3.5). Including current or lagged public education, spending lowered the coefficient on lagged per capita GDP, and its own coefficient averaged 0.10 (t-statistic = 3.8). Including the family size variable led to similar estimates, also tending to lower the estimated coefficient on lagged per capita GDP, with its own coefficient typically negative and statistically significant. The regressions in first differences produced similar results. A typical regression yielded estimated coefficients of 0.1 (t-statistic = 2.1) on lagged GDP, 1.1 (t-statistic = 2.1) on lagged public education and -0.09 (t-statistic = 2.2) on family size; the estimated coefficients on lagged returns to schooling tended to be statistically insignificant.

Within the limits of the data and the underlying process of educational formation, the time-series regressions thus gave results consistent with the principal conclusion The hypothesised causal mechanism linking per capita GDP to educational attainment works via women's labour-force participation. The two are highly correlated. Regressing (in logs) female labour-force participation onto per capita GDP and country dummy variables produced an estimated coefficient on per capita GDP of 4.2 (t-statistic = 5.1) and an adjusted r-squared of 0.73; in first differences, the coefficient was 31 (t-statistic = 2.3).

The Argentine Case

Is the evidence for Argentina, where children's education and family size do not vary inversely, at variance with the simple predictions of the EHC model? The answer is "no", because the impacts of changes in the returns to schooling versus per capita GDP on demographic outcomes likely are asymmetric.

This plausible asymmetry in true household behaviour does not appear as immediately evident in the simpler EHC models, where a change in the relative price of the number versus the quality of children leads to an opposite change in the ratio of number versus average quality. Changing female opportunity costs should directly alter women's participation rates and thereby lower family size. Indirectly, higher opportunity costs also lead to family substitution in consumption towards

higher quality per child. The asymmetry emerges because, while changes in the returns to education, by definition, directly affect the value of children's education, higher opportunity costs affect only mothers' fertility decisions.

This postulated asymmetry — where changes in per capita output have first-order effects on fertility and educational attainment, while changes in returns to education have such effects only on educational attainment — fits the facts well for Argentina. Educational attainment rose over most of 1976-94, while family size remained nearly constant. Over much of the period, university over secondary returns to schooling rose rapidly and steadily (average returns to education in general did not rise), but per capita output fell[7]. Estimated female opportunity costs held nearly constant, save for a one-year fall in 1990. The female labour-force participation rate stayed flat until 1985, climbed rapidly to a peak in 1992, then tapered off and began to reverse. Thus, the rise in returns to university education appears to have stimulated rising educational attainment, but falling per capita GDP held family size constant. The increased participation rate after 1985 could not have reflected a response to rising opportunities because the nation experienced a deepening economic crisis. Women more likely entered the labour market to supplement rapidly falling family incomes. Once per capita GDP began to rise after 1990, female labour-force participation began to subside.

Conclusion

In this search for the underlying causes of rising educational attainment, the work has found a dominant pattern that accords strongly with a demographic transition from large families with low education per child to small families with high education per child, consistent with the EHC model. Yet what has driven this process, among the many different forces which could affect the relative price of child quantity versus child up over time?

The role of women holds a primary place throughout. The central findings reveal, first, that changes in female opportunity costs primarily caused rising average educational attainment and, in association, rising female participation rates and falling family size. Second, growth in per capita GDP drives the rising opportunity costs of women's time. Third, changing returns to schooling had relatively little impact compared to opportunity costs and per capita GDP; changes in per capita GDP dominated them in all cases except Argentina, for which an alternative explanation, still broadly consistent with the EHC model, serves well.

An Afterthought

Greater variance in the education levels of recent school leavers (young cohorts and recent graduates) did not generally accompany rising mean educational attainment, which thus did not take place at the expense of worsening distribution in educational achievement. Nevertheless, inequality of educational attainment, high initially in these countries, remains high today. The results of this study imply that per capita economic growth may furnish a key to inducing lower population growth rates and higher human capital — but economic growth alone cannot solve problems of inequality.

While it cannot explain the increase over time in mean educational attainment, family income is crucial for inequality in earnings and educational attainment, as well as the reproduction of inequality across generations. The statistical analysis showed that, controlling for other factors, children in families with higher head-of-household incomes consistently reached higher educational levels in every country. Because parental schooling largely determines these incomes, inequalities get transmitted across generations. This statistical result gives strong support to the EHC model's assumption that financial markets for education are highly imperfect. While head-of-household income did not rise consistently over time and could not explain the rise in mean educational attainment, it did explain much of the inequality in educational attainment across families at any given moment.

NOTES

1. One should view the figures for Costa Rica with caution, and the first observation for family size in Mexico may be due to sampling error.
2. The comparatively small changes in Uruguay are obscured by the average scaling in the figure.
3. Mexico yielded only two observations.
4. Derivation of The Concavity of The Impact of Returns to Education on Educational Attainment:

   The estimated coefficient on the returns to education in the educational attainment function corresponds to the derivative of the individual's optimising education with respect to the returns to education. This derivative will be increasing and concave in the *level* of the returns to education. This is due to the diminishing marginal utility of children's schooling. In the standard demand formulation with marginal diminishing utility, the amount demanded falls at a declining rate with the good's price: monotonically decreasing and convex. Because returns to schooling are a negative price of schooling, the corresponding demand curve for schooling as a function of the returns to schooling is a mirror image of the standard demand curve: monotonically increasing and concave.

   This point can be illustrated by examining a simplified version of the utility maximisation problem. Let utility be a function only of child quality (schooling) and assume that this utility is an increasing, concave function in quality, say:

   $$u = q^a \,,\ a \in (0,1) \qquad (1)$$

   Families maximise subject to the budget constraint:

   $$I = p_q q \qquad (2)$$

   The FOC is:

   $$a q^{(a-1)} = \lambda p_q \qquad (3)$$

   and the demand curve for q is:

   $$q^* = ((\lambda/a)\, p_q)^{(1/a-1)}. \qquad (4)$$

   For a = ½, then

   $$q^* = ((2\lambda)\, p_q)^{-2} \qquad (5)$$

   $$dq^*/dp_q = m\,(-2)\, p_q^{-3} < 0$$

   $$d^2q^*/dp_q^2 = m(-2)(-2)\, p_q^{-4} > 0 \qquad (6)$$

   Because returns to schooling, r, are a negative price, the signs of the first and second derivatives are reversed:

   $$p_q = -\,r \qquad (7)$$

   So,

   $$dq^*/dr = m\,(-2)\,(-r)^{-3} > 0 \qquad (8)$$

   $$d^2q^*/dp_q^2 = m(-2)(-2)(-r)^{-4} < 0$$

   The level of schooling demanded thus is an increasing, concave function of the returns to schooling. In other words, the effect of returns to schooling on the level of schooling demanded declines with the level of returns to schooling. This means that the impact of changes in the returns to schooling upon educational attainment may be very small when returns are high. These effects may be easily dominated by changes in other factors affecting the desired level of schooling.

5. In measuring the appropriate prices in the EHC model, there is an important asymmetry between women's opportunity costs and head-of-household income from work. In the former case, we are interested in the *ex ante* wage net of women's supply response, while in the latter we are interested in *ex post* income. Thus, no correction of the income measure is required.

6. The same basic results hold if we include male labour force participation and assume it is roughly constant, or exogenous: i.e. we find that female labour force participation is an increasing function of per capita aggregate output:

$$L^s = N [\theta Pf(w) + (1-\theta) Pm] = N [\theta b w + (1-\theta) Pm].$$

Then setting supply equal demand we get:

$$aq = [\theta b w^2 + w(1-\theta)],$$

$$w^* = \frac{[4 \cdot a \cdot b\theta \cdot q + (\theta - 1)^2]^{1/2} + \theta - 1}{2 \cdot b \cdot \theta}$$

$$Pf^* = \frac{[4 \cdot a \cdot b\theta \cdot q + (\theta - 1)]^{1/2} + \theta - 1}{2\theta}$$

$$dPf^*/dq \geq 0.$$

Or in general functional form, as before:

$$w^* = f(q), f'>0, f''< 0$$
$$Pf = b \cdot f(q),$$

Thus the equilibrium wage and female participation rate are increasing, concave functions of per capita output. Clearly, if the participation rate is a non-linear, though increasing, function in the wage, this will alter the functional form of the equilibrium participation rate accordingly.

7. Rising returns to university education probably resulted from the well documented de-industrialisation of the Argentine economy over this period.

STATISTICAL ANNEX

Figure 1. **Relative Supply in Education: University Equivalents/Primary-Complete Equivalents**

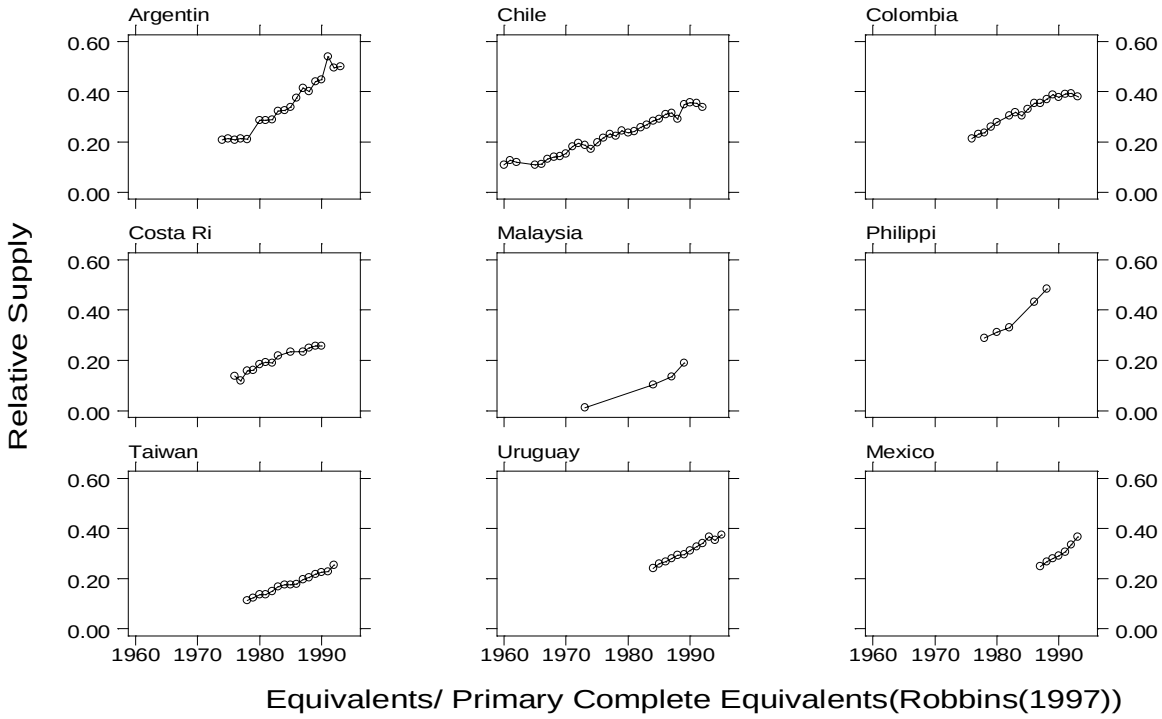


Figure 2. **Percentages of the Adult Population with University and Completed Secondary Education**

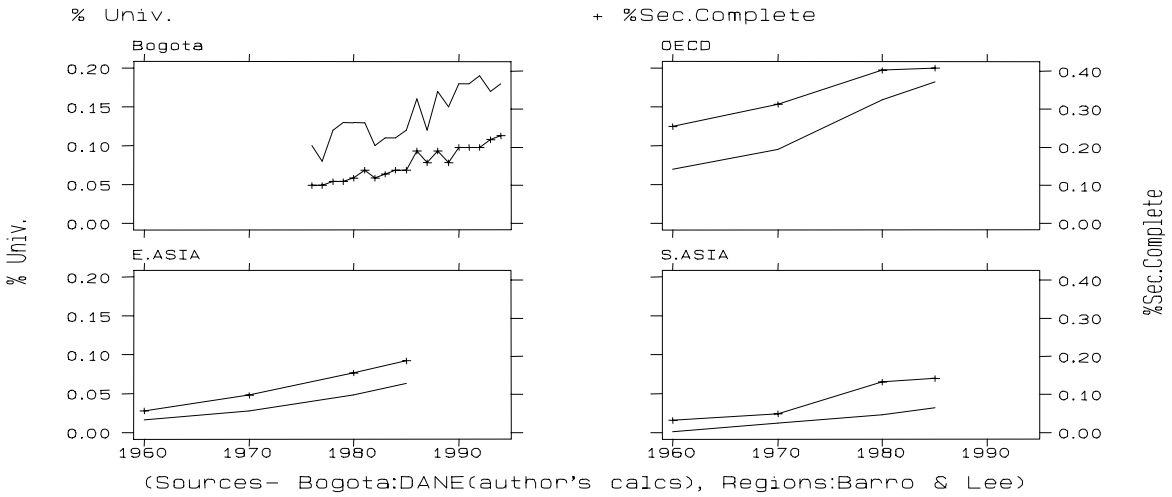


Figure 3. **Relative Supply and Relative Wages (Lagged Five Years)**

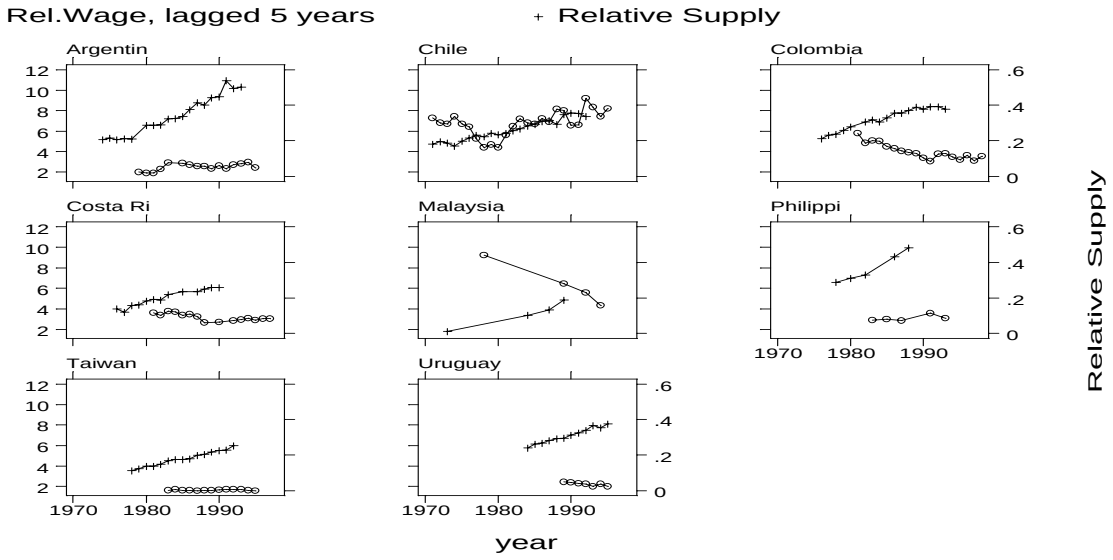


Figure 4. **Relative Supply and Relative Wages (Lagged Ten Years**)

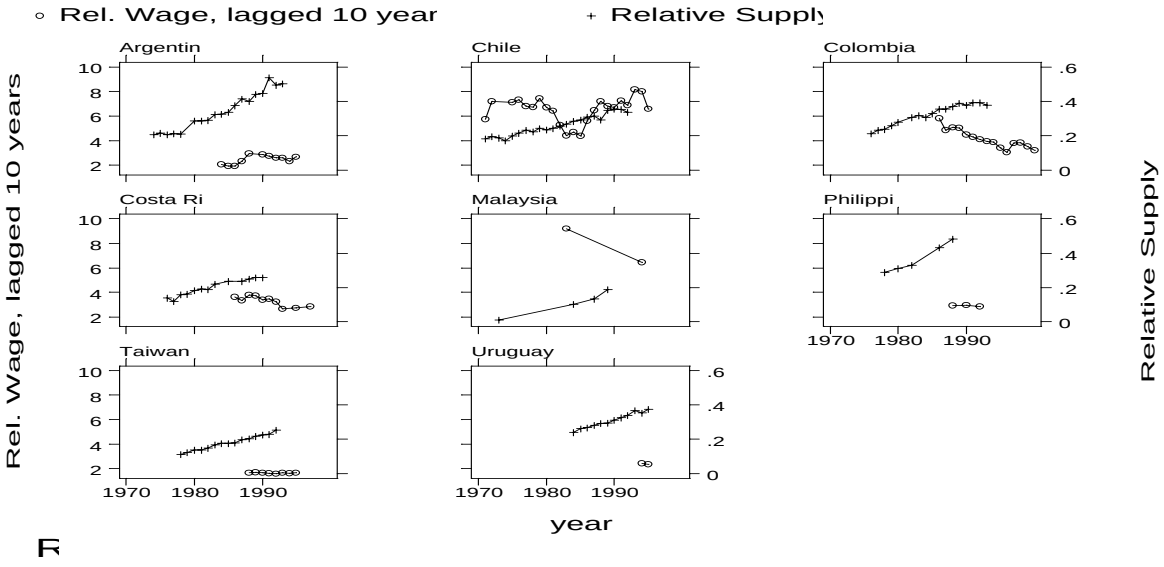


Figure 5. **Argentina: Mean Education of Recent Graduates and Relative Supply**

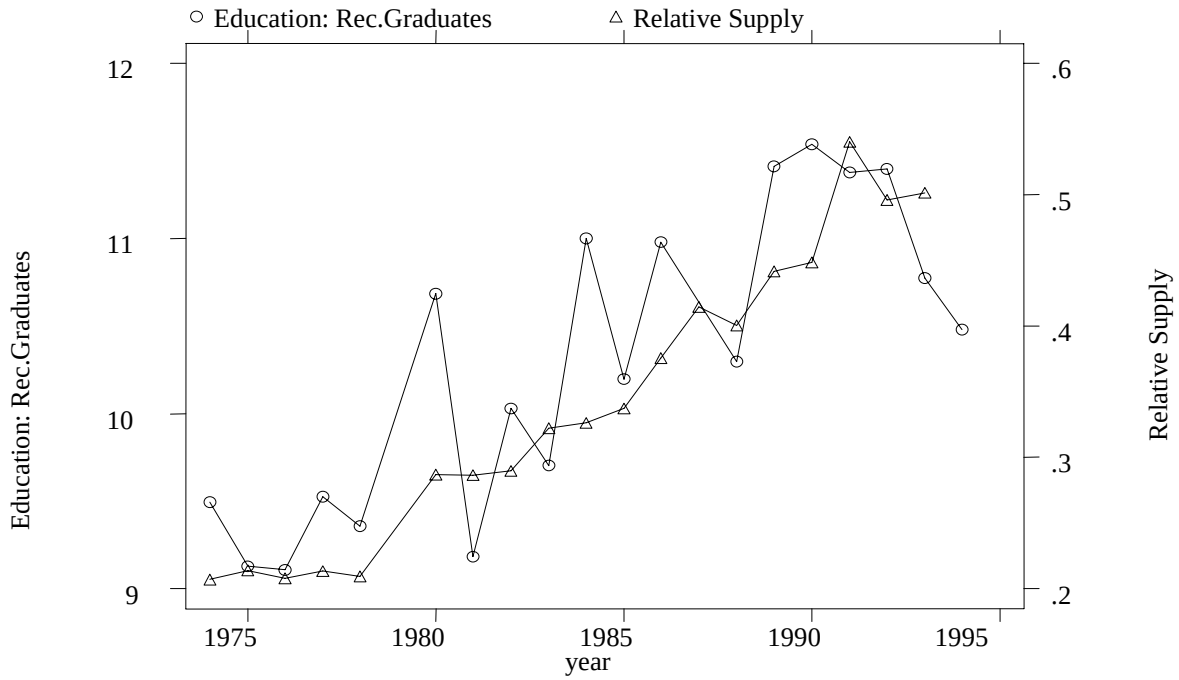


Figure 6. **Argentina: Average Number of Children**

Figure 7. **Argentina: Returns to Schooling**

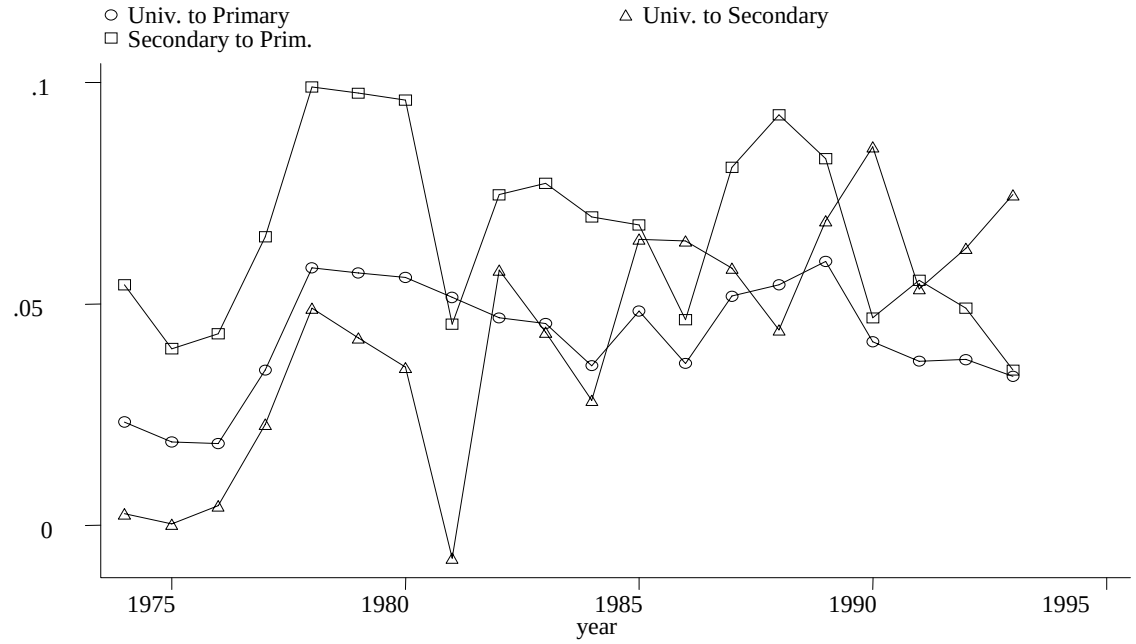


Figure 8. **Argentina: Head-of-Household Income**

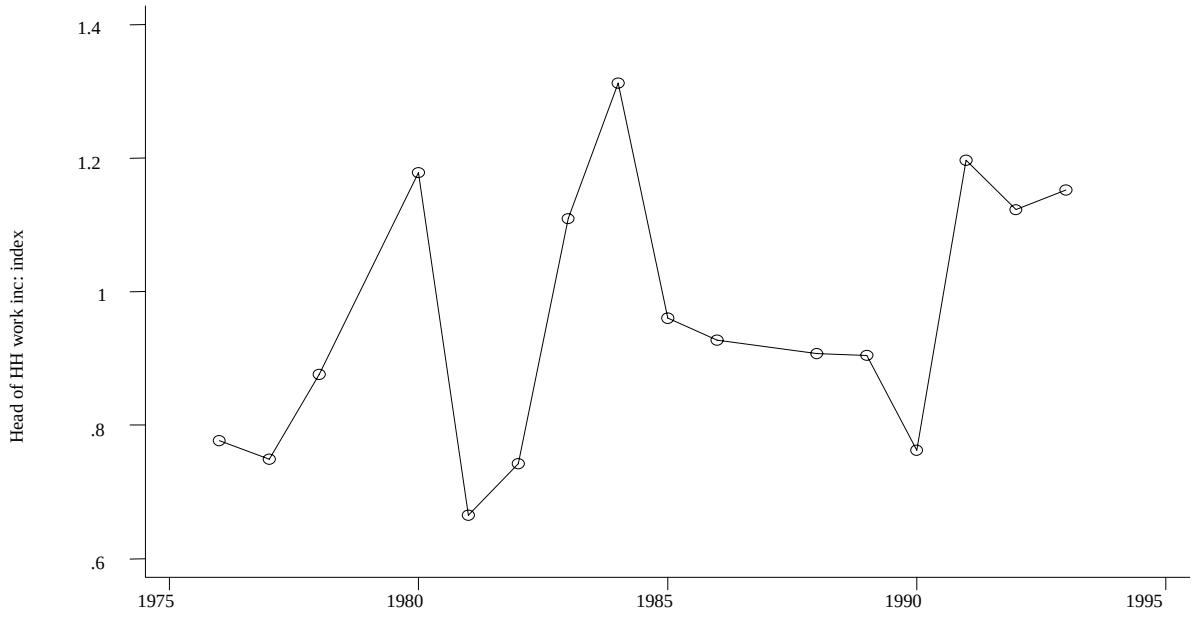


Figure 9. **Argentina: Females' Opportunity Costs and Per Capita GDP**

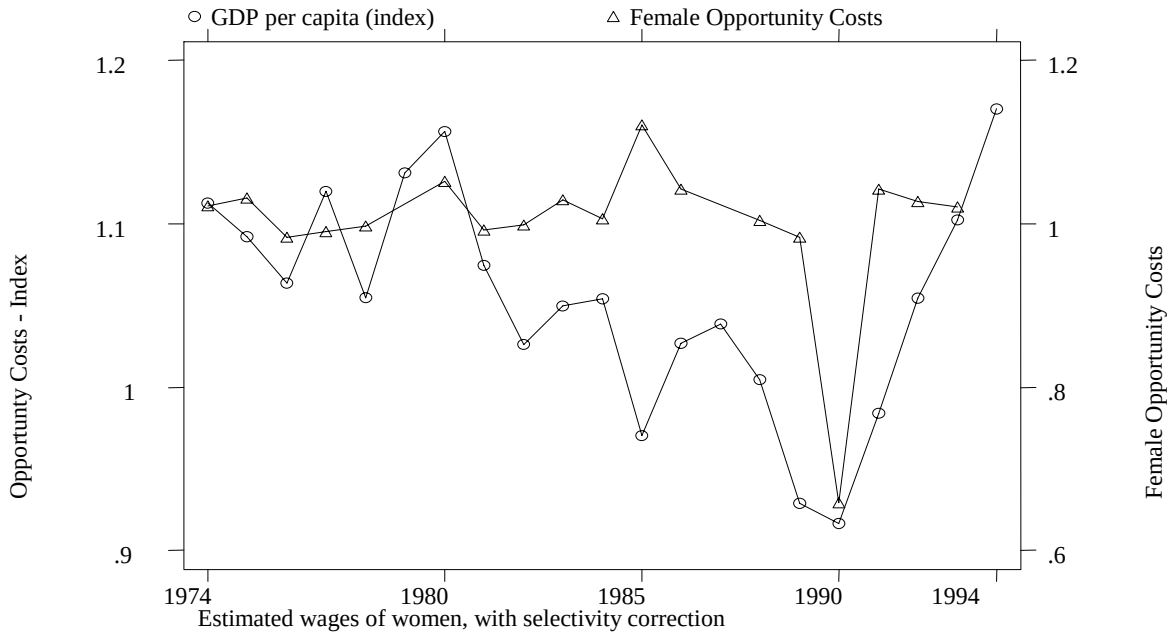


Figure 10. **Argentina: Female Labour Force Participation**

Figure 11. **Argentina: Distribution of Public Spending on Education**

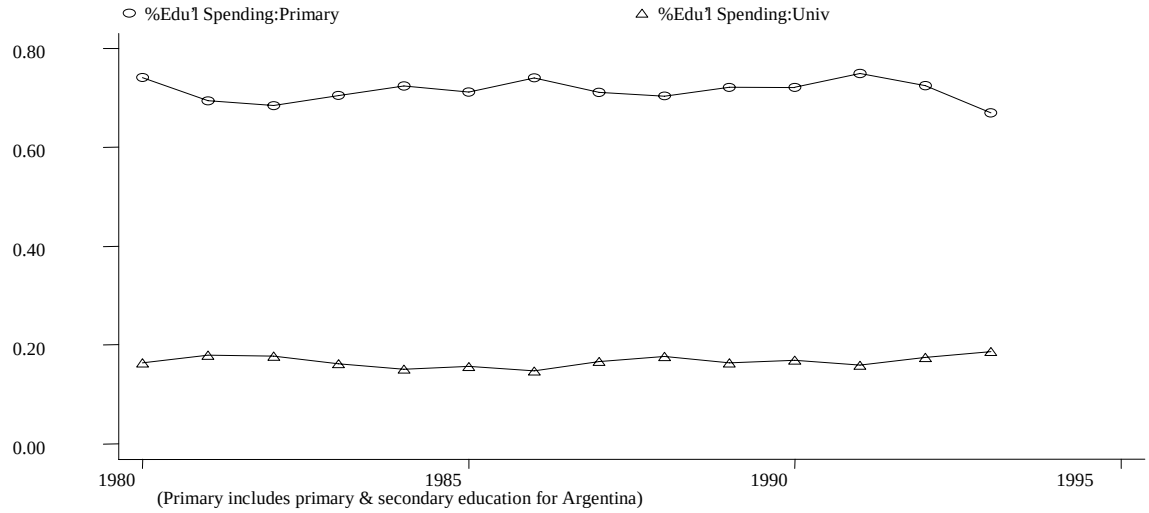


Figure 12. **Argentina: Total Per Capita Public Spending on Education**

(1988 = 100)

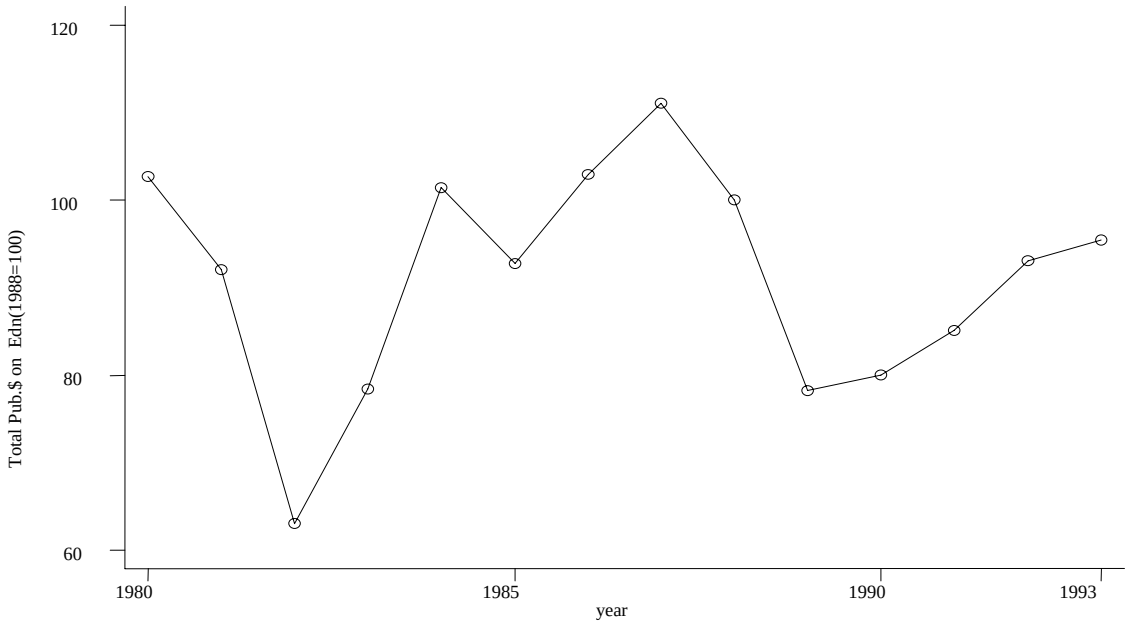


Figure 13. **Argentina: Educational Attainment of Recent Graduates and Returns to University over Secondary Education**

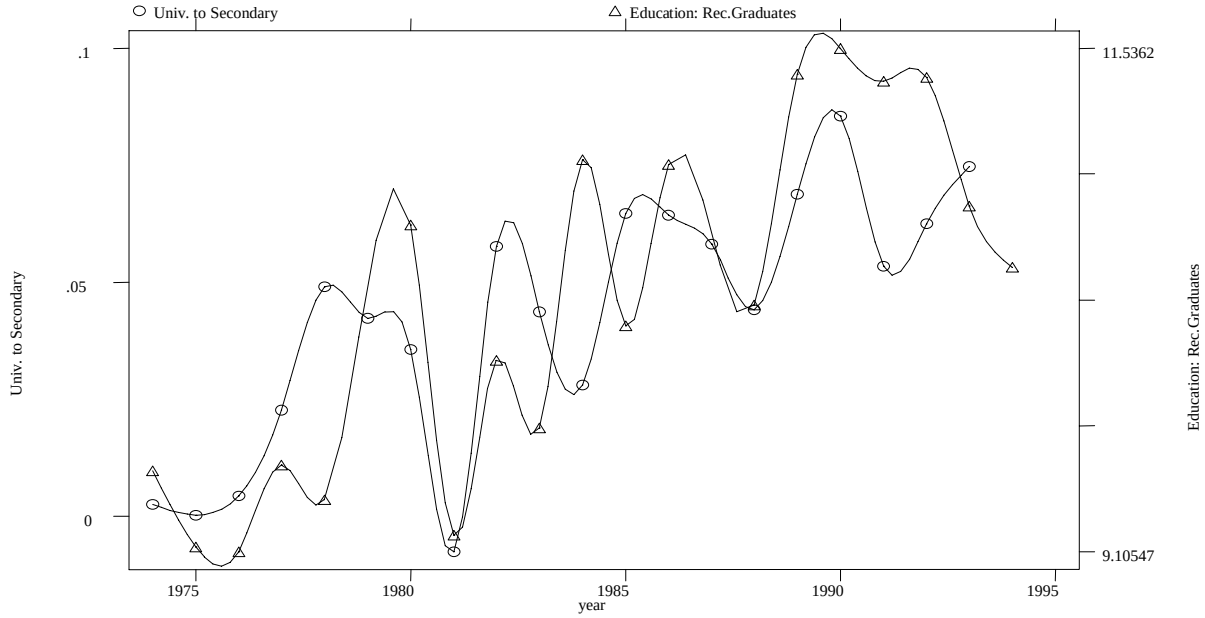


Figure 14. **Chile: Mean Education of Recent Graduates and Relative Supply**

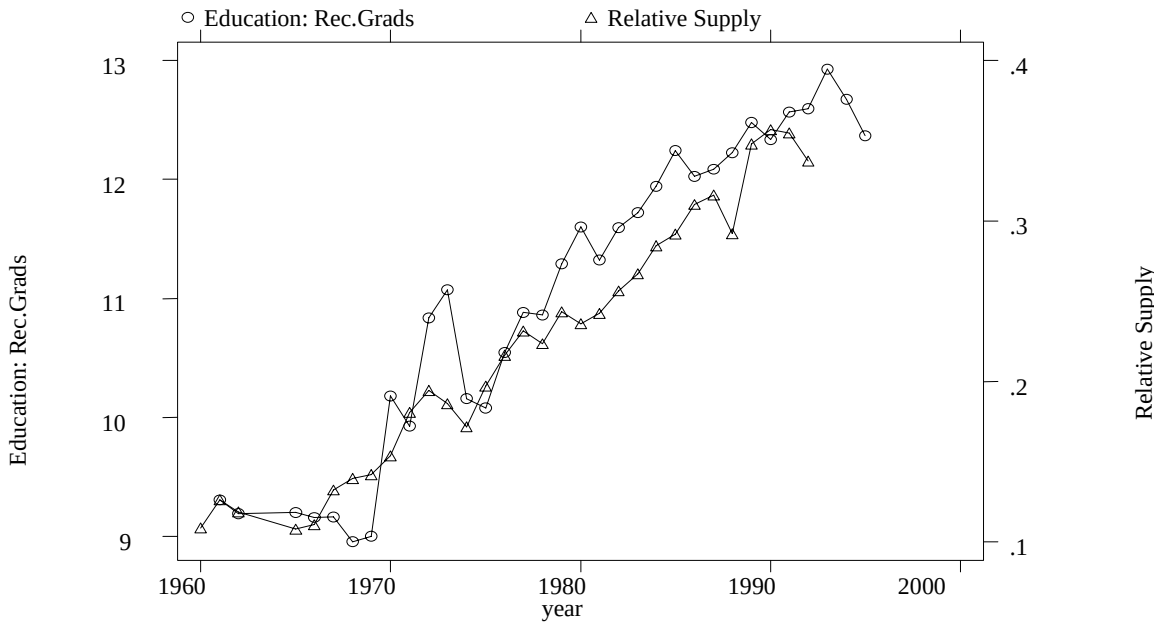


Figure 15. **Chile: Average Number of Children**

Figure 16. **Chile: Average Number of Children and Recent Graduates**

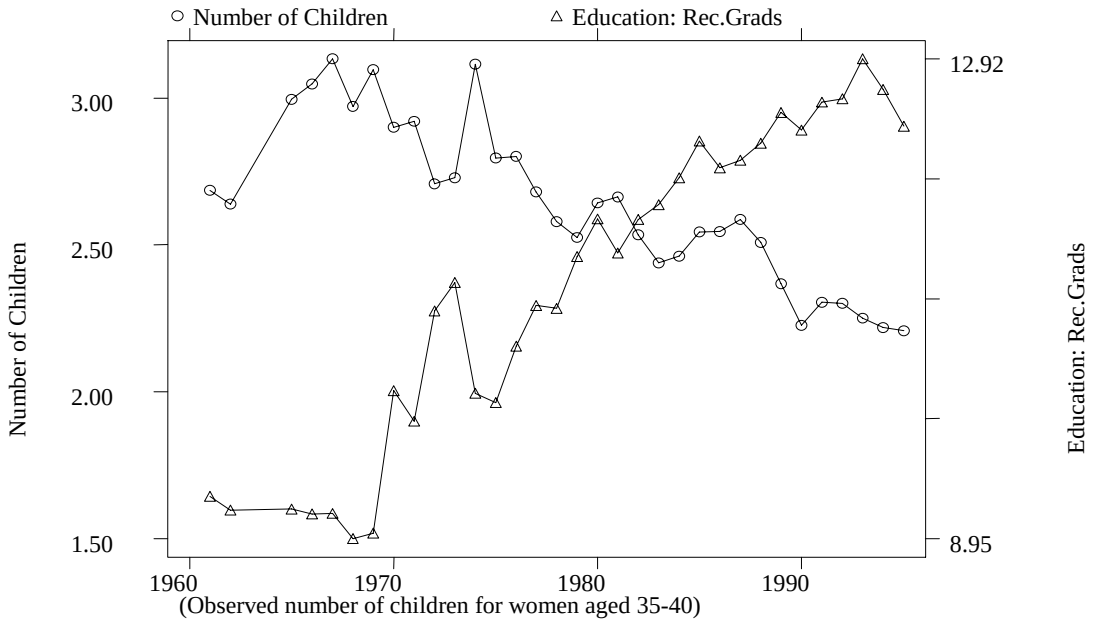


Figure 17. **Chile: Rates of Return to Schooling**

Figure 18. **Head-of-Household Income**

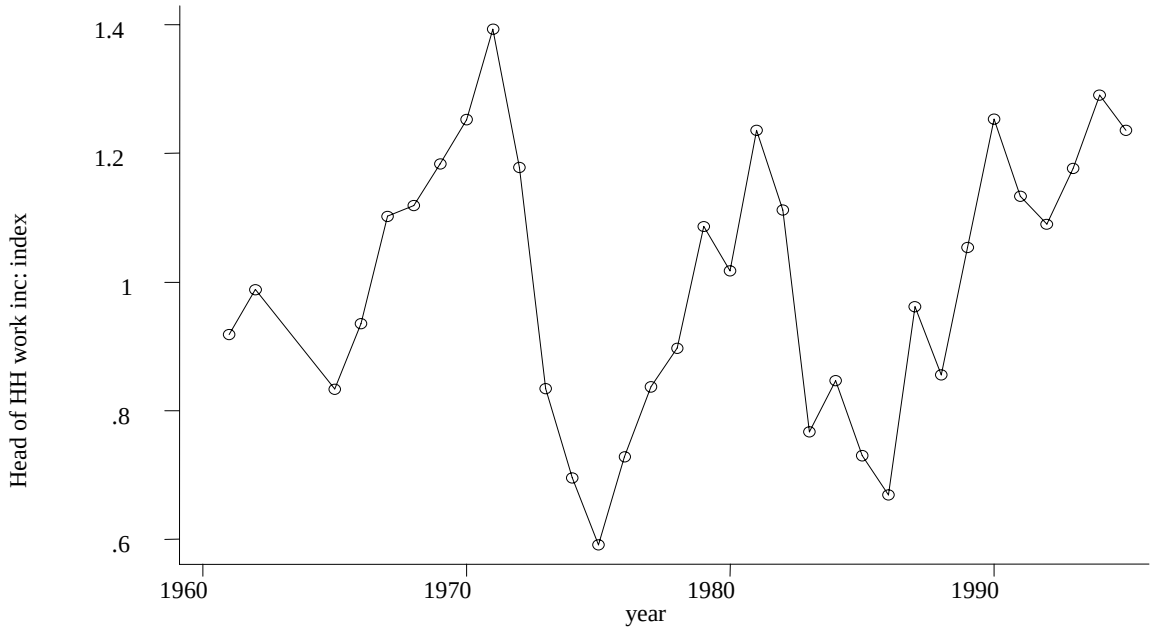


Figure 19. **Chile: Indexes of Women's Opportunity Costs and Per Capita GDP**

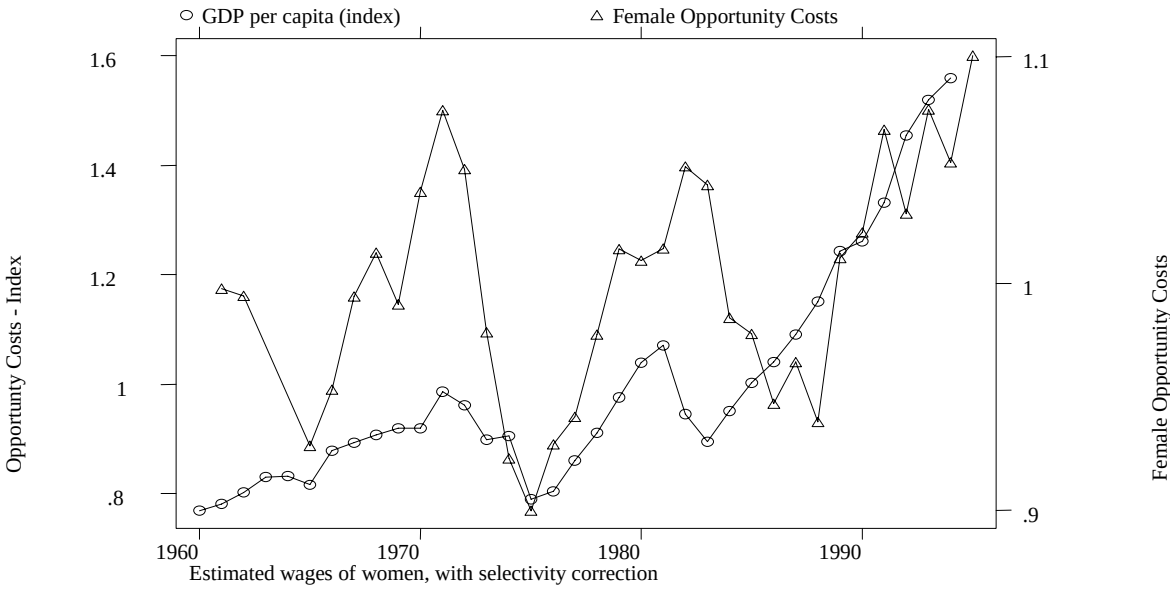


Figure 20. **Chile: Female Labour Force Participation and GDP**

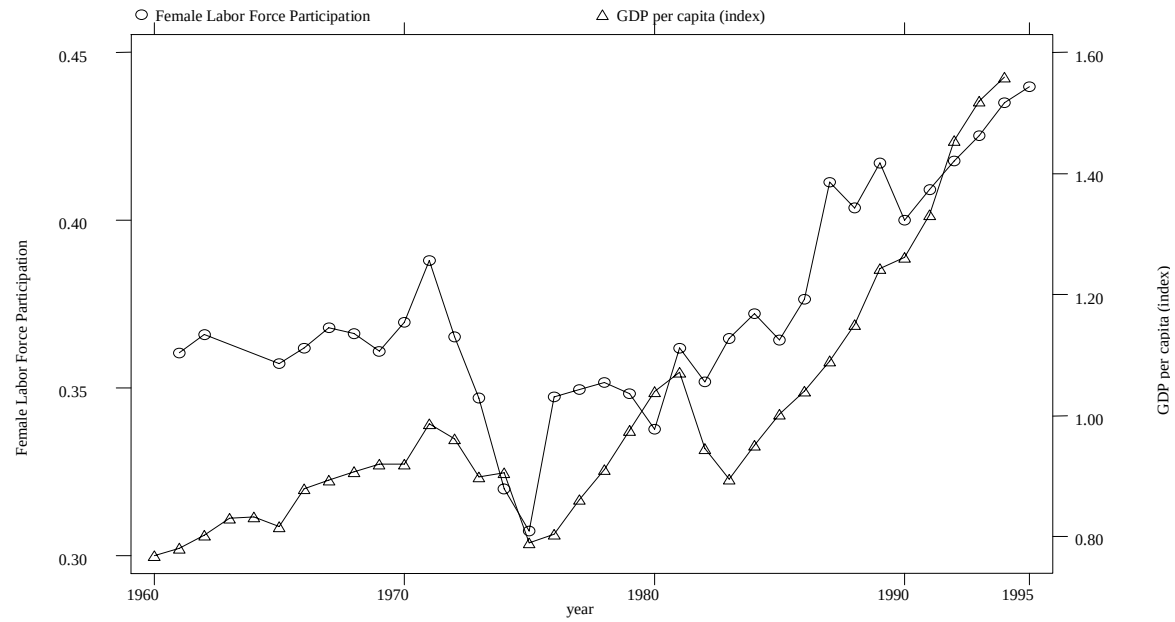


Figure 21. **Real Earnings of Males and Females**

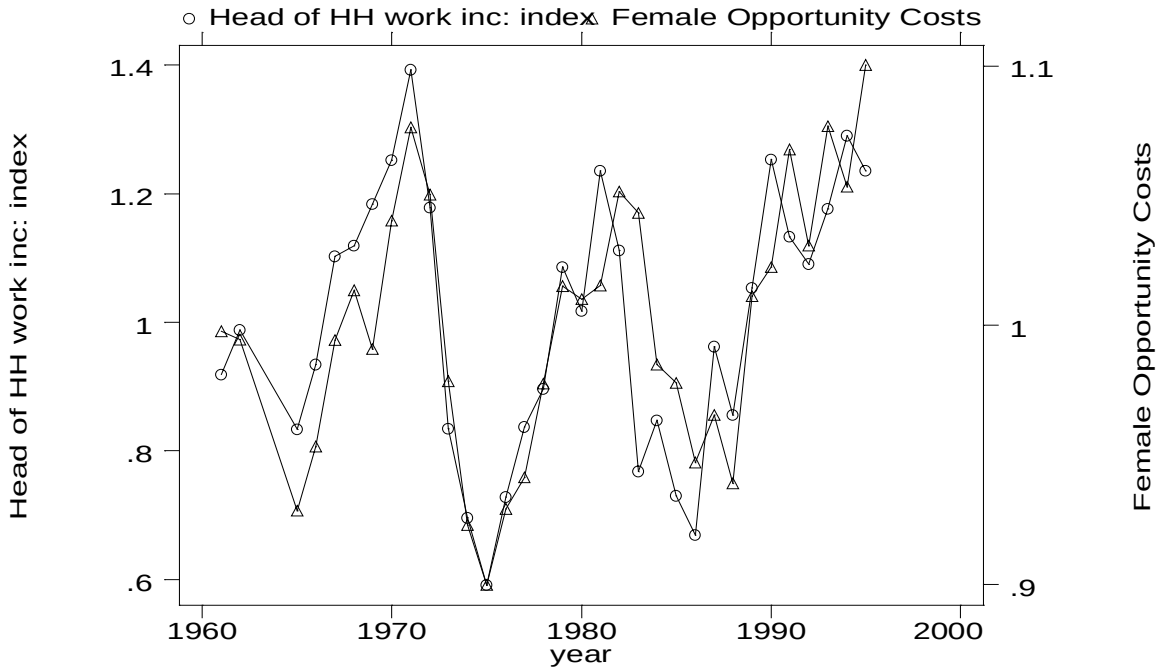


Figure 22. **Chile: Total Public Spending on Education Per Capita**

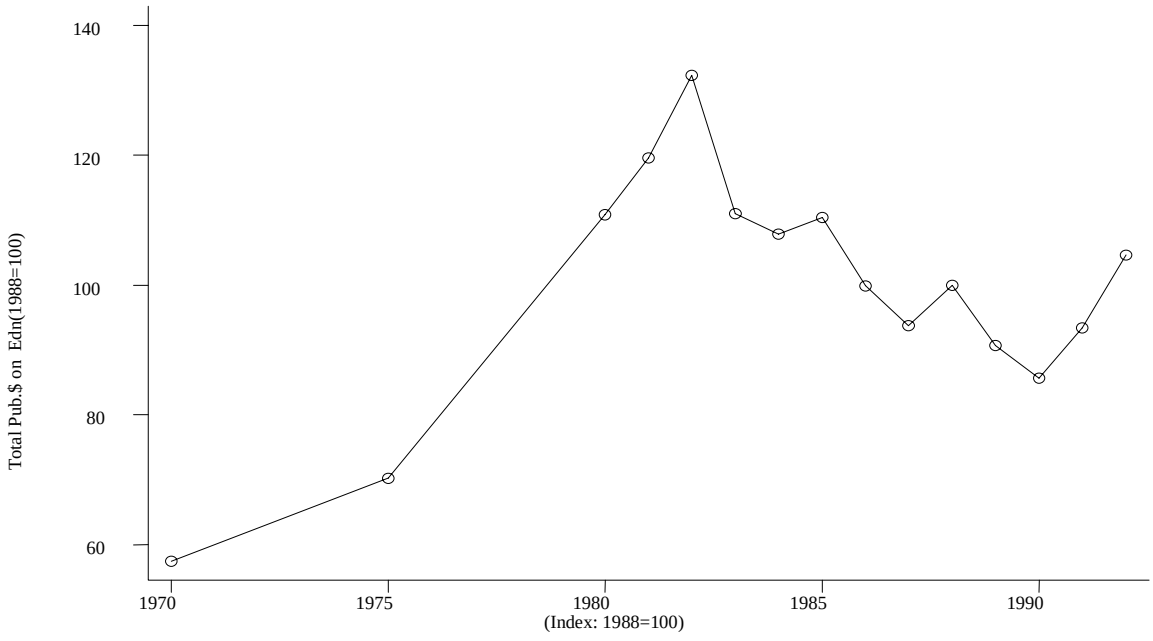


Figure 23. **Chile: Public Spending on Education, by Level**

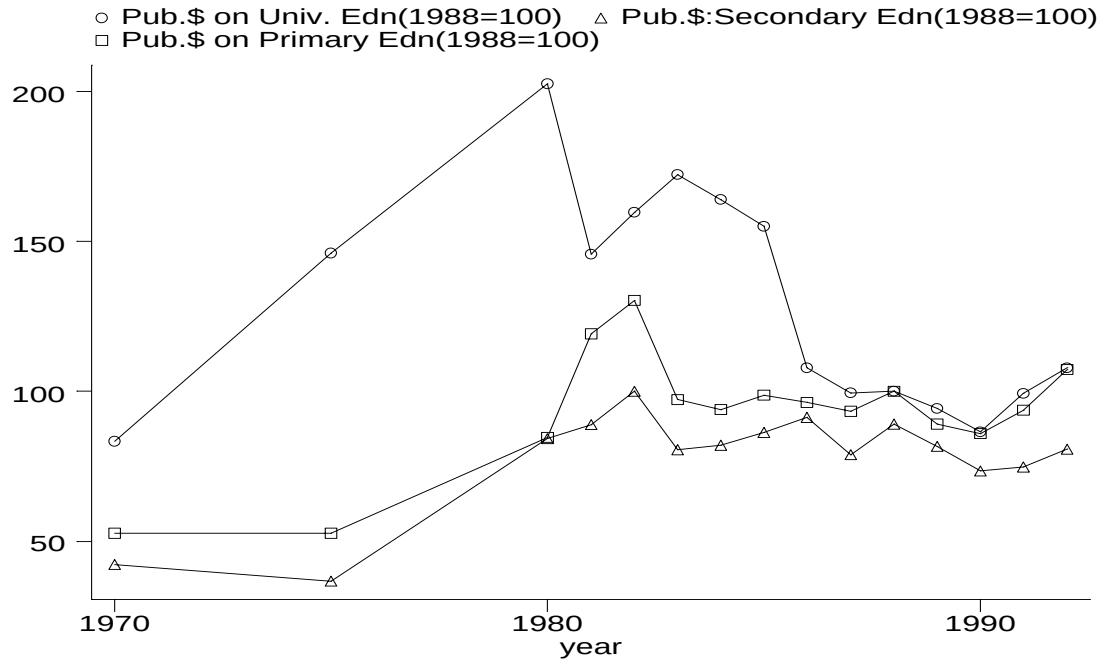


Figure 24. **Chile: The Distribution of Public Spending on Education**

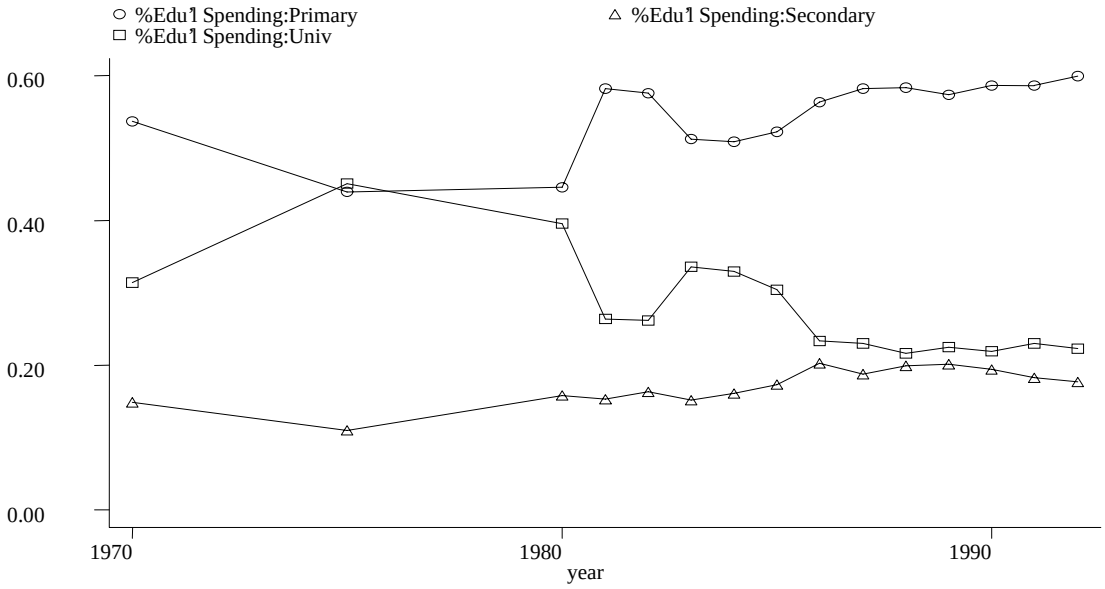


Figure 25. **Colombia: Mean Education of Recent Graduates and Relative Supply**

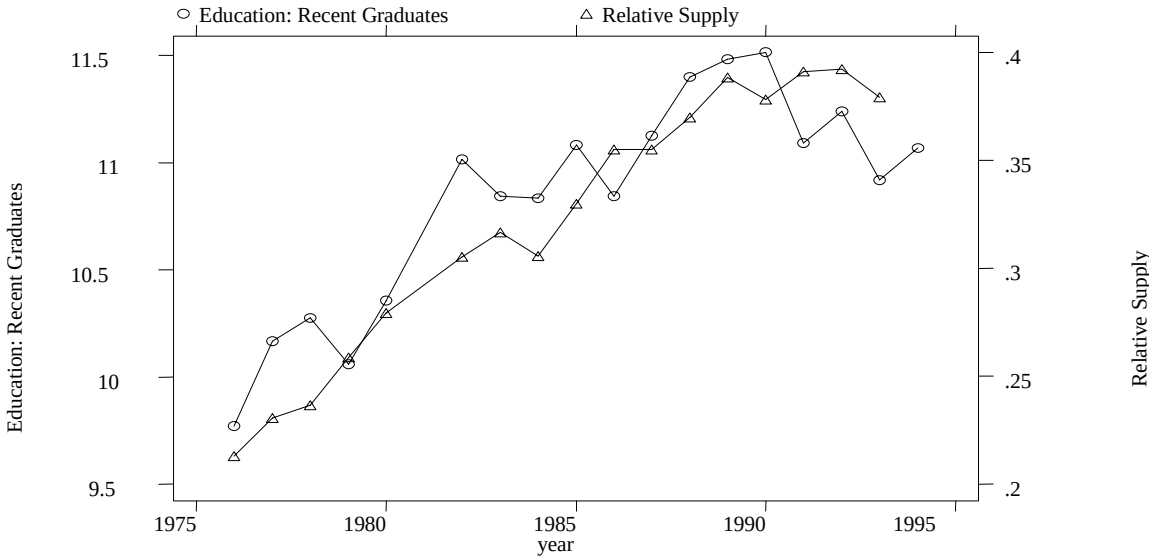


Figure 26. **Colombia: Average Number of Children**

Figure 27. **Colombia: Returns to Schooling**

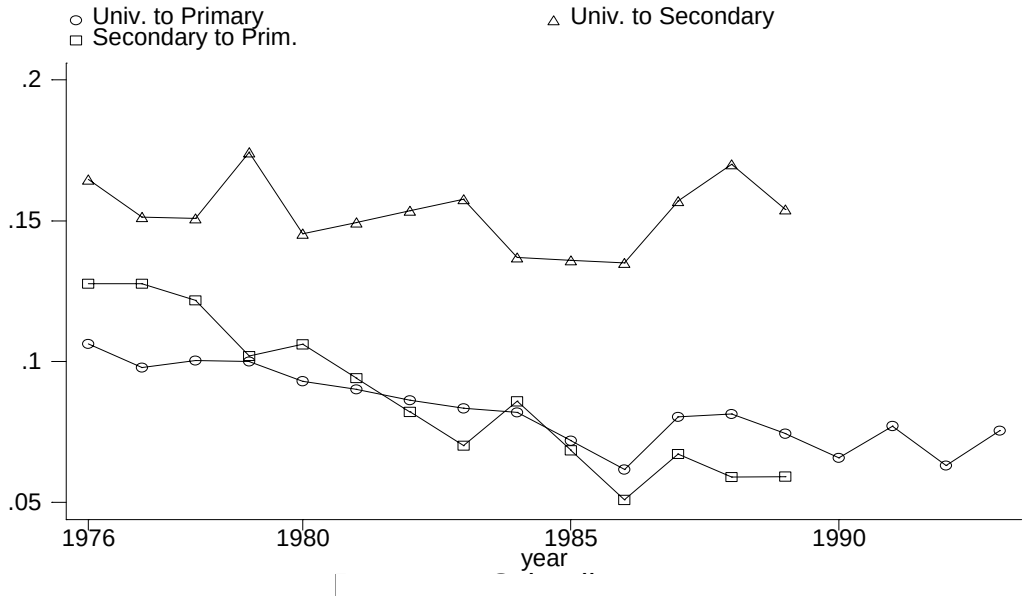


Figure 28. **Colombia: Head-of-Household Income**

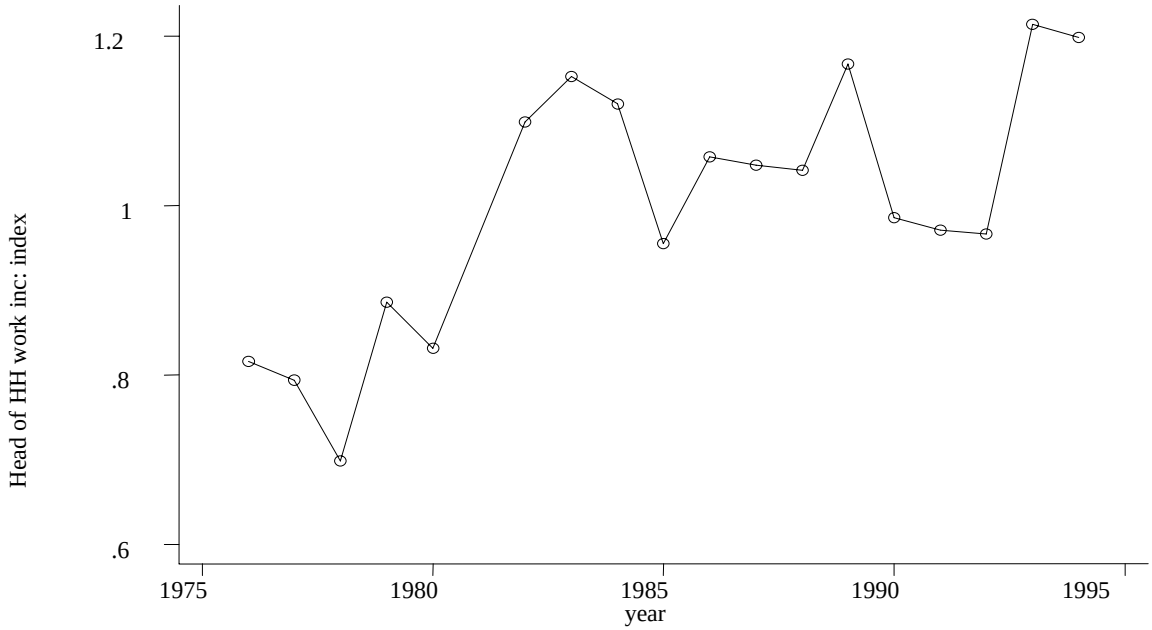


Figure 29. **Colombia: Head-of-Household Income and Educational Attainment**

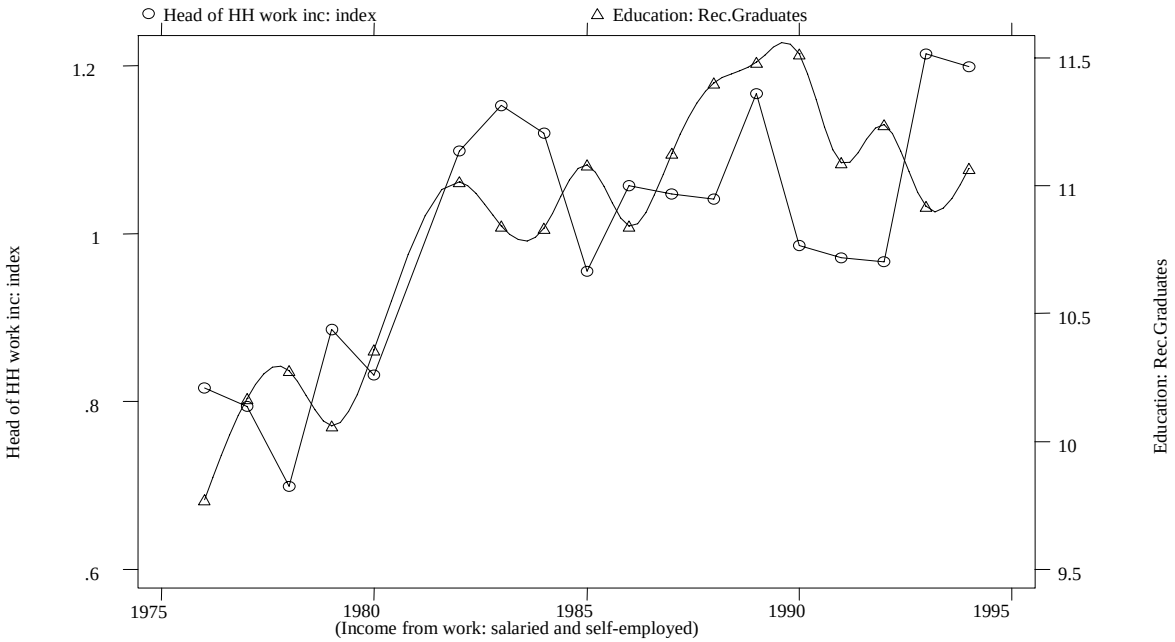


Figure 30. **Colombia: Indexes of Women's Opportunity Costs and Per Capita GDP**

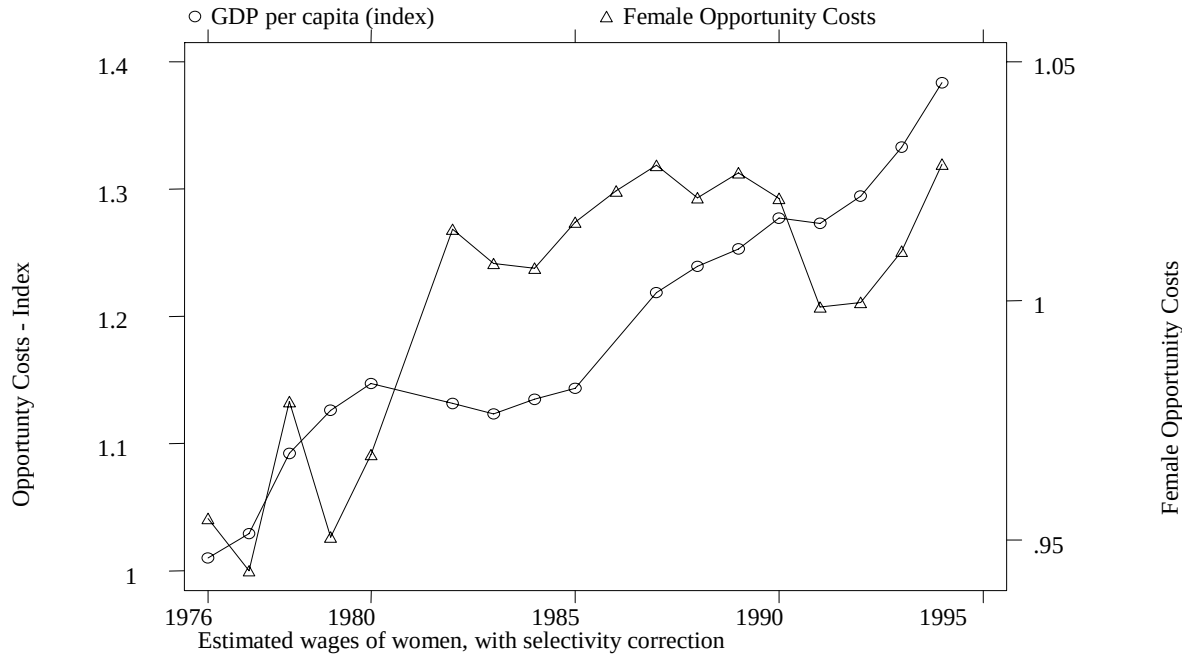


Figure 31. **Colombia: Female Labour-Force Participation**

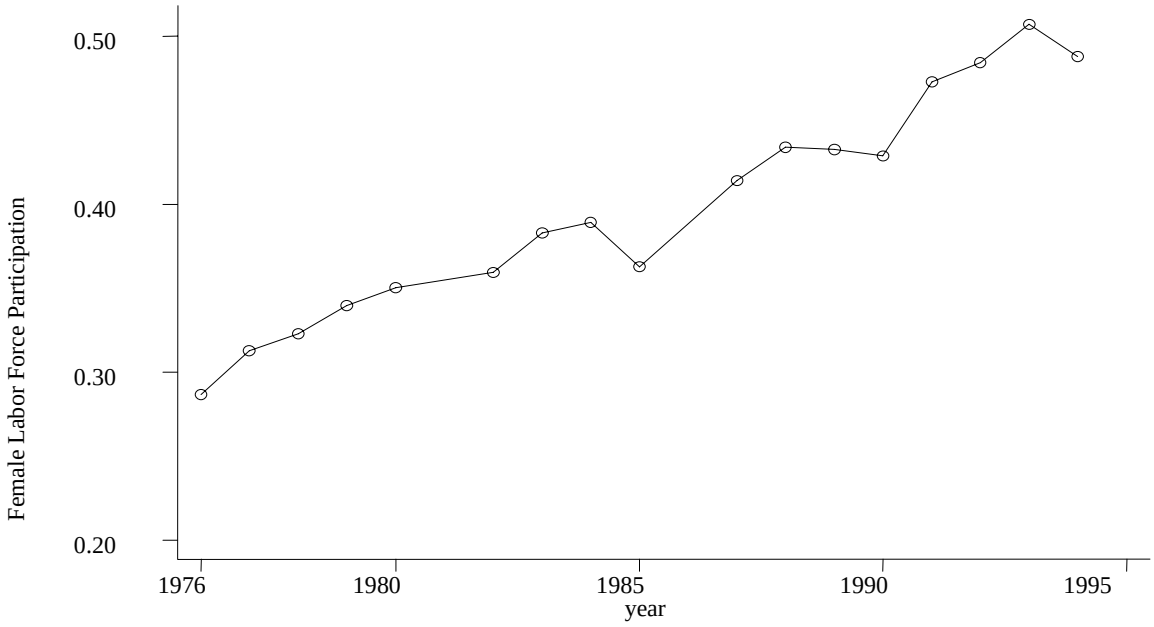


Figure 32. **Colombia: Total Public Education Spending Per Capita**

(1988 = 100)

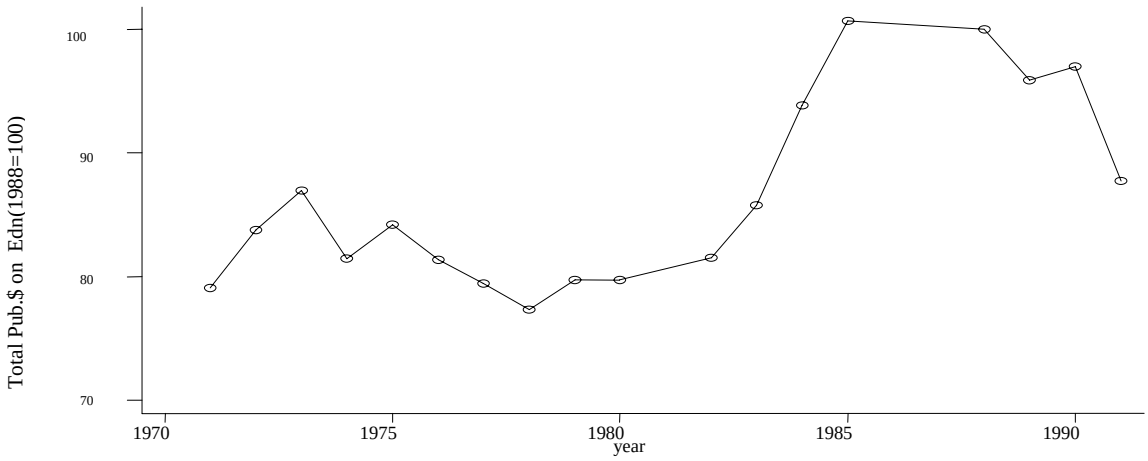


Figure 33. **Colombia: Public Education Spending Per Capita by School Level**

(1988 = 100)

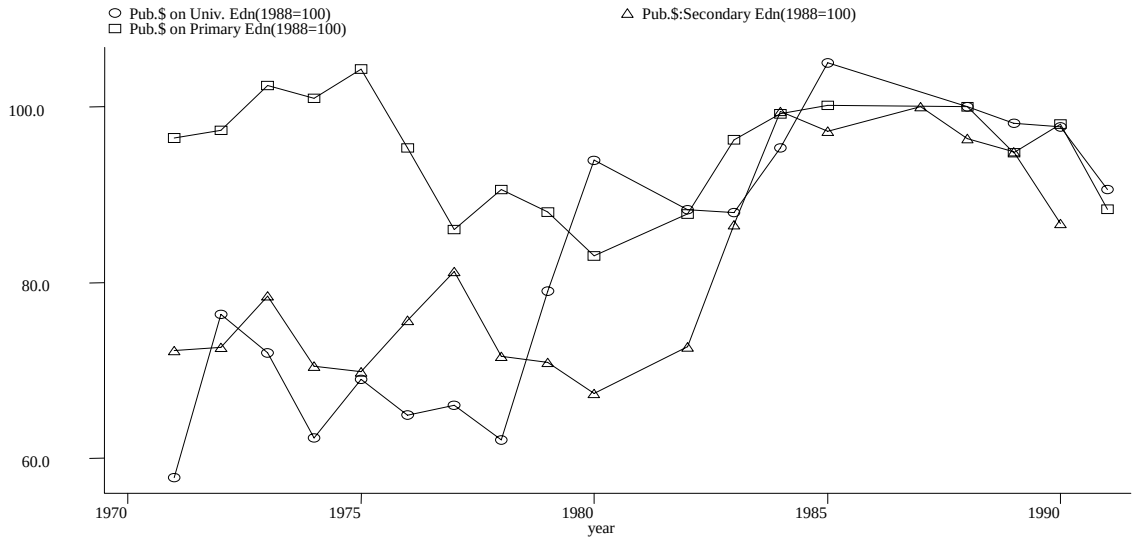


Figure 34. **Colombia: Distribution of Public Spending on Education**

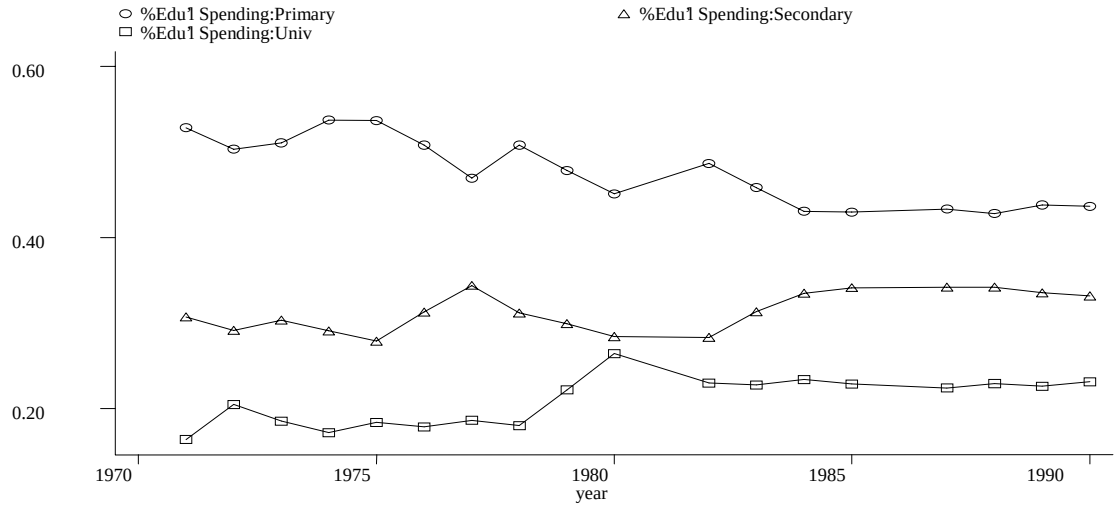


Figure 35. **Costa Rica: Mean Education of Recent Graduates and Relative Supply**

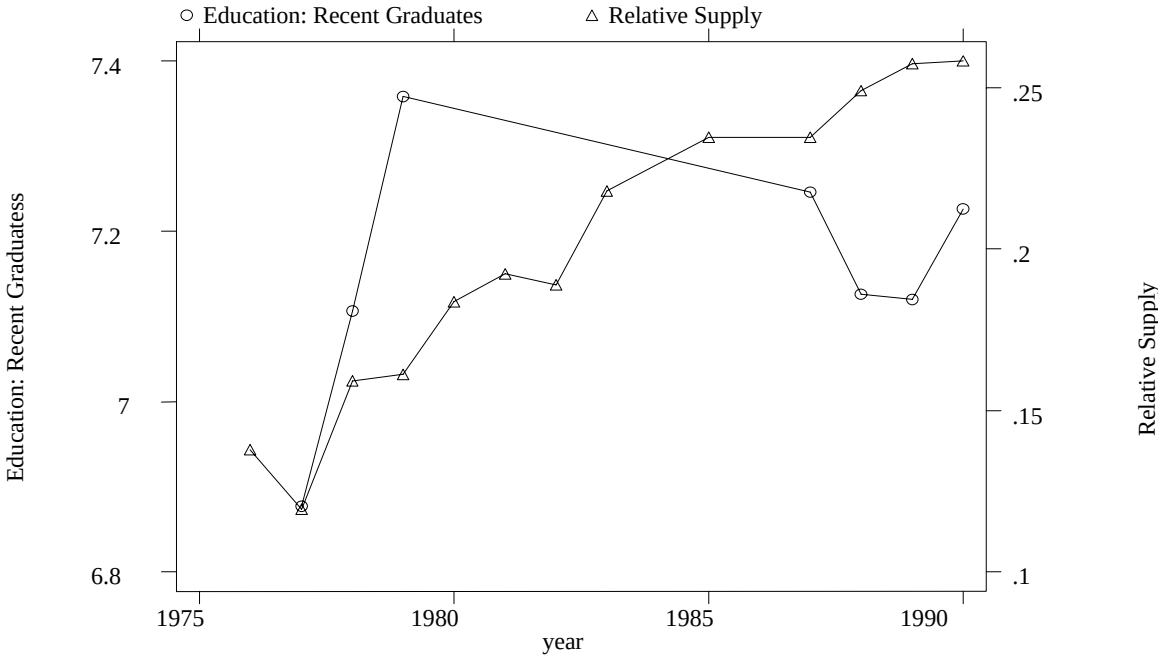


Figure 36. **Costa Rica: Number of Children Per Family**

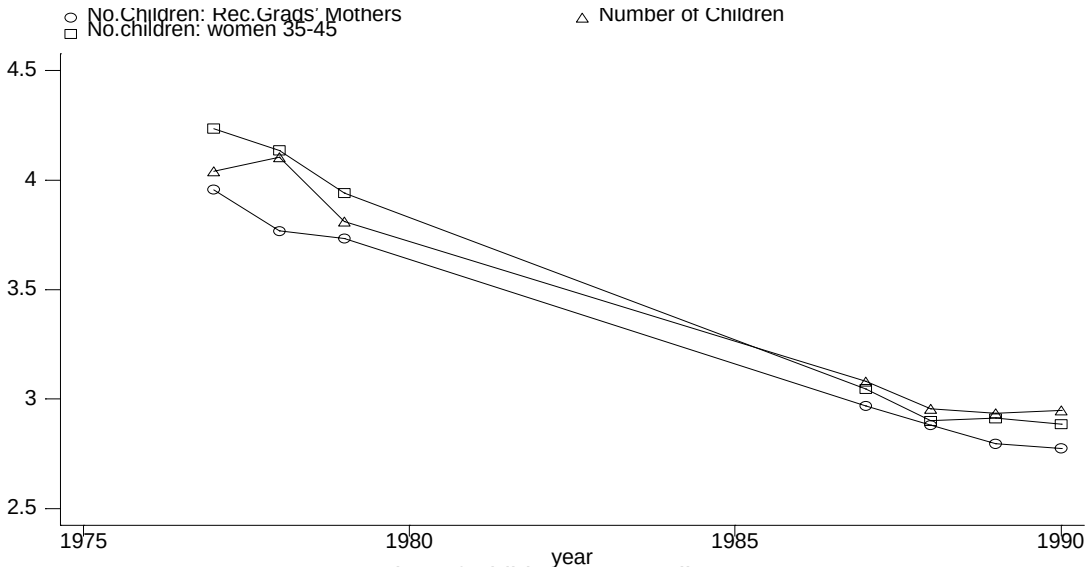


Figure 37. **Costa Rica: Per Capita GDP**

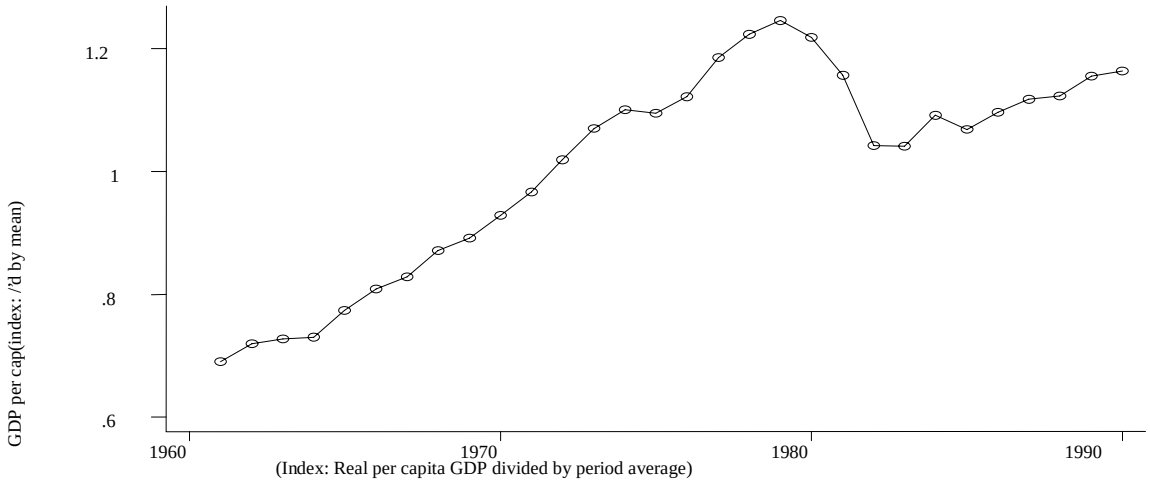


Figure 38. **Costa Rica: Returns to Education and Relative Wages**

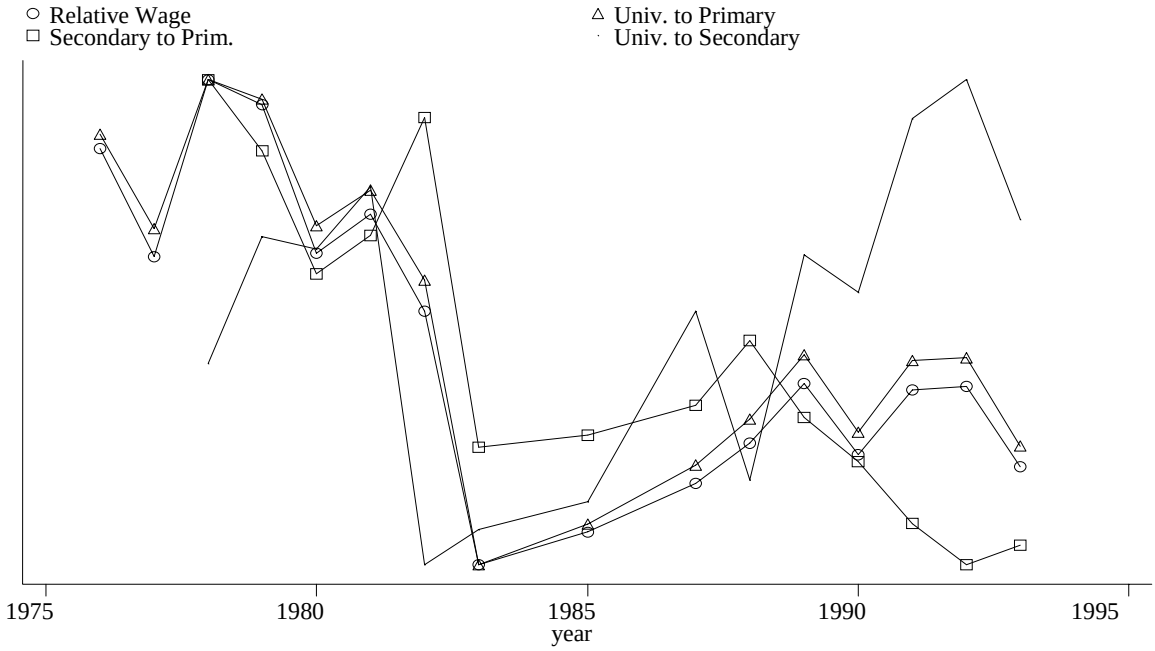


Figure 39. **Costa Rica: Head-of-Household Income**

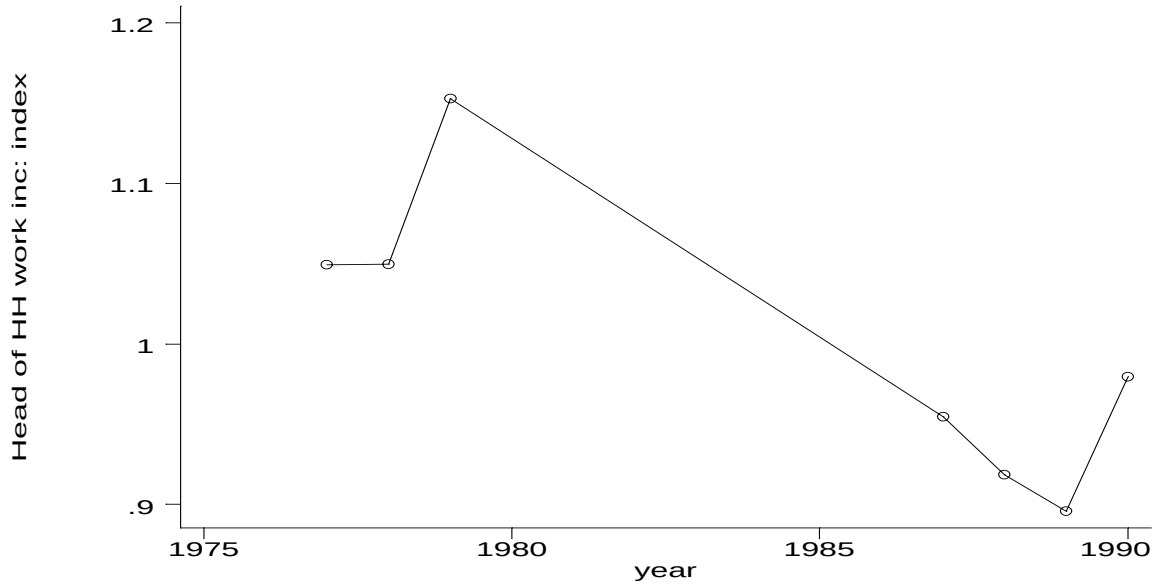


Figure 40. **Costa Rica: Female Labour-Force Participation and Opportunity Costs**

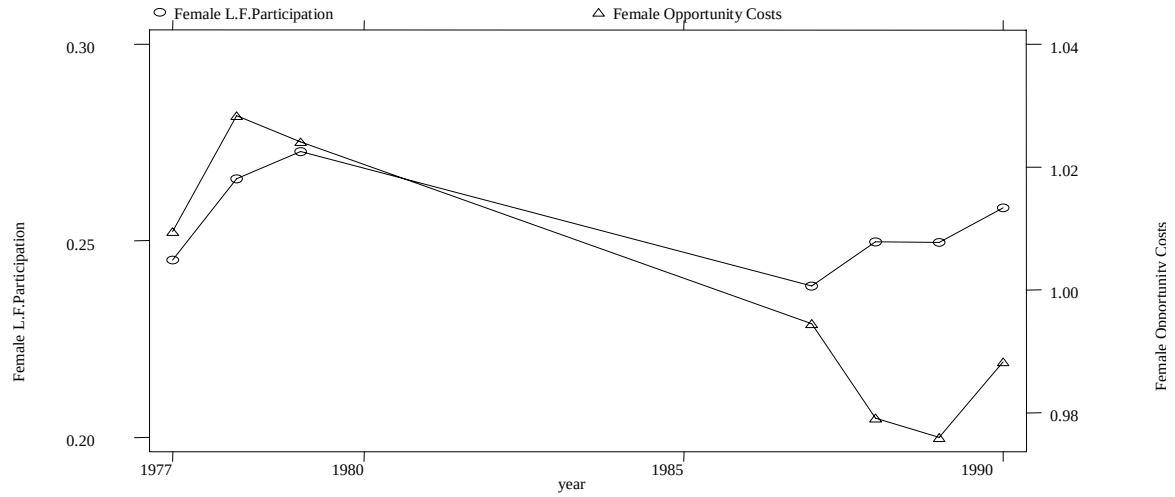


Figure 41. **Costa Rica: Total Public Education Spending Per Capita**

(1988 = 100)

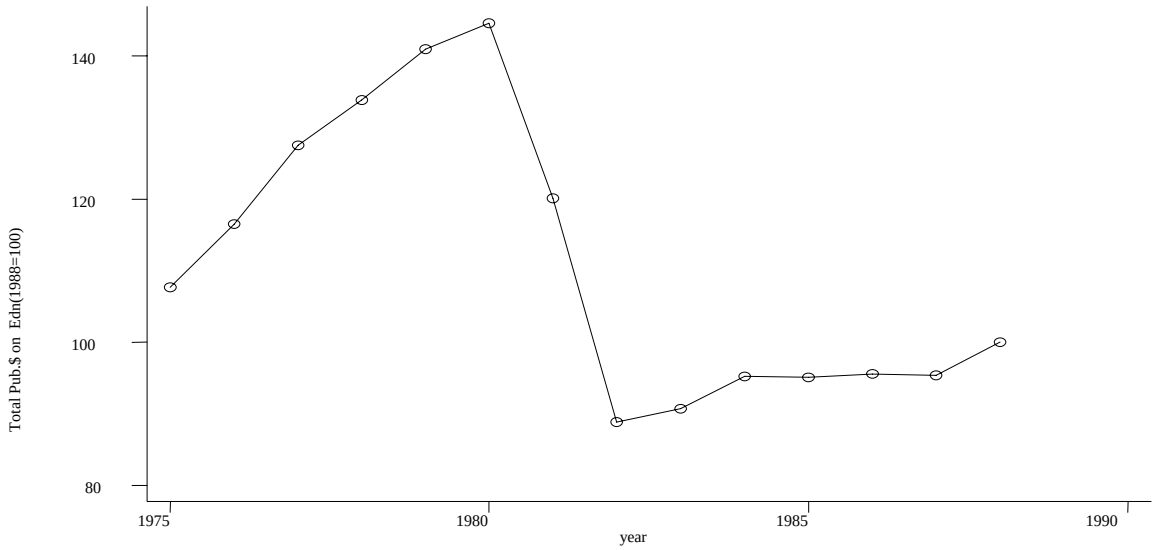


Figure 42. **Costa Rica: Public Education Spending Per Capita, by Level**

(1988 = 100)

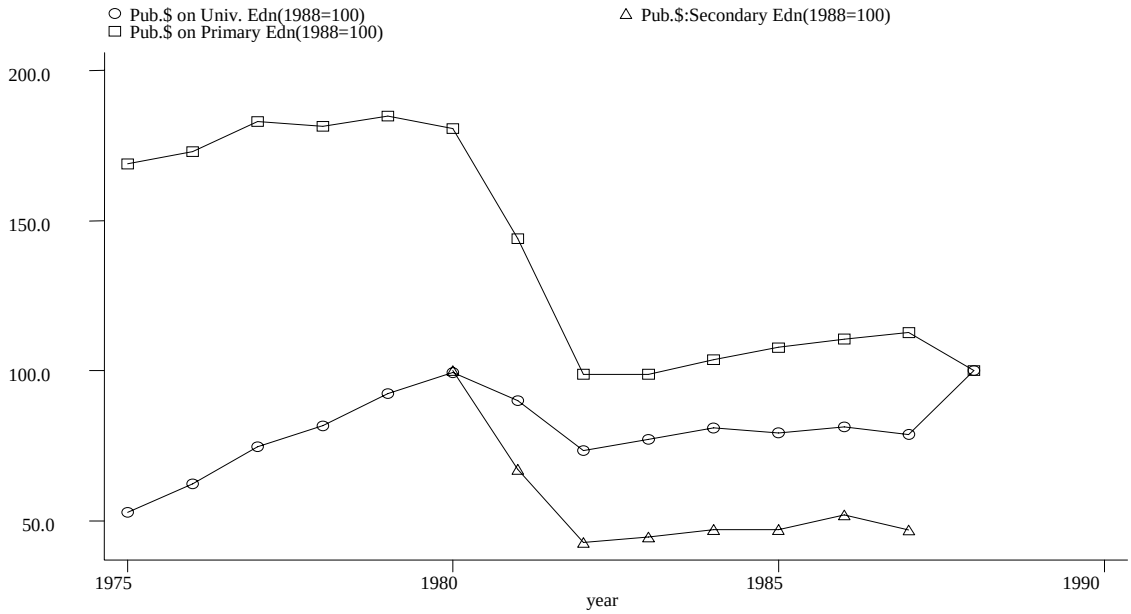


Figure 43. **Costa Rica: Distribution of Public Spending on Education**

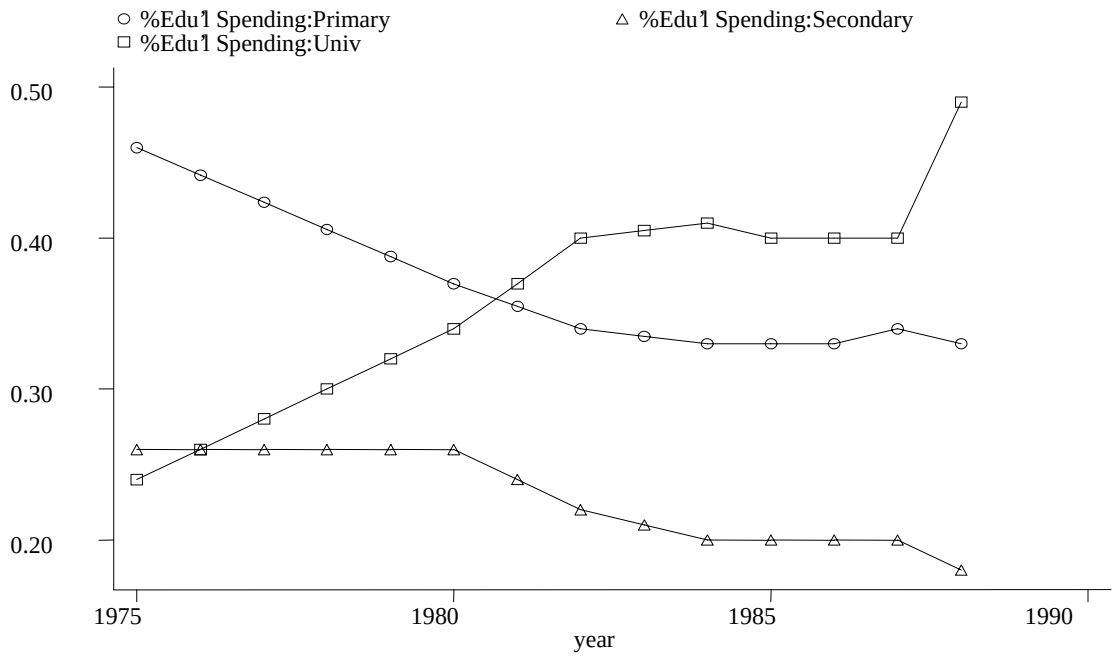


Figure 44. **Mexico: Mean Education of Recent Graduates and Relative Supply**

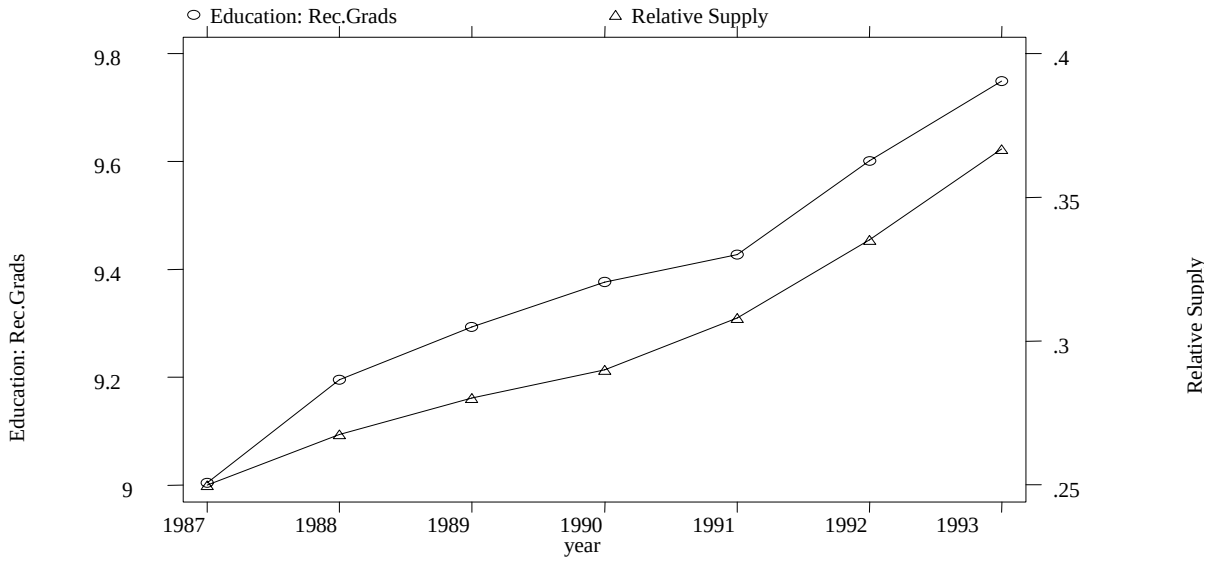


Figure 45. **Mexico: Average Number of Children for Women Aged 35 to 40**

Figure 46. **Mexico: Returns to Schooling**

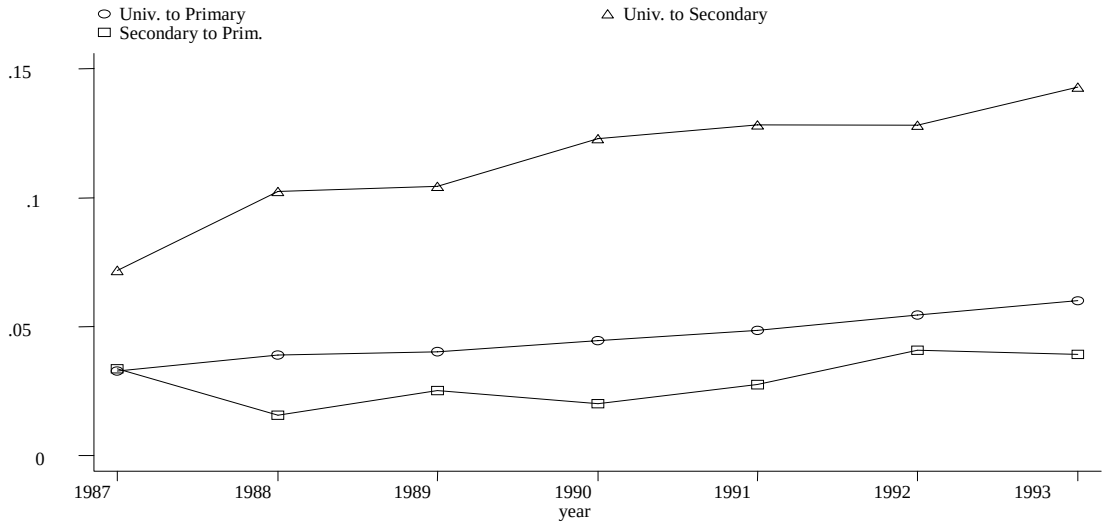


Figure 47. **Head-of-Household Income and Education of Recent Graduates**

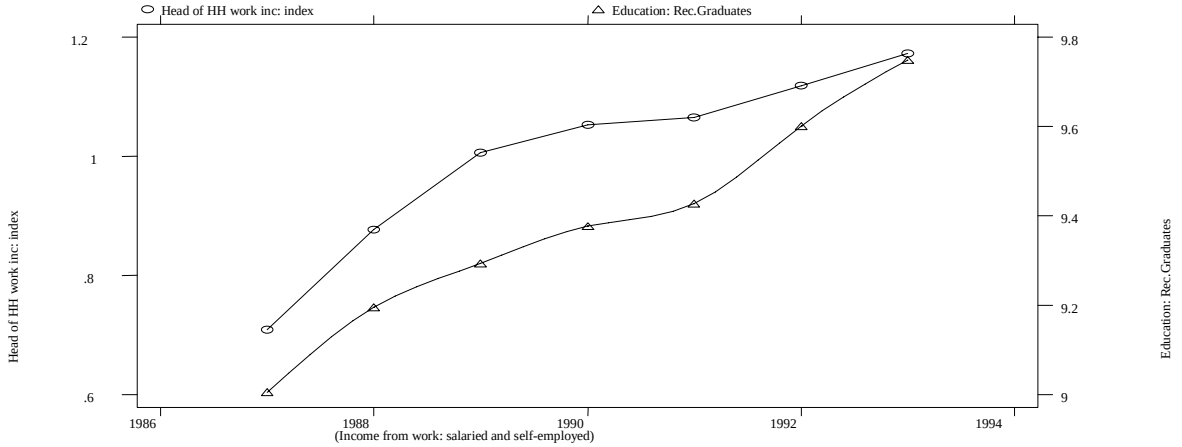


Figure 48. **Mexico: Female Labour-Force Participation**

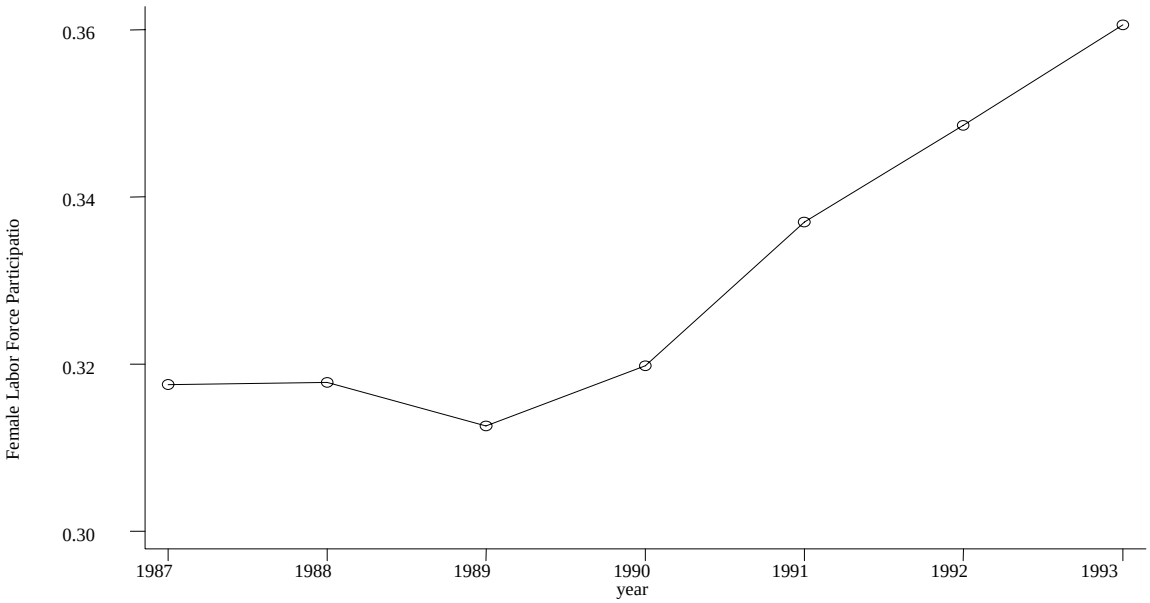


Figure 49. **Mexico: Female Opportunity Costs**

(1988 = 100)

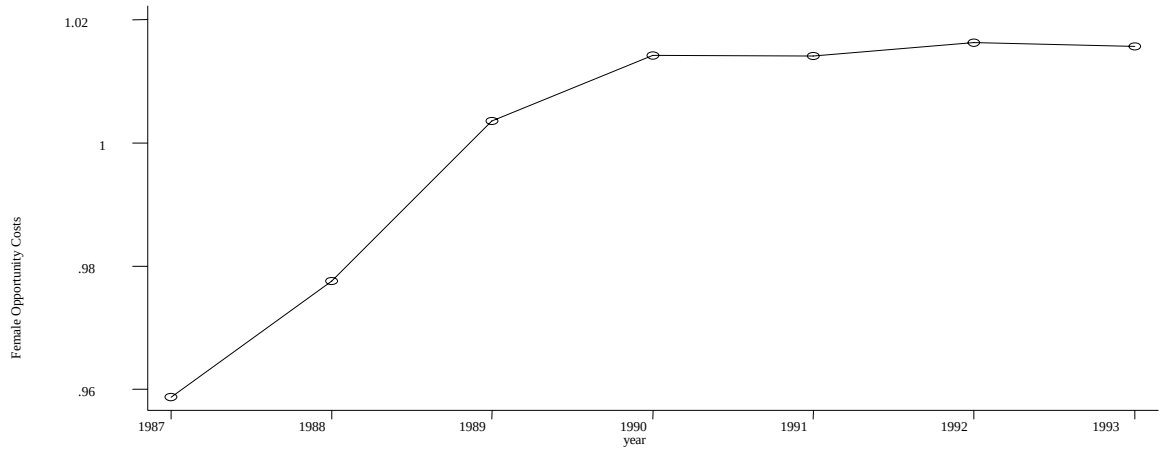


Figure 50. **Mexico: The Confluence of Educational Attainment with Per Capita GDP, Female Labour-Force Participation and Female Opportunity Costs**

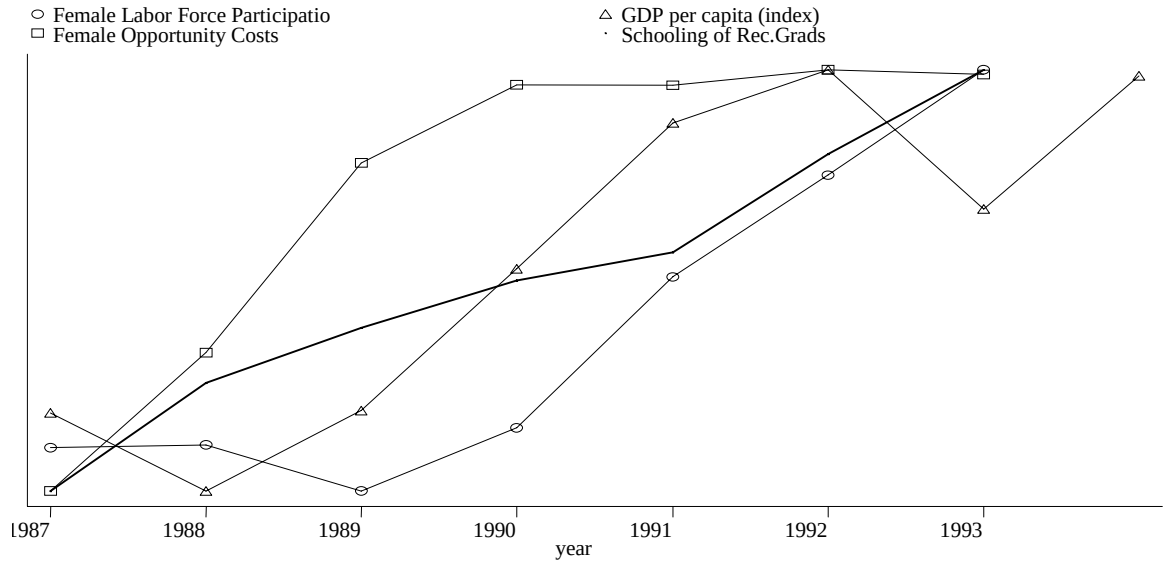


Figure 51. **Uruguay: Mean Education of Recent Graduates and Relative Supply**

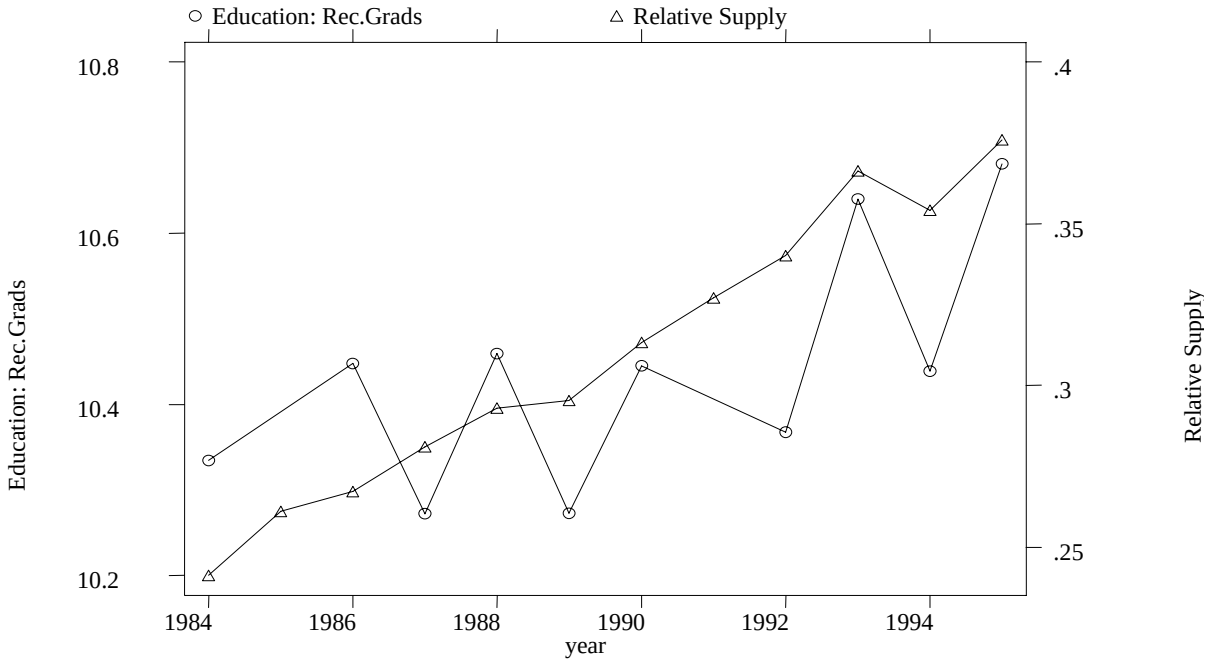


Figure 52. **Uruguay: Average Number of Children per Family**

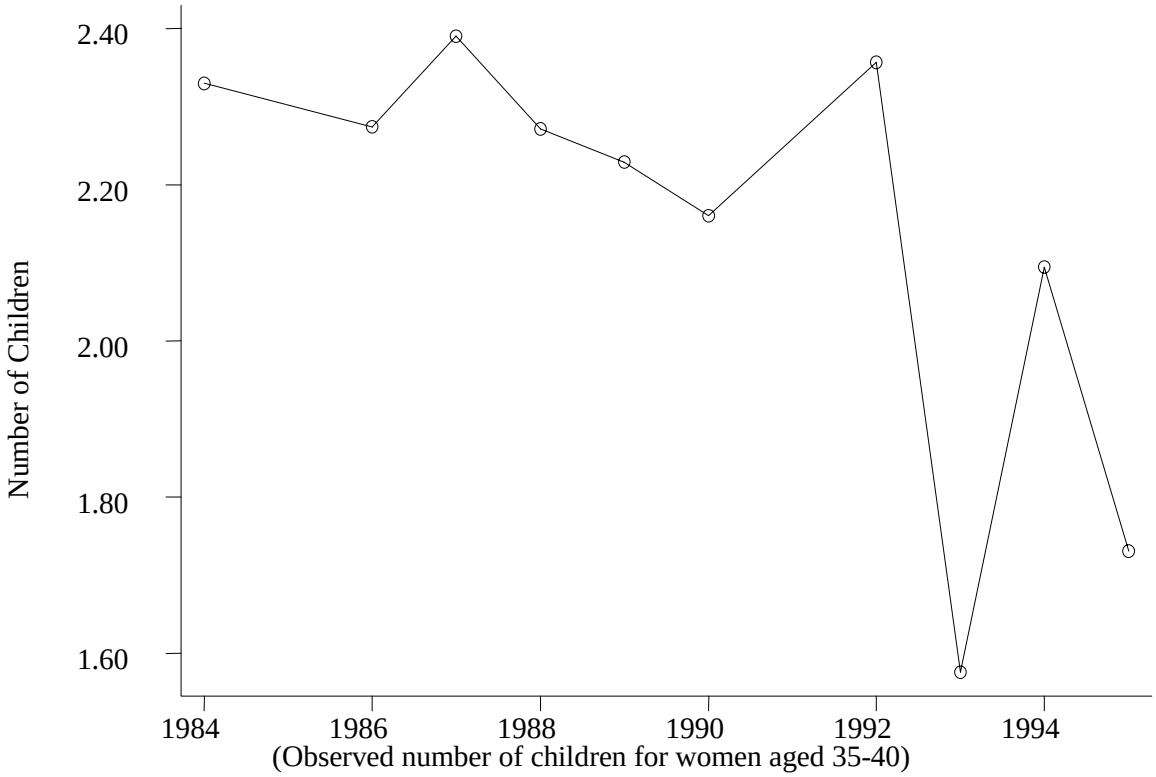


Figure 53. **Uruguay: Returns to Schooling**

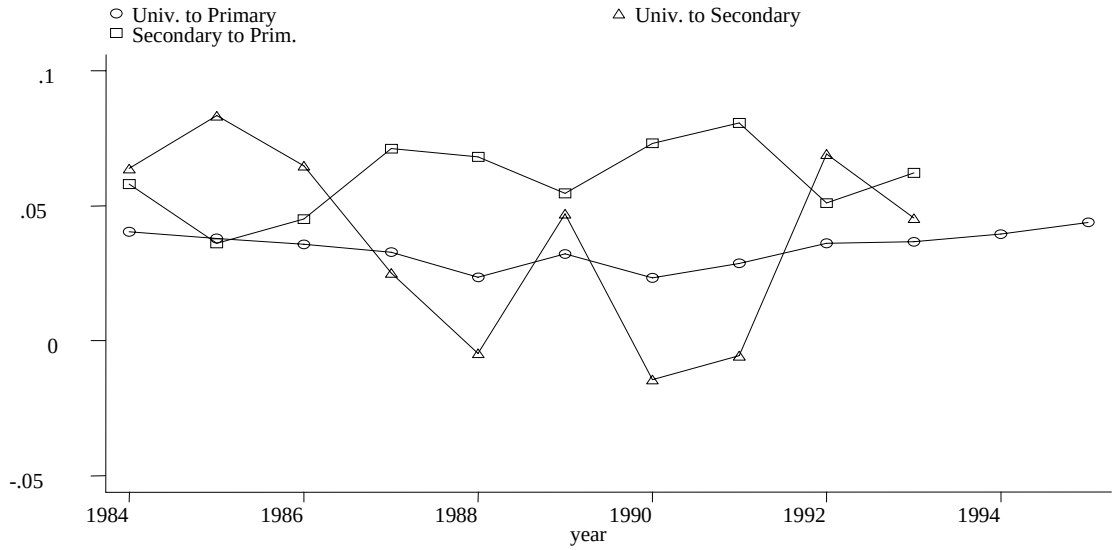


Figure 54. **Head-of-Household Income**

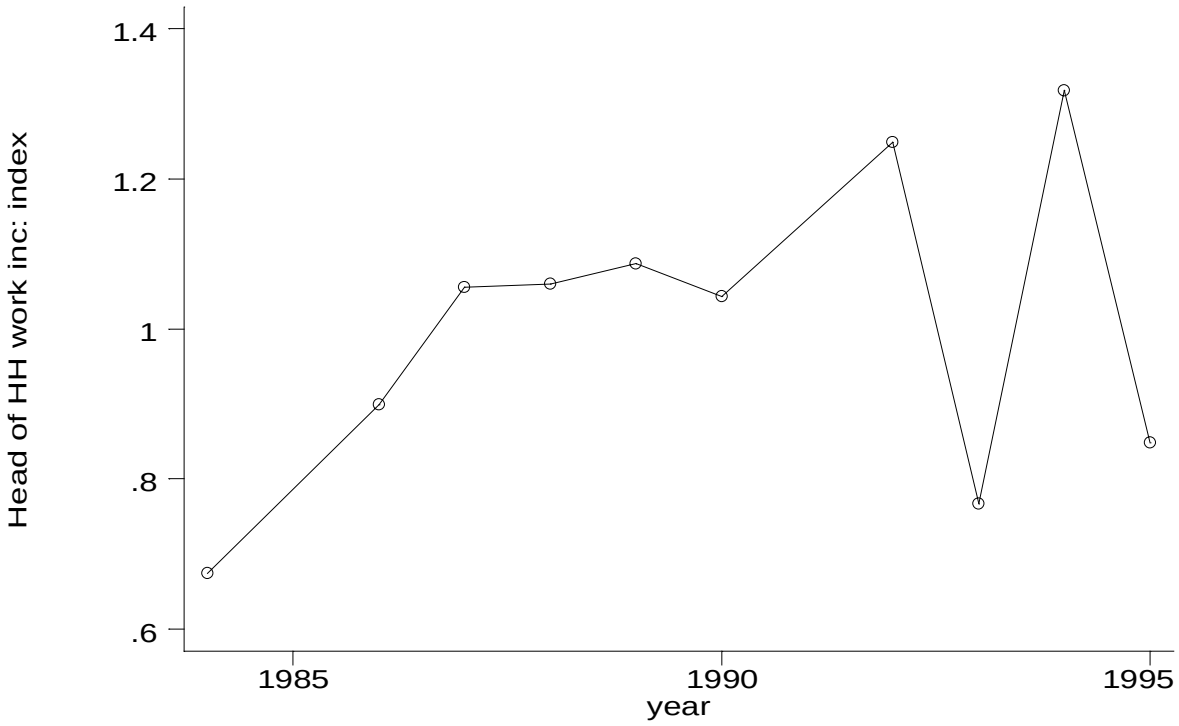


Figure 55. **Uruguay: Womens' Opportunity Costs and Per Capita GDP**

(Indexes)

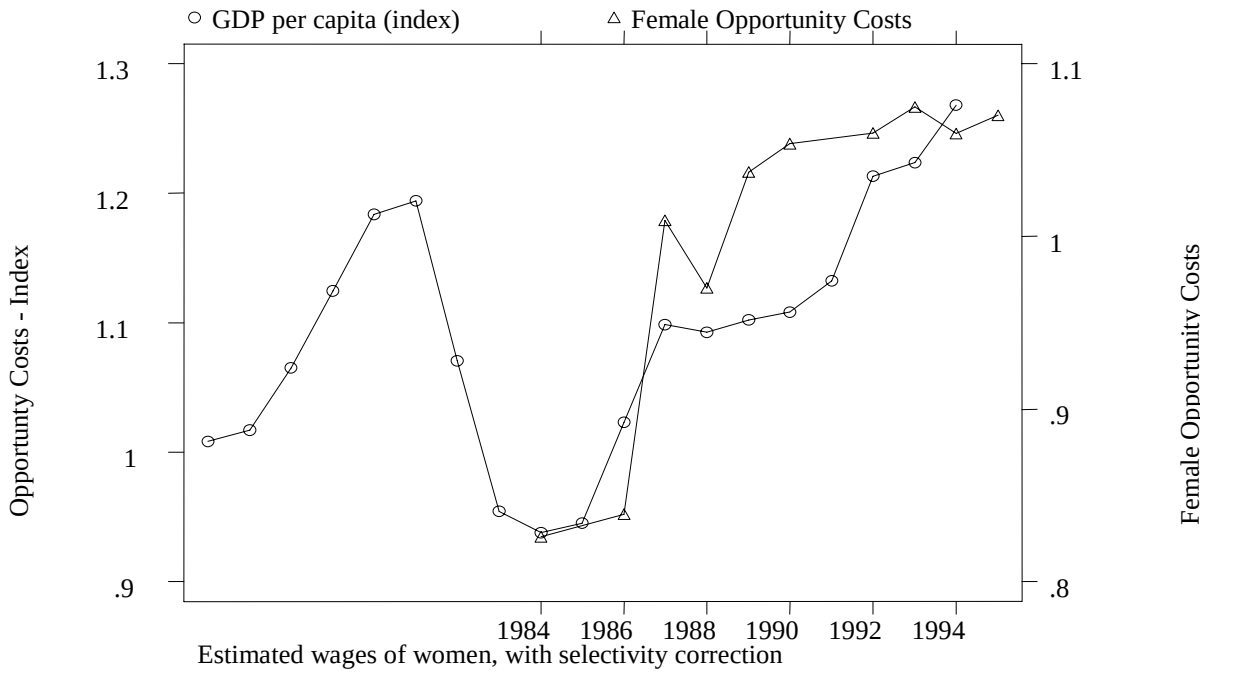


Figure 56. **Uruguay: Female Labour-Force Participation**

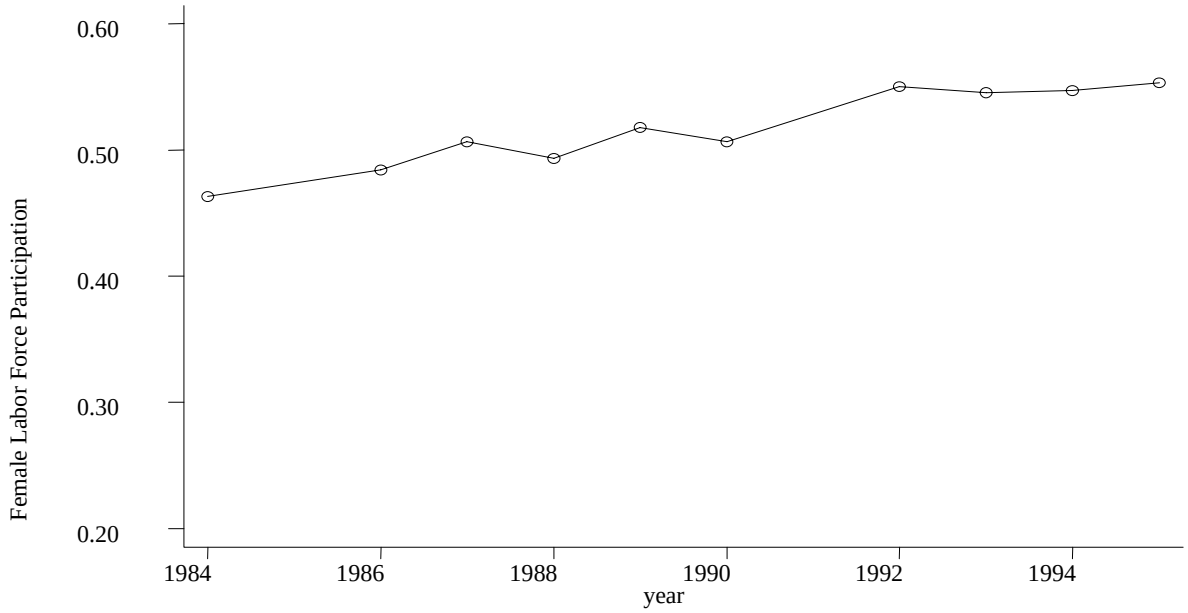


Figure 57. **Uruguay: Total Public Spending on Education and Mean Years of Schooling of Recent Graduates**

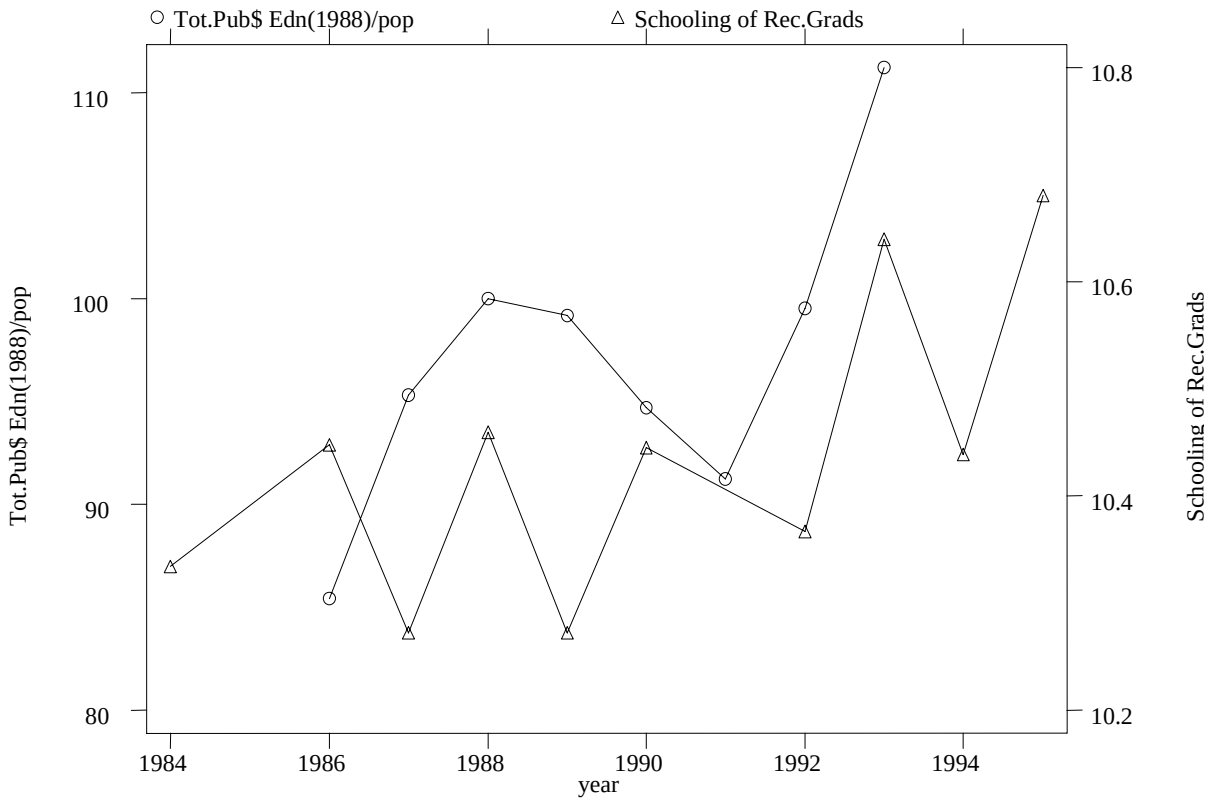


Figure 58. **Uruguay: The Distribution of Public Spending on Education**

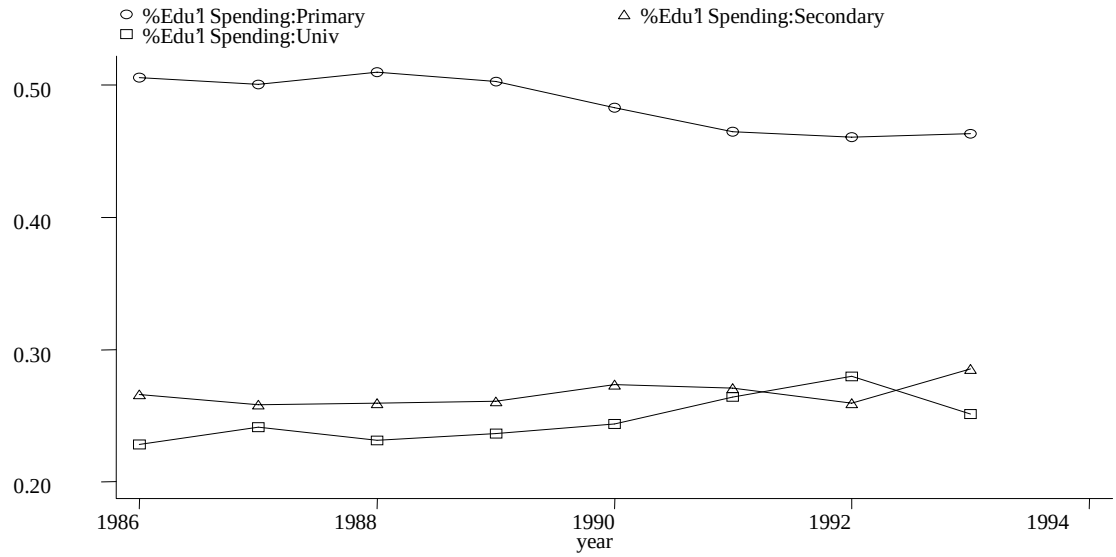


Figure 59. **Uruguay: Indexes of Public Education Spending Per Capita**

(1988 = 100)

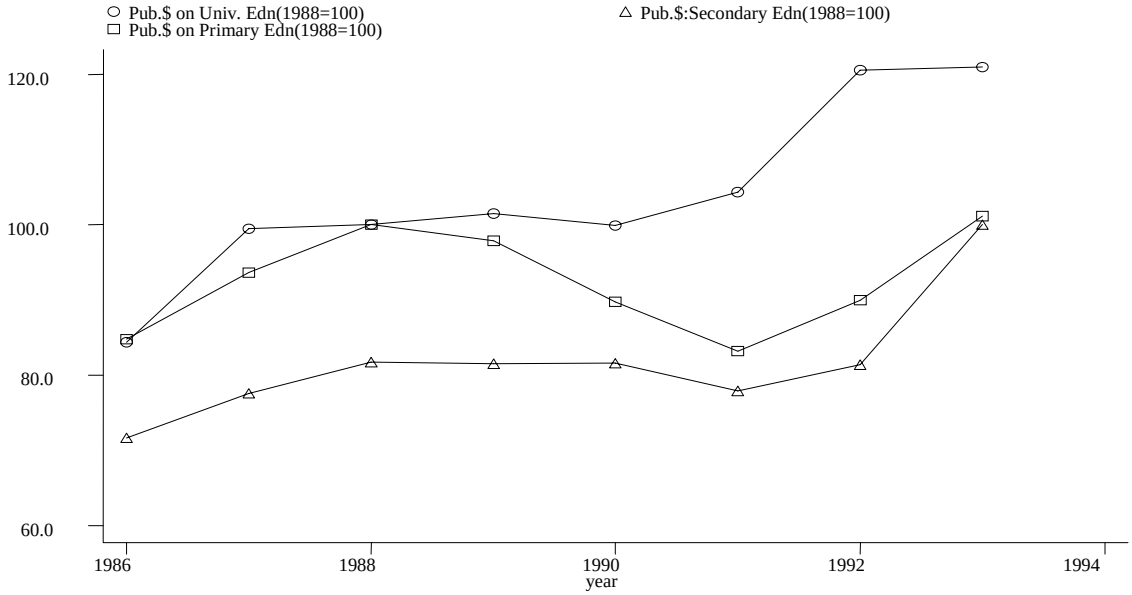


Figure 60. **Average Education of Recent School Leavers in the Six Countries Studied**

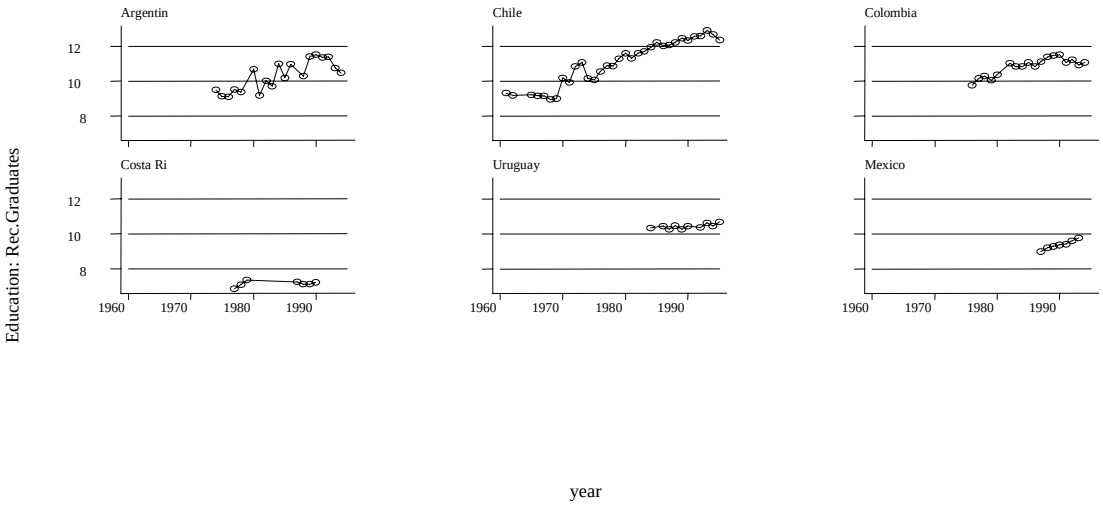


Figure 61. **Education Levels of Recent Graduates and Numbers of Children of Women aged 35-40**

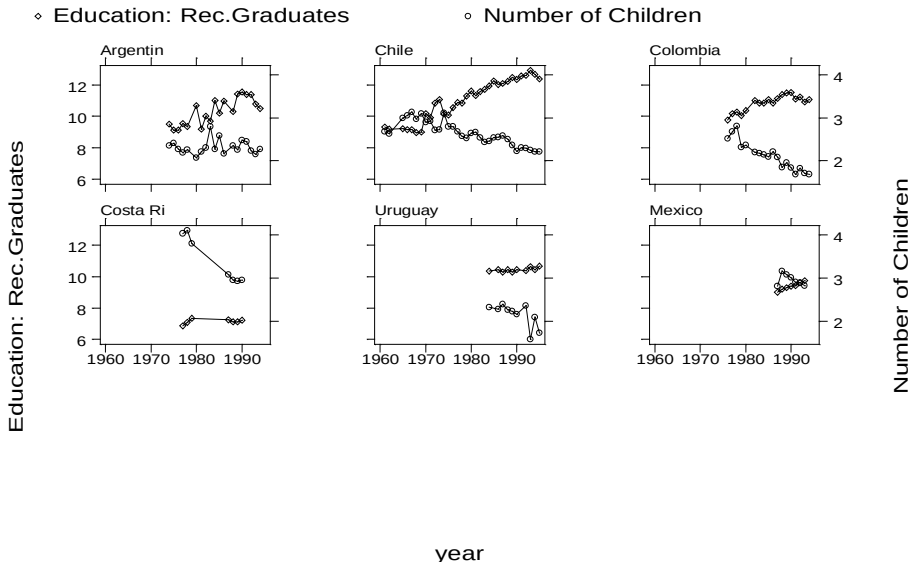


Figure 62. **Number of Children and Female Labour-Force Participation in Five Countries**

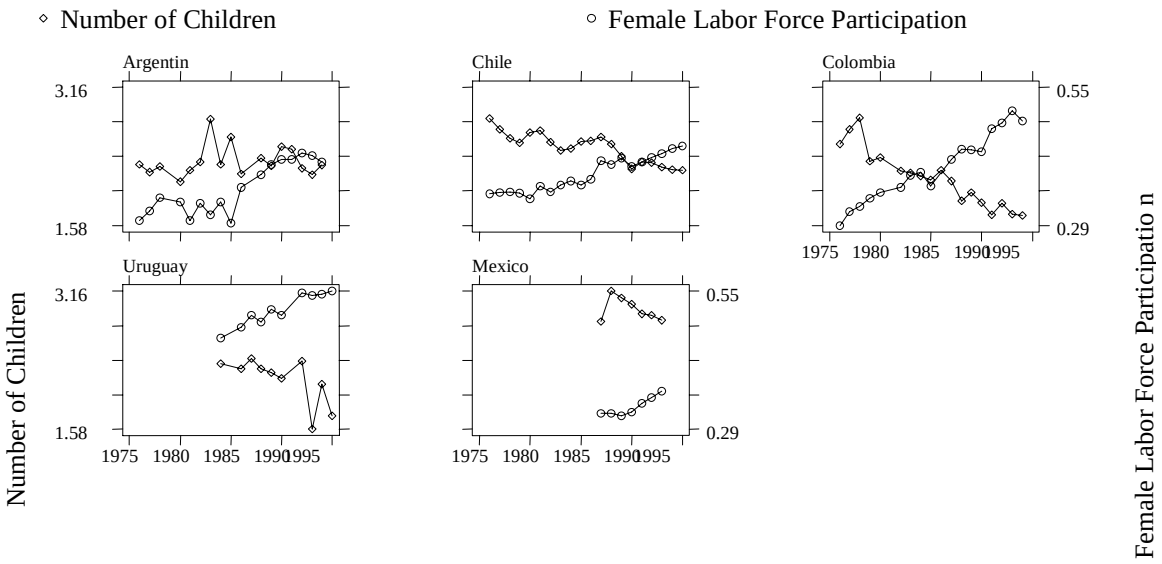


Figure 63. **Returns to Schooling in Six Countries**

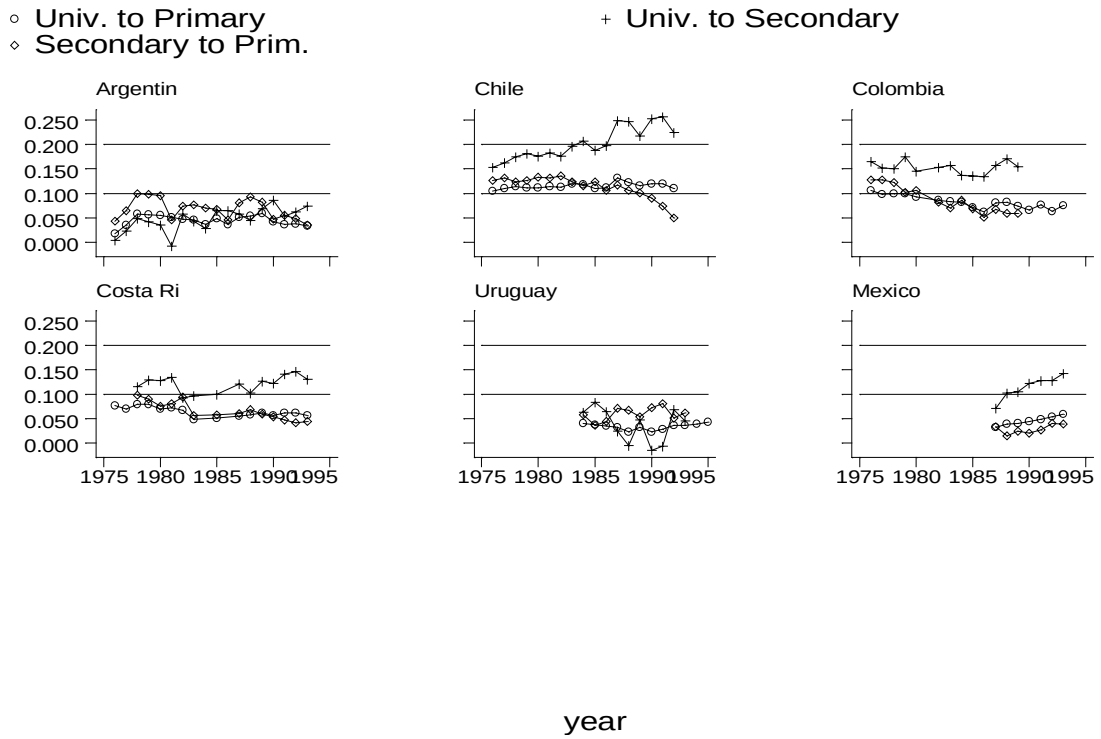
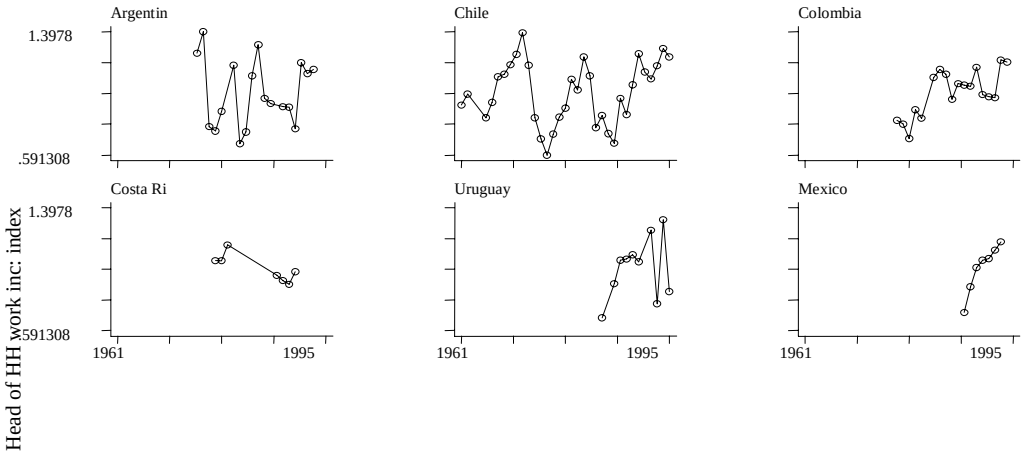


Figure 64. **Head-of-Household Income from Work in Six Countries**



(Income from labor: employed and self-employed)

Figure 65. **Education of Recent Graduates and Public Education Expenditures, Lagged Five Years, in Five Countries**

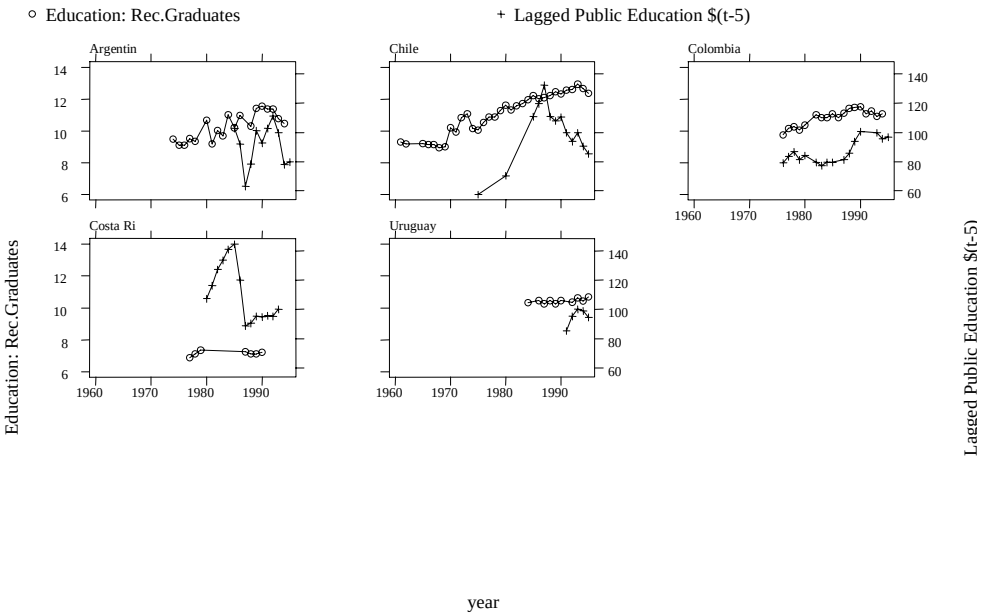
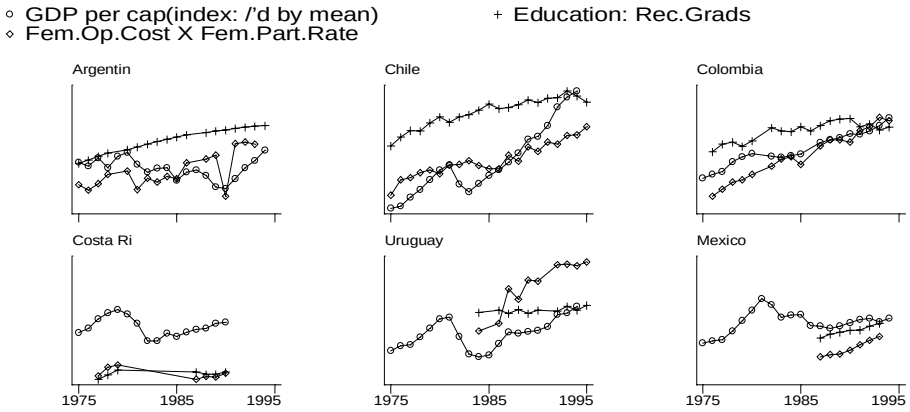


Figure 66. **Per Capita GDP, Participation Weighted Wages and Mean Educational Attainment in Six Countries**



(Op.Costs=Part.Rate*Est'd Op.costs(Heck.); Edu. Attain.: rec.grads)

Table 1. **Educational Attainment : Argentina, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.177 (-2.681)	-.206 (-2.661)	-.224 (-3.397)	-.212 (-2.742)	-.106 (-1.716)	-.098 (-1.368)	-.144 (-2.325)	-.103 (-1.445)
Head of Household's Income	-.230 (-3.865)	-.140 (-1.988)	-.143 (-2.365)	-.117 (-1.652)	-.201 (-3.603)	-.139 (-2.140)	-.113 (-1.996)	-.119 (-1.814)
Avg. Parental Education	2.401 (27.693)	2.788 (22.047)	2.170 (23.353)	2.749 (21.573)	2.258 (27.662)	2.555 (21.900)	2.013 (23.037)	2.528 (21.502)
Sex Dummy	.238 (3.361)	.396 (4.763)	.245 (3.481)	.403 (4.847)	.231 (3.465)	.357 (4.656)	.239 (3.604)	.363 (4.723)
Mothers' Opportunity Costs	1.84e-09 (1.122)	-6.10e-06 (-2.369)	-3.12e-09 (-1.739)	-8.77e-06 (-3.118)	1.85e-09 (1.201)	-5.43e-06 (-2.288)	-2.82e-09 (-1.671)	-7.87e-06 (-3.033)
Returns: univ/primary: lagged 5 years		25.840 (3.445)		25.282 (3.371)		19.310 (2.790)		19.056 (2.754)
Returns: univ/secondary: lagged 5 years		5.232 (2.011)		1.819 (.611)		4.952 (2.063)		1.901 (.692)
Returns: sec/primary: lagged 5 years		-21.253 (-5.477)		-19.544 (-4.954)		-15.654 (-4.372)		-13.945 (-3.831)
n	4435	2872	4435	2872	4435	2872	4435	2872
Adj.R^2	.7640	.7182	.7663	.7187				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) For Argentina, educational spending data exist only for two categories: higher and secondary-and-primary education.
3) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 2. **Educational Attainment: Argentina, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.452 (-4.347)	-.465 (-4.231)	-.506 (-4.853)	-.465 (-4.250)	-.365 (-3.737)	-.315 (-3.349)	-.431 (-4.406)	-.309 (-3.289)
Head of Household's Income	.645 (4.991)	.973 (6.997)	.810 (6.002)	1.118 (7.639)	.647 (5.316)	.857 (7.195)	-.839 (6.616)	.917 (7.288)
Avg. Parental Education	2.536 (18.088)	2.495 (14.090)	2.296 (15.111)	2.439 (13.766)	2.366 (17.922)	1.999 (13.186)	2.082 (14.583)	1.981 (13.009)
Sex Dummy	-.056 (-.495)	.038 (.326)	-.051 (-.453)	.077 (.659)	-.073 (-.683)	.068 (.684)	-.064 (-.608)	.082 (.818)
Mothers' Opportunity Costs	1.28e-08 (3.704)	1.24e-06 (3.619)	8.69e-09 (2.418)	7.97e-06 (2.147)	1.40e-08 (4.304)	8.41e-06 (2.863)	1.03e-08 (3.036)	5.47e-06 (1.714)
Returns: univ/primary: lagged 5 years		-20.236 (-1.946)		-22.027 (-2.124)		-11.613 (-1.304)		-11.214 (-1.258)
Returns: univ/secondary: lagged 5 years		6.390 (1.974)		.480 (.128)		6.987 (2.521)		3.864 (1.196)
Returns: sec/primary: lagged 5 years		-17.255 (-3.646)		-13.508 (-2.774)		-15.896 (-3.922)		-13.660 (-3.264)
n	1252	953	1252	953	1252	953	1252	953
Adj.R^2	.7181	.5322	.7214	.5364				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) For Argentina, educational spending data exist only for two categories: higher and secondary-and-primary education.
3) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 3. **Educational Attainment: Argentina, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.300 (-3.106)	-.481 (-5.243)	-.440 (-4.796)	-.476 (-5.177)	-.159 (-1.820)	-.329 (-3.879)	-.289 (-3.408)	-.3344 (-3.938)
Head of Household's Income	-.197 (-2.317)	-.099 (-1.249)	-.038 (-.475)	-.091 (-1.141)	-.130 (-1.686)	-.080 (-1.093)	-.028 (-.374)	-.084 (-1.144)
Avg. Parental Education	2.234 (12.699)	.995 (5.389)	1.00 (5.420)	.989 (5.353)	2.000 (12.558)	.910 (5.335)	.939 (5.483)	.924 (5.416)
Sex Dummy	.313 (3.044)	.316 (3.275)	.275 (2.830)	.314 (3.258)	.315 (3.385)	.359 (4.029)	.323 (3.604)	.359 (4.021)
Mothers' Opportunity Costs	.121 (7.973)	.336 (16.829)	.113 (7.89)	.324 (14.347)	.138 (10.059)	.350 (18.969)	.131 (9.957)	.361 (17.319)
Returns: univ/primary: lagged 5 years	275.211 (5.885)		685.108 (13.157)		247.919 (5.856)		608.554 (12.656)	
Returns: univ/secondary: lagged 5 years	-51.154 (-6.347)		-163.940 (-15.254)		-48.631 (-6.664)		-147.613 (-14.873)	
Returns: sec/primary: lagged 5 years	-51.203 (-9.359)		-88.575 (-15.411)		-51.940 (-10.485)		-86.975 (-16.387)	
Returns: univ/primary: lagged 10 years		-419.416 (-17.566)		-424.406 (-17.484)		-403.370 (-18.289)		-401.363 (-17.889)
Returns: univ/secondary: lagged 10 years		7.775 (1.487)		4.821 (.826)		-.913 (-.189)		.725 (.134)
Returns: sec/primary: lagged 10 years		57.311 (8.166)		63.564 (7.133)		61.163 (9.434)		57.452 (6.979)
% Public Education Spending University, lagged 5 years	-162.303 (-5.547)	-217.638 (-16.891)	-495.171 (-13.921)	-221.922 (14.347)	-137.230 (-5.180)	-192.293 (-16.156)	-426.272 (-12.978)	-189.276 (-15.265)
n	1840	1840	1840	1840	1840	1840	1840	1840
Adj.R^2	.6653	.7042	.7013	.7026				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) For Argentina, educational spending data exist only for two categories: higher and secondary-and-primary education.

3) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 4. **Educational Attainment: Argentina, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.261 (-2.021)	-.256 (-1.966)	-.275 (-2.122)	-.273 (-2.108)	-.129 (-1.151)	-.131 (-1.116)	-.132 (-1.178)	-.128 (-1.138)
Head of Household's Income	1.276 (7.449)	1.362 (7.954)	1.293 (7.532)	1.282 (7.468)	.944 (6.369)	1.107 (7.143)	.943 (6.336)	.925 (6.199)
Avg. Parental Education	1.937 (7.523)	1.681 (5.765)	1.760 (6.060)	1.733 (5.978)	1.675 (7.516)	1.543 (5.843)	1.615 (6.411)	1.562 (6.201)
Sex Dummy	-.077 (-.571)	-.047 (-.349)	-.073 (-.539)	-.0583 (-.430)	.051 (.436)	.060 (.490)	.054 (.463)	.085 (.728)
Mothers' Opportunity Costs	.123 (6.545)	.240 (7.366)	.123 (6.524)	.266 (7.960)	.182 (11.111)	.335 (11.337)	.182 (11.094)	.386 (13.296)
Returns: univ/primary: lagged 5 years	99.895 (1.904)		168.629 (2.278)		132.608 (2.919)		156.466 (2.436)	
Returns: univ/secondary: lagged 5 years	-30.322 (-3.178)		-49.488 (-2.841)		-38.202 (-4.624)		-44.763 (-2.963)	
Returns: sec/primary: lagged 5 years	-36.491 (-5.385)		-42.954 (-5.133)		-57.835 (-9.857)		-60.293 (-8.307)	
Returns: univ/primary: lagged 10 years		-230.59 (-5.908)		-176.13 (-4.153)		-298.664 (-8.446)		-202.015 (-5.481)
Returns: univ/secondary: lagged 10 years		-18.167 (-2.726)		-6.4922 (-.857)		-29.808 (-4.937)		-7.261 (-1.103)
Returns: sec/primary: lagged 10 years		51.288 (5.402)		21.277 (1.590)		67.373 (7.834)		11.957 (1.028)
% Public Education Spending University, lagged 5 years	-54.524 (-1.632)	-96.384 (-4.705)	-109.525 (-2.047)	-64.107 (-2.817)	-50.127 (-1.733)	-100.791 (-5.431)	-68.926 (-1.485)	-46.734 (-2.363)
n	631	631	631	631	631	631	631	631
Adj.R^2	.5898	.5851	.5903	.5910				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) For Argentina, educational spending data exist only for two categories: higher and secondary-and-primary education.
3) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 5. **Educational Attainment: Chile, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
***Explanatory Variables**:*								
Family Size	-.451 (-5.866)	-.238 (-3.073)	-.227 (-3.010)	-.226 (-2.911)	-.534 (-6.593)	-.302 (-3.744)	-.283 (-3.623)	-.286 (-3.551)
Head of Household's Income	.481 (9.291)	.555 (10.748)	.589 (11.656)	.573 (11.075)	.521 (9.559)	.609 (11.357)	.649 (12.377)	.633 (11.798)
Avg. Parental Education	1.964 (21.999)	1.768 (19.791)	1.740 (19.927)	1.741 (19.452)	2.066 (22.001)	1.798 (19.364)	1.761 (19.446)	1.755 (18.911)
Sex Dummy	.124 (1.451)	.054 (.639)	.067 (.804)	.052 (.613)	.090 (1.000)	.026 (.302)	.038 (.448)	.024 (.274)
Mothers' Opportunity Costs	.047 (16.110)	.039 (13.184)	.027 (9.170)	.032 (9.569)	.048 (15.768)	.040 (13.024)	.027 (8.926)	.031 (9.112)
Returns: univ/primary: lagged 5 years		-107.835 (-8.595)		-62.045 (-3.688)		-120.501 (-9.239)		-64.316 (-3.686)
Returns: univ/secondary: lagged 5 years		38.290 (16.215)		21.812 (4.664)		42.343 (17.249)		21.977 (4.530)
Returns: sec/primary: lagged 5 years		17.155 (5.908)		9.948 (2.929)		18.683 (6.190)		9.840 (2.794)
n	8441	8059	8441	8059	8441	8059	8441	8059
Adj.R^2	.2224	.2630	.2654	.2644				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 6. **Educational Attainment: Chile, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.493 (-3.522)	-.362 (-2.577)	-.389 (-2.843)	-.352 (-2.514)	-.649 (-4.507)	-.547 (-3.835)	-.561 (-4.022)	-.546 (-3.845)
Head of Household's Income	.843 (7.583)	.841 (7.531)	.840 (7.741)	.869 (7.780)	.949 (8.303)	.947 (8.343)	.945 (8.549)	.988 (8.714)
Avg. Parental Education	2.157 (14.393)	1.990 (13.203)	1.944 (13.162)	1.979 (12.923)	2.367 (15.355)	2.146 (13.999)	2.091 (13.898)	2.09 (13.686)
Sex Dummy	-.012 (-.083)	-.007 (-.052)	-.017 (-.118)	.001 (.006)	-.065 (-.413)	-.056 (-.364)	-.063 (-.413)	-.047 (-.310)
Mothers' Opportunity Costs	.054 (9.159)	.044 (7.350)	.030 (4.888)	.032 (4.860)	.055 (9.095)	.044 (7.349)	.030 (4.799)	.032 (4.742)
Returns: univ/primary: lagged 5 years		-53.378 (-2.379)		13.582 (.463)		-59.977 (-2.629)		15.671 (.526)
Returns: univ/secondary: lagged 5 years		25.640 (5.921)		.239 (.029)		28.452 (6.463)		-.404 (-.048)
Returns: sec/primary: lagged 5 years		8.184 (1.624)		-2.796 (-.473)		9.058 (1.767)		-3.378 (-.563)
n	2461	2378	2461	2378	2461	2378	2461	2378
Adj.R^2	.2104	.2364	.2464	.2401				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 7. **Educational Attainment: Chile, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.239 (-2.521)	-.262 (-2.766)	-.126 (-1.295)	-.273 (-2.882)	-.395 (.-4.100)	-.412 (-4.263)	-.270 (-2.729)	-.420 (-4.350)
Head of Household's Income	.476 (7.978)	.451 (7.517)	.504 (8.170)	.456 (7.601)	.547 (9.021)	.524 (8.580)	.575 (9.204)	.528 (8.645)
Avg. Parental Education	1.594 (14.810)	1.587 (14.751)	1.442 (12.909)	1.582 (14.706)	1.674 (15.313)	1.659 (15.128)	1.487 (13.158)	1.652 (15.071)
Sex Dummy	-.074 (-.752)	-.044 (-.449)	-.148 (-1.435)	-.041 (-.414)	-.094 (-.933)	-.066 (-.065)	-.158 (-1.510)	-.061 (-.603)
Mothers' Opportunity Costs	.293 (17.206)	.349 (17.950)	.655 (22.120)	.374 (16.831)	.300 (17.328)	.341 (17.240)	.664 (22.177)	.365 (16.111)
Returns: univ/primary: lagged 5 years	.34.003 (-1.985)		-306.405 (-12.347)		-46.233 (-2.658)		-332.443 (-13.238)	
Returns: univ/secondary: lagged 5 years	18.156 (4.030)		132.875 (15.101)		21.868 (4.779)		143.422 (16.108)	
Returns: sec/primary: lagged 5 years	16.708 (5.006)		70.817 (14.625)		18.681 (5.511)		74.399 (15.183)	
Returns: univ/primary: lagged 10 years		126.909 (5.818)		119.364 (5.417)		99.022 (4.454)		92.533 (4.119)
Returns: univ/secondary: lagged 10 years		-46.011 (-7.368)		-44.441 (-7.080)		-38.398 (-6.033)		-37.032 (-5.787)
Returns: sec/primary: lagged 10 years		-20.727 (-4.740)		-18.539 (-4.150)		-16.411 (-3.682)		-14.408 (-3.164)
% Public Education Spending University, lagged 5 years	-2.294 (-1.467)	-3.702 (-1.846)	-8.566 (-7.465)	-2.894 (-1.423)	-3.310 (-2.084)	-4.260 (-2.084)	-10.322 (-8.889)	-3.469 (-1.673)
% Public Education Spending Secondary, lagged 5 years	-14.998 (-2.698)	9.625 (1.874)	-9.322 (-1.979)	19.469 (2.951)	-17.473 (-3.095)	7.601 (1.452)	d	17.005 (2.528)
n	5440	5440	4765	5440	5440	5440	5440	5440
Adj.R^2	.2019	.2032	.2404	.2038				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.
3) "d" means variable was dropped from regression to colinearity.

Table 8. **Educational Attainment: Chile, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables (logs):								
Family Size	-.4754	-.5138	-.4104	-.5176	-.741	-.780	-.663	-.782
	(-2.914)	(-3.147)	(-2.547)	(-3.168)	(-4.636)	(-4.836)	(-4.182)	(-4.847)
Head of Household's Income	.8591	.8083	.9151	.8165	1.027	.991	1.054	.994
	(6.767)	(6.275)	(7.295)	(6.303)	(8.253)	(7.785)	(8.545)	(7.765)
Avg. Parental Education	1.791	1.788	1.695	1.782	1.923	1.922	1.838	1.924
	(10.369)	(10.332)	(9.922)	(10.276)	(11.358)	(11.243)	(10.940)	(11.225)
Sex Dummy	-.139	-.149	-.1985	-.1533	-.180	-.205	-.222	-.207
	(-.825)	(-.884)	(-1.189)	(-.907)	(-1.091)	(-1.233)	(-1.354)	(-1.239)
Mothers' Opportunity Costs	.2866	.3423	.5599	.3543	.294	.327	.537	.329
	(9.470)	(10.011)	(11.508)	(8.95)	(9.934)	(9.688)	(11.236)	(8.424)
Returns: univ/primary: lagged 5 years	-1.093		-177.126		-2.900		-164.151	
	(-.037)		(-4.634)		(-.100)		(-4.365)	
Returns: univ/secondary: lagged 5 years	15.922		92.63		18.798		89.341	
	(1.986)		(6.927)		(2.391)		(6.791)	
Returns: sec/primary: lagged 5 years	11.698		49.179		12.279		46.540	
	(2.020)		(6.329)		(2.162)		(6.088)	
Returns: univ/primary: lagged 10 years		113.137		109.62		59.688		58.473
		(3.034)		(2.904)		(1.619)		(1.567)
Returns: univ/secondary: lagged 10 years		-42.594		-41.802		-28.531		-28.230
		(-3.976)		(-3.873)		(-2.685)		(-2.646)
Returns: sec/primary: lagged 10 years		-15.875		-14.968		-8.088		-7.826
		(-2.142)		(-1.979)		(-1.104)		(-1.047)
% Public Education Spending University, lagged 5 years	-5.273	-6.382	-8.453	-6.122	-5.757	-6.998	-9.034	-6.943
	(-1.994)	(-1.814)	(-3.194)	(-1.727)	(-2.220)	(-2.012)	(-3.470)	(-1.981)
% Public Education Spending Secondary, lagged 5 years	-30.9091	-3.285	-10.003	.8293	-33.917	-7.473	-15.584	-6.625
	(-3.290)	(-.365)	(-1.029)	(.073)	(-3.682)	(-.840)	(-1.630)	(-.594)
n	1770	1770	1770	1770	1770	1770	1770	1770
Adj.R^2	.2190	.2169	.2404	.2404				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 9. **Educational Attainment: Colombia, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.110 (-3.273)	-.039 (-1.079)	-.047 (-1.361)	-.028 (-.763)	-.108 (-3.203)	-.045 (-1.216)	-.052 (-1.509)	-.034 (-.929)
Head of Household's Income	.167 (6.931)	.202 (7.789)	.173 (7.174)	.199 (7.685)	.178 (7.272)	.208 (7.900)	.182 (7.480)	.205 (7.793)
Avg. Parental Education	.248 (7.167)	.236 (6.305)	.235 (6.812)	.233 (6.250)	.268 (7.669)	.256 (6.737)	.253 (7.261)	.253 (6.670)
Sex Dummy	-.201 (-5.898)	-.228 (-6.247)	-.201 (-5.939)	-.228 (-6.260)	-.181 (-5.259)	-.215 (-5.809)	-.183 (-5.331)	-.216 (-5.844)
Mothers' Opportunity Costs	.718 (14.026)	.770 (13.587)	.725 (14.248)	.772 (13.658)	.709 (13.710)	.768 (13.351)	.716 (13.880)	.769 (13.386)
Returns: univ/primary: lagged 5 years		-13.310 (-1.524)		-10.235 (-1.170)		-13.076 (-1.474)		-10.273 (-1.157)
Returns: univ/secondary: lagged 5 years		4.844 (1.296)		4.438 (1.189)		4.720 (1.243)		4.489 (1.185)
Returns: sec/primary: lagged 5 years		-.727 (-.209)		6.805 (1.747)		-.365 (-.104)		7.365 (1.862)
n	4937	4290	4937	4290	4937	4290	4937	4290
Adj.R^2	.8854	.8855	.8866	.8859				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 10. **Educational Attainment: Colombia, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.126 (-2.163)	-.071 (-1.147)	-.091 (-1.534)	-.057 (-.915)	-.143 (-2.491)	-.092 (-1.493)	-.114 (-1.942)	-.078 (-1.265)
Head of Household's Income	.135 (3.129)	.171 (3.743)	.136 (3.148)	.169 (3.706)	.138 (3.244)	.164 (3.628)	.139 (3.263)	.163 (3.614)
Avg. Parental Education	.255 (4.263)	.258 (4.078)	.251 (4.205)	.262 (4.150)	.290 (4.912)	.294 (4.700)	.285 (4.820)	.298 (4.763)
Sex Dummy	-.201 (-3.318)	-.184 (-2.881)	-.196 (-3.232)	-.183 (-2.872)	-.187 (-3.114)	-.175 (-2.775)	-.183 (-3.046)	-.174 (-2.762)
Mothers' Opportunity Costs	.777 (8.256)	.765 (7.538)	.776 (8.264)	.763 (7.538)	.729 (7.845)	.721 (7.188)	.734 (7.898)	.716 (7.144)
Returns: univ/primary: lagged 5 years		-15.516 (-1.020)		-13.228 (-.871)		-15.551 (-1.034)		-14.406 (-.958)
Returns: univ/secondary: lagged 5 years		11.684 (1.800)		11.343 (1.752)		12.499 (1.948)		12.639 (1.973)
Returns: sec/primary: lagged 5 years		-.131 (-.022)		9.442 (1.373)		.597 (.099)		9.945 (1.461)
n	1640	1451	1640	1451	1640	1451	1640	1451
Adj.R^2	.8786	.8797	.8790	.8803				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 11. **Educational Attainment: Colombia, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.033 (-.917)	-.026 (-.530)	-.028 (-0.768)	-.026 (-.514)	-.040 (-1.068)	-.030 (-.586)	-.017 (-.402)	-.029 (-.569)
Head of Household's Income	.202 (7.803)	.201 (5.763)	.199 (7.692)	.200 (5.741)	.208 (7.884)	.217 (6.163)	.201 (6.703)	.217 (6.143)
Avg. Parental Education	.231 (6.178)	.187 (3.657)	.233 (6.23)	.187 (3.656)	.251 (6.618)	.224 (4.340)	.270 (6.239)	.225 (4.342)
Sex Dummy	-.230 (-6.314)	-.263 (-5.347)	-.228 (-6.263)	-.263 (-5.352)	-.218 (-5.893)	-.253 (-5.093)	-.202 (-4.843)	-.254 (-5.102)
Mothers' Opportunity Costs	.779 (13.732)	.851 (10.928)	.773 (13.629)	.848 (10.877)	.777 (13.487)	.841 (10.686)	.726 (11.092)	.838 (10.627)
Returns: univ/primary: lagged 5 years	9.818 (.797)		-7.666 (-.572)		8.779 (.702)		22.910 (.605)	
Returns: univ/secondary: lagged 5 years	.-2.655 (-.558)		3.371 0.663))		-2.312 (-.479)		-15.421 (-1.403)	
Returns: sec/primary: lagged 5 years	-8.850 (-1.837)		-5.341 (0.828)		-7.984 (-1.632)		-22.475 (-1.422)	
Returns: univ/primary: lagged 10 years		11.539 (.420)		16.440 (.562)		8.687 (.313)		13.755 (.466)
Returns: univ/secondary: lagged 10 years		-8.992 (-1.081)		-7.486 (-.845)		-8.978 (-1.068)		-7.341 (-.819)
Returns: sec/primary: lagged 10 years		-11.901 (-1.064)		-10.259 (-.879)		-10.925 (-.967)		-9.067 (-.769)
% Public Education Spending University, lagged 5 years	.316 (.244)	-1.673 (-.174)	-.653 (-.493)	-3.599 (-.346)	.403 (.307)	1.573 (.162)	1.288 (.603)	-.376 (-.036)
% Public Education Spending Secondary, lagged 5 years	3.296 (2.456)	-2.858 (-.830)	-.063 (-.038)	-3.689 (-.962)	3.176 (2.330)	-2.464 (-.708)	-6.496 (-.915)	-3.318 (-.856)
n	4290	2536	4290	2536	4290	2536	3240	2536
Adj.R^2	.8856	.8762	.8856	.8762				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 12. **Educational Attainment: Colombia, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.0673 (-1.072)	-.0546 (-.645)	-.0566 (-.902)	-.0538 (-.635)	-.089 (-1.439)	-.087 (-1.038)	-.078 (-1.259)	-.084 (-1.009)
Head of Household's Income	.1719 (3.751)	.1390 (2.193)	.1685 (3.683)	.1384 (2.180)	.164 (3.616)	.147 (2.349)	.1617 (3.573)	.146 (2.324)
Avg. Parental Education	.2561 (4.038)	.1199 (1.408)	.2626 (4.145)	.1203 (1.411)	.292 (4.665)	.181 (2.145)	.299 (4.788)	.182 (2.161)
Sex Dummy	-.1878 (-2.933)	-.1807 (-2.117)	-.1827 (-2.856)	-.1799 (-2.104)	-.179 (-2.828)	-.176 (-2.085)	-.172 (-2.724)	-.173 (-2.049)
Mothers' Opportunity Costs	.7730 (7.607)	1.058 (.1375)	.7610 (7.495)	1.054 (7.641)	.728 (7.249)	.967 (7.097)	.707 (7.049)	.958 (7.001)
Returns: univ/primary: lagged 5 years	-1.323 (-.063)		-24.485 (-1.076)		-8.549 (-.413)		-35.220 (-1.564)	
Returns: univ/secondary: lagged 5 years	7.917 (.966)		15.527 (1.784)		11.180 (1.379)		20.057 (2.330)	
Returns: sec/primary: lagged 5 years	-3.490 (-.421)		15.345 (1.387)		-.102 (-.012)		20.804 (1.901)	
Returns: univ/primary: lagged 10 years		38.807 (.807)		43.970 (.853)		40.276 (.845)		52.840 (1.034)
Returns: univ/secondary: lagged 10 years		-15.482 (-1.059)		-14.196 (-.926)		-15.512 (-1.070)		-12.232 (-.805)
Returns: sec/primary: lagged 10 years		-29.893 (-1.545)		-28.520 (-1.428)		-31.668 (-1.650)		-27.933 (-1.410)
% Public Education Spending University, lagged 5 years	2.568 (1.118)	-14.429 (-.871)	1.130 (.479)	-16.344 (-.912)	2.734 (1.203)	-16.072 (-.979)	1.200 (.514)	-20.625 (-1.161)
% Public Education Spending Secondary, lagged 5 years	3.767 (1.644)	-11.819 (-2.039)	-.849 (-.292)	-12.653 (-1.942)	2.886 (1.273)	-13.538 (-2.356)	-2.180 (-.757)	-15.560 (-2.408)
n	1451	896	1451	896	1451	896	1451	896
Adj.R^2	.8797	.8695	.8802	.8694				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 13. **Educational Attainment: Costa Rica, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.105 (-2.697)	.015 (.274)	-.065 (-1.669)	.015 (.274)	-.098 (-2.570)	.030 (.550)	-.058 (-1.538)	.030 (.550)
Head of Household's Income	.033 (.929)	-.009 (-.196)	.017 (.501)	-.009 (-.196)	.030 (.858)	-.020 (-.431)	.016 (.462)	-.020 (-.431)
Avg. Parental Education	.168 (4.287)	.168 (2.818)	.147 (3.813)	.168 (2.818)	.158 (4.128)	.150 (2.647)	.135 (3.571)	.150 (2.647)
Sex Dummy	-.072 (-1.628)	-.059 (-.860)	-.068 (-1.575)	-.059 (-.860)	-.073 (-1.683)	-.035 (-.541)	-.069 (-1.626)	-.035 (-.541)
Mother's Opportunity Costs	.071 (7.715)	1.843 (9.882)	.148 (10.973)	1.843 (9.882)	.076 (8.487)	1.882 (10.590)	.156 (11.848)	1.882 (10.590)
Returns: univ/primary: lagged 5 years		d		d		d		d
Returns: univ/secondary: lagged 5 years		d		d		d		d
Returns: sec/primary: lagged 5 years		-26.418 (-8.076)		d		-26.131 (-8.383)		d
n	1838	830	1838	830	1838	830	1838	830
Adj.R^2	.8409	.8672	.8458	.8672				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) d indicates coefficient was dropped from regression because of collinearity.
3) For Costa Rica and Mexico: regional dummies included.
4) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 14. **Educational Attainment: Costa Rica, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.083 (-1.101)	.020 (.175)	-.030 (-.404)	.020 (.175)	-.075 (-1.104)	.058 (.514)	-.017 (-.242)	.058 (.514)
Head of Household's Income	-.106 (-1.368)	-.177 (-1.737)	-.144 (-1.879)	-.177 (-1.737)	-.139 (-1.830)	-.208 (-2.130)	-.174 (-2.339)	-.208 (-2.130)
Avg. Parental Education	.270 (3.440)	.322 (2.616)	.238 (3.090)	.322 (2.616)	.305 (3.988)	.394 (3.343)	.268 (3.581)	.394 (3.343)
Sex Dummy	-.078 (-.832)	.010 (.073)	-.055 (-.598)	.010 (.073)	-.096 (-1.050)	-.001 (-.006)	-.081 (-.905)	-001 (-.006)
Mothers' Opportunity Costs	.087 (4.767)	1.576 (4.497)	.168 (6.692)	1.576 (4.497)	.100 (5.624)	1.690 (5.037)	.182 (7.445)	1.690 (5.037)
Returns: univ/primary: lagged 5 years		d		d		d		d
Returns: univ/secondary: lagged 5 years		d		d		d		d
Returns: sec/primary: lagged 5 years		-24.388 (-3.750)		d		-25.460 (-4.089)		d
n	468	220	468	220	468	220	468	220
Adj.R^2	.8443	.8480	.8508	.8480				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) d indicates coefficient was dropped from regression because of collinearity.
3) For Costa Rica and Mexico: regional dummies included.
4) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table15. **Educational Attainment: Costa Rica, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	.426 (11.110)	.467 (8.827)	.431 (11.111)	.467 (8.827)	.553 (21.401)	.577 (22.292)	.582 (23.693)	-577 (22.292)
Head of Household's Income	-.045 (-1.626).	-.074 (-1.853)	-.048 (-1.716)	-.074 (-1.853)	-.004 (-.219)	-.014 (-.715)	.001 (.034)	-.014 (-.715)
Avg. Parental Education	.077 (2.343)	-.016 (-.345)	.092 (2.798)	-.016 (-.345)	.078 (3.528)	.020 (.902)	.067 (3.241)	.020 (.902)
Sex Dummy	.008 (.223)	-.0165 (-.316)	.011 (.301)	-.016 (-.316)	-.026 (-.990)	-.035 (-1.406)	-.026 (-1.083)	-.035 (-1.406)
Mothers' Opportunity Costs	9.962 (52.483)	11.824 (40.371)	9.885 (52.900)	11.824 (40.371)	10.812 (84.456)	13.242 (92.269)	11.107 (93.898)	13.242 (92.269)
Returns: univ/primary: lagged 5 years	d		d		d		d	
Returns: univ/secondary: lagged 5 years	d		d		d		d	
Returns: sec/primary: lagged 5 years	21.195 (8.630)		d		15.510 (9.364)		d	
Returns: univ/primary: lagged 10 years		d		d		d		d
Returns: univ/secondary: lagged 10 years		d		d		d		d
Returns: sec/primary: lagged 10 years		-340.261 (-36.044)		d		-379.182 (-81.971)		d
% Public Education Spending University, lagged 5 years	d	d	d	d	d	d	d	d
% Public Education Spending Secondary, lagged 5 years	-635.002 (-43.293)	d	d	d	-681.963 (-68.937)	d	d	d
n	1085	603	1009	603	1085	603	1009	603
Adj.R^2	.9435	.9459	.9465	.9459				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) d indicates coefficient was dropped from regression because of collinearity.
3) For Costa Rica and Mexico: regional dummies included.
4) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 16. **Educational Attainment: Costa Rica, Partitioned**
(t-statistics in parentheses)

Dependent Variable: years of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	.2942 (4.056)	.3826 (3.558)	.2942 (4.056)	.3826 (3.558)	.444 (8.882)	.583 (11.038)	.444 (8.882)	.583 (11.038)
Head of Household's Income	.0357 (.629)	.0947 (.987)	.0357 (.629)	.0947 (.987)	.019 (.488)	-.042 (-.920)	.019 (.488)	-.042 (-.920)
Avg. Parental Education	.1794 (2.997)	.0721 (.892)	.1794 (2.997)	.0720 (.892)	.177 (4.289)	.061 (1.606)	.177 (4.289)	.061 (1.606)
Sex Dummy	-.1000 (-1.278)	-.1655 (-1.537)	-.1000 (-1.278)	-.1655 (-1.537)	-.124 (-2.305)	-.063 (-1.216)	-.124 (-2.305)	-.063 (-1.216)
Mothers' Opportunity Costs	9.325 (27.511)	11.205 (22.138)	9.325 (27.511)	11.205 (22.138)	9.651 (41.250)	12.454 (42.659)	9.651 (41.250)	12.454 (42.659)
Returns: univ/primary: lagged 5 years	d		d		d		d	
Returns: univ/secondary: lagged 5 years	d		d		d		d	
Returns: sec/primary: lagged 5 years	19.115 (4.293)		-58.056 (-16.106)		13.935 (4.534)		-63.741 (-25.619)	
Returns: univ/primary: lagged 10 years		d		d		d		d
Returns: univ/secondary: lagged 10 years		d		d		d		d
Returns: sec/primary: lagged 10 years		-320.85 (-19.521)		d		-354.298 (-38.671)		d
% Public Education Spending University, lagged 5 years					d	d	d	d
% Public Education Spending Secondary, lagged 5 years	-596.413 (-22.896)	d	d	d	-600.311 (-33.389)	d	d	d
n	284	162	284	162	284	160	284	160
Adj.R^2	.9483	.9412	.9483	.9412				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.
2) d indicates coefficient was dropped from regression because of collinearity.
3) For Costa Rica and Mexico: regional dummies included.
4) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 17. **Educational Attainment: Mexico, Unpartitioned**
(t-statistics in parentheses)

***Dependent Variable**:* years of completed schooling	OLS	
	1	2*
***Explanatory Variables**:*		
Family Size	-.179 (-5.569)	-.202 (-6.291)
Head-of-Household Income	.411 (16.087)	.430 (16.824)
Average Parental Education	1.951 (55.296)	1.890 (53.202)
Sex Dummy	.329 (9.738)	.328 (9.739)
Mothers' Opportunity Costs	.952 (26.437)	1.193 (29.397)
n	38375	38375
Adjusted R^2	.3928	.3953

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.
1) * specifications include time trend.
2) For Costa Rica and Mexico: regional dummies included.

Table 18. **Educational Attainment: Mexico, Partitioned**
(t-statistics in parentheses)

***Dependent Variable**:* years of completed schooling	OLS	
	1	2*
***Explanatory Variables**:*		
Family Size	-.200 (-3.935)	-.223 (-4.389)
Head-of-Household Income	.765 (12.591)	.769 (12.690)
Average Parental Education	1.763 (30.672)	1.703 (29.747)
Sex Dummy	.246 (4.532)	.240 (4.429)
Mothers' Opportunity Costs	.954 (16.457)	1.204 (18.544)
n	14951	14951
Adjusted R^2	.3860	.3889

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.
1) * specifications include time trend.
2) For Costa Rica and Mexico: regional dummies included.

Table 19. **Educational Attainment: Uruguay, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: ***years*** of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.065 (-1.228)	-.119 (-1.600)	-.072 (-1.351)	-.117 (-1.573)	-.018 (-.358)	-.056 (-.787)	-.021 (-.426)	-.053 (-.747)
Head-of-Household Income	.225 (6.296)	.285 (5.762)	.232 (6.462)	.285 (5.744)	.212 (6.198)	.238 (4.954)	.217 (6.293)	.237 (4.947)
Avg. Parental Education	4.136 (59.063)	4.124 (41.676)	4.138 (59.096)	4.127 (41.700)	4.301 (64.030)	4.442 (46.375)	4.304 (64.055)	4.440 (46.360)
Sex Dummy	-.063 (-1.171)	-.122 (-1.634)	-.065 (-1.196)	-.122 (-1.632)	-.065 (-1.251)	-.115 (1.593)	-.066 (-1.267)	-.114 (-1.582)
Mothers' Opportunity Costs	.165 (4.768)	.217 (3.924)	.179 (5.078)	.215 (3.888)	.105 (3.171)	.097 (1.825)	.113 (3.358)	.095 (1.788)
Returns: univ/primary: lagged 5 years		60.494 (1.267)		188.246 (1.793)		24.940 (.540)		193.840 (1.908)
Returns: univ/secondary: lagged 5 years		-15.526 (14.538)		-44.738 (-1.730)		-4.536 (-.322)		-43.646 (-1.744)
Returns: sec/primary: lagged 5 years		-23.436 (-1.254)		-59.317 (-1.840)		-8.556 (-.473)		-56.571 (-1.813)
n	11154	5882	11154	5882	11154	5882	11154	5882
Adj.R^2	.3821	.3733	.3823	.3734				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 20. **Educational Attainment: Uruguay, Partitioned**
(t-statistics in parentheses)

Dependent Variable: *years* of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.007	.008	-.019	.009	.027	.096	.017	.100
	(-.071)	(.057)	(-.187)	(.069)	(.288)	(.718)	(.184)	(.746)
Head-of-Household Income	.7408	.895	.776	.890	.591	.663	.616	.668
	(9.120)	(7.855)	(9.476)	(7.815)	(7.742)	(6.185)	(7.978)	(6.227)
Avg. Parental Education	4.829	4.825	4.841	4.831	5.709	6.064	5.722	6.401
	(36.237)	(25.641)	(36.369)	(25.681)	(45.509)	(34.237)	(45.547)	(34.099)
Sex Dummy	-.216	-.103	-.219	-.112	-.183	-.036	-.187	-.040
	(-1.981)	(-.693)	(-2.008)	(-.757)	(-1.782)	(-.261)	(-1.813)	(-.290)
Mothers' Opportunity Costs	.116	.221	.155	.220	.087	.113	.113	.111
	(1.694)	(2.062)	(2.230)	(2.056)	(1.354)	(1.127)	(1.726)	(1.109)
Returns: univ/primary: lagged 5 years		173.405		448.169		128.985		372.095
		(1.866)		(2.324)		(1.475)		(2.048)
Returns: univ/secondary: lagged 5 years		-55.799		-117.995		-41.703		-97.646
		(-1.993)		(-2.489)		(-1.583)		(-2.187)
Returns: sec/primary: lagged 5 years		-83.296		-159.776		-62.156		-130.925
		(-2.306)		(-2.694)		(-1.828)		(-2.344)
n	2766	1486	2766	1486	2766	1486	2766	1486
Adj.R^2	.4819	.4748	.4835	.4754				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 21. **Educational Attainment: Uruguay, Unpartitioned**
(t-statistics in parentheses)

Dependent Variable: ***years*** of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.105 (-1.037)	-.114 (-.778)	-.108 (-.770)	-.114 (-.778)	-.009 (-.092)	-.021 (-.146)	-.015 (-.109)	-.021 (-.146)
Head-of-Household Income	.263 (3.892)	.359 (3.735)	.142 (1.501)	.359 (3.735)	.155 (2.354)	.256 2.735)	.046 (.491)	.256 (2.735)
Avg. Parental Education	4.241 (29.619)	3.700 (18.655)	4.846 (23.270)	3.700 (18.655)	4.897 (35.026)	4.465 (23.122)	5.316 (25.881)	4.465 (23.122)
Sex Dummy	-.130 (-1.239)	-.118 (-.788)	-.102 (-.701)	-.118 (-.788)	-.101 (-.987)	-.178 (-1.221)	-.005 (-.036)	-.178 (-1.221)
Mothers' Opportunity Costs	.343 (4.303)	.583 (4.101)	.225 (2.355)	.583 (4.101)	.250 (3.210)	.419 (3.031)	.163 (1.731)	.419 (3.031)
Returns: univ/primary: lagged 5 years	d		d		d		d	
Returns: univ/secondary: lagged 5 years	9.625 (1.829)		d		14.106 (2.744)		d	
Returns: sec/primary: lagged 5 years	20.453 (1.701)		d		28.868 (2.458)		d	
Returns: univ/primary: lagged 10 years		d		d		d		d
Returns: univ/secondary: lagged 10 years		d		d		d		d
Returns: sec/primary: lagged 10 years		-6.189 (-.766)		d		-4.682 (-.595)		d
% Public Education Spending University, lagged 5 years	d	d	d	d	d	d	d	d
% Public Education Spending Secondary, lagged 5 years	25.268 (1.639)	d	d	d	31.944 (2.121)	d	d	d
n	3072	1542	1530	1542	3072	1542	1530	1542
Adj.R^2	.3666	.3399	.3978	.3399				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.

1) * specifications include time trend.

2) d indicates coefficient was dropped from regression because of collinearity.

3)I RLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 22. **Educational Attainment: Uruguay, Partitioned**
(t-statistics in parentheses)

Dependent Variable: *years* of completed schooling	OLS				IRLS			
	1	2	3*	4*	5	6	7*	8*
Explanatory Variables:								
Family Size	-.0276 (-.141)	-.3954 (-1.367)	-.0276 (-.141)	-.3954 (-1.367)	.113 (.610)		.113 (.610)	
Head-of-Household Income	1.102 (6.896)	1.355 (5.777)	1.102 (6.896)	1.355 (5.777)	.805 (5.283)		.805 (5.283)	
Avg. Parental Education	4.670 (17.407)	4.020 (10.745)	4.670 (17.407)	4.020 (10.745)	6.109 (23.865)		6.109 (23.865)	
Sex Dummy	-.1008 (-.484)	-.0596 (-.198)	-.1007 (-.484)	-.0596 (-.198)	-.046 (-.232)		-.046 (-.232)	
Mothers' Opportunity Costs	.4494 (2.857)	1.123 (4.009)	.4494 (2.857)	1.123 (4.009)	.301 (2.009)		.301 (2.009)	
Returns: univ/primary: lagged 5 years		d		d		d		d
Returns: univ/secondary: lagged 5 years		12.871 (1.265)		-3.807 (-.795)		14.807 (1.525)		-2.391 (-.524)
Returns: sec/primary: lagged 5 years		41.737 (1.745)		d		45.345 (1.988)		d
Returns: univ/primary: lagged 10 years			d		d			
Returns: univ/secondary: lagged 10 years			d		d			
Returns: sec/primary: lagged 10 years			-36.621 (-2.338)		d			
% Public Education Spending University, lagged 5 years		d	d	60.525 (2.182)	d	d		60.757 (2.295)
% Public Education Spending Secondary, lagged 5 years		58.081 (2.024)	d	d	d	53.099 (1.940)		d
n	797	419	797	419	797		797	
Adj.R^2	.4594	.4208	.4594	.4208				

Notes: All specifications control for age. Female opportunity costs are estimated earnings functions using Heckman correction evaluated at age 30 and schooling level of mother.
1) * specifications include time trend.
2) d indicates coefficient was dropped from regression because of collinearity.
3)I IRLS: Iteratively reweighted least squares, obtains robust regression estimates. From OLS estimates, this first drops observations with Cook's D values greater than one. Next weighted least squares (WLS) is performed using observation weights from a Huber function, down-weighting observations with large residuals. After iterating on WLS Tukey biweight weights are used.

Table 23. **Average Estimated Coefficients from Country-Level Educational Attainment Regressions — Key Variables**

(Where there is a second row the figures exclude Costa Rica)

	Unpartitioned		Partitioned	
Variable(logged except for Sex Dummy)	***Range***	***Mean***	***Range***	***Mean***
Number of Children	(-.5 , 0) (-.5 , -.05)	-.2	(-.5 , 0) (-.3 , 0)	0
Head of Household Income	(0 , .8) (.2 , .8)	.5	(-.05 , .5)	.17
Average Parental Education	(.15 , .25)	.75	(0.7 , 4.5) (.2 , 4.5)	1.3
Sex Dummy	(-.2 , .05)	0	(-.5 , .3) 0	
Estimated Mothers' Opportunity Costs	(0 , 1.8) (0 , .3)	.5 .25	(.2 , 10) (.2 , .8)	(1.98) .5
Returns to University versus Secondary Education	(-15 , 30)	8	(-300 , 22)	-10

Source: Chapter Three.

Note: t-statistics were typically very high, except for the sex dummy and returns to schooling. The minimum, maximum and mean t-statistics for the estimates were 3, 28 and 11.8 for Mothers' Opportunity Costs; 0, 12 and 7.8 for Head-of-Household Income; -6 , -1 and 3.2 for Family Size; 3, 55 and 25.7 for Parental Education; and -5.8, 0 and -1.5 for the Sex Dummy.

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