ERIA-DP-2020-27

ERIA Discussion Paper Series

No. 354

Intergenerational Transmission of Human Capital: The Case of Thailand

Sasiwimon Warunsiri PAWEENAWAT[#§]

School of Economics, University of the Thai Chamber of Commerce, Thailand

December 2020

Abstract: *This study provides evidence of intergenerational transmission of human capital in Thailand, using data from the Thailand Labor Force Survey of 1985–2017. Employing the instrumental variable approach using Thailand's compulsory educational reform of 1978 as the instrumental variable to minimise bias caused by the endogeneity of parental education, this study estimates the effect of parental education on children's education and their labour market outcomes. Besides reaffirming the conventional positive link between parental and children's years of education, new and intriguing evidence is put forth on the negative link between parental education and the child's brawn skill, based on the industry and occupation adopted by the child in the labour market. The influence of paternal education is found to outweigh that of maternal education, in contrast to the evidence from developed countries. High intergenerational educational persistence and low intergenerational mobility indicate unequal opportunities in the country, as individual welfare is largely tied to parental background. Therefore, it is recommended that the Government of Thailand weaken this linkage to improve equality in the country.*

Keywords: intergenerational transmission, parental education, child education, child skill outcomes, education reforms, Thailand

JEL Classification: I21, J13, J24

[#] Corresponding author: Sasiwimon Warunsiri Paweenawat. Address: School of Economics, University of the Thai Chamber of Commerce, 126/1 Vibhavadee-Rangsit Road, Dindaeng, Bangkok, 10400, Thailand. Phone: +66-81-8443426. Fax: +66-2-277-4359.
email: sasiwimon_war@utcc.ac.th; sasiwimon.warunsiri@gmail.com

[§] This research was conducted as part of the Economic Research Institute for ASEAN and East Asia (ERIA) project 'Human Capital Development in Asia'. The author would like to thank ERIA for funding this research project; and the National Statistical Office of Thailand, Research Institute for Policy Evaluation and Design, and University of the Thai Chamber of Commerce for access to the data used in this paper. I am very grateful for the helpful comments and guidance from Fukunari Kimura, Ian Coxhead, Rashesh Shrestha, and all participants at the First Technical Workshop on Human Capital Development in Asia at ERIA and the Second E-Workshop on Human Capital Development in Asia (online).

1. Introduction

Family background is widely recognised as a major determinant of a child's success. Based on a global study spanning 50 years, Narayan et al. (2018) advise that developing economies have lower intergenerational mobility compared to developed ones, indicating that the success of individuals in these economies still depends heavily on their parental backgrounds, exacerbating inequality of opportunity and hindering human capital development.

Although it is acknowledged that family background is a strong and logical influencer in developing economies, the literature seldom explores intergenerational transmission of human capital in developing countries because of data limitations (Hertz et al., 2007). Numerous studies examine this issue in the context of developed economies, but only a few contributors, like Tansel (2015) for Turkey, Celhay and Gallego (2015) for Chile, Azam and Bhatt (2015) for India, and Shrestha and Shrestha (2019) for Nepal, focus on developing countries.

Given this gap in the research, this study investigates the intergenerational transmission of human capital in terms of the effect of parental education on children's education and skill level in Thailand. Thailand was chosen for the case study because it is a developing country with a relatively large annual investment in education (around 4.8% of its gross domestic product, or 20% of the total government budget) (Organisation for Economic Co-operation and Development/United Nations Educational, Scientific and Cultural Organization, 2016). The country has had remarkable success in improving the education level of its population over the last 30 years, mainly through policy interventions.

Furthermore, the Thai household unit, where multiple generations reside together in an extended family system, is typical of households in developing countries (Liao and Paweenawat, 2019), and thus ideal for a study of intergenerational transmission of human capital in households in the context of a developing economy. The country's remarkable improvement in education and characteristics of the typical household unit raise further questions as to how an increase in education in one generation can affect outcomes for the next, as well as on the spillover effects of Thailand's education policy on the intergenerational transmission mechanism.

This study first estimates the intergenerational transmission of human capital when household members are adolescents (or workers in the labour market), and explores the effect of years of parental education on the child's years of education. Beyond the 'nature versus nurture' effect examined by Black and Devereux (2011), the effect of individual parental attributes on the child's brawn skill is examined through a constructed index based on self-reported occupation and industry, reflecting the influence of intergenerational transmission of human capital on the labour market. No previous studies have explored this aspect. The study also covers a group of children who reside with their parents and have not yet completed their education. University or post-compulsory education in particular was chosen to assess the impact of parental education on the child's decision to pursue post-compulsory education.

The study employs the instrumental variable approach, using the 1978 educational policy reform and instrumental variable probit analysis in the estimation, to account for the endogeneity of parental education. The study's key results indicate that parental education is positively associated with child outcomes, particularly education and skills used in the labour market. This suggests high intergenerational educational persistence in the country and implies unequal opportunities, as individual welfare is largely tied to parental background. Weakening this linkage is one way that the government can promote equality in the country.

This analysis contributes to the existing literature in several significant ways. First, the study is a comprehensive exploration of the intergenerational transmission of human capital in the context of developing economies using a unique dataset from the Thailand Labor Force Survey, which spans more than 30 years and provides complete information on reported education, income, and occupation. Second, in addition to finding an overall effect, this study allows for separate effects of maternal and paternal education on both male and female children. Such an analysis based on the gender of both the parents and children allows for nuanced, gender-sensitive policy recommendations.

Third, there is little evidence of the effect of parental education on adult child labour outcomes, which is related to skills possessed in adolescence. This study is the first to explore the intergenerational transmission of human capital based on skills used in the labour market, which is a new dimension of the intergenerational transmission of skills. Finally, understanding the determinants of intergenerational transmission is crucial for understanding the effect of policy intervention, and to gauge whether there exist large spillover effects across generations. This could help the government develop appropriate public policy to tackle inequality issues and identify resource misallocations in the country.

The remainder of this chapter is organised as follows: this study first reviews the relevant extant literature on the intergenerational transmission of human capital and charts the research gaps that require further empirical exploration. The study then describes the data and methodology used, followed by a discussion of the results, conclusions, and policy recommendations.

2. Literature Review

Extensive literature on the intergenerational transmission of human capital has investigated the effects of parental background (e.g. genetics, income, and education) on different child outcomes, such as crime (Lindqvist and Hjalmarsson, 2013; Hjalmarsson, Holmlund, and Lindquist, 2015), IQ (Black, Devereux, and Salvanes, 2009), income (Amin, Lundborg, and Rooth, 2011), health (Thompson, 2014), and voting behaviour (Cesarini et al., 2014).

Although several studies confirm intergenerational income mobility, which is a positive correlation between the permanent incomes of parents and children (Björklund and Jantti, 1997 for the United States [US] and Sweden; Björklund, Eriksson, and Jantti, 2002 for the US, Norway, Denmark, Sweden, and Finland; and Bratberg, Nilsen, and Vaage, 2002 for Norway), Black and Devereux (2011) stated that the education variable is more amenable to estimation than income because measurement errors are less likely. Most people finish their education by their mid-20s, and education does not change over time like incomes, which can be difficult to track, causing serious measurement errors.

Checchi, Fiori, and Leonardi (2013) clearly stated that, given data limitations due to the lack of a proper measure for permanent income, educational attainment could be used to represent human capital provision, as it is usually positively associated with permanent income. Tansel (2015) stated that, due to the high correlation of income with education, intergenerational transmission of education could also adequately represent the transmission of income. Cameron and Heckman (1998) and Chevalier and Lanot (2002) suggest using the influence of family fixed effects against permanent income, finding that parental education positively predicts child education. Carneiro and Heckman (2004) stated that parental income does not affect a child's educational decisions, but parental education does. Further, while there are no complete data on parental income over an individual's full lifecycle, parental education is straightforward, with no contamination from income, shocks, maternal leave, or pauses in the labour market. Thus, it does not lead to lifecycle bias (Black and Devereux, 2011), making its use popular in research.

Chevalier et al. (2013) insisted that increases in parental education and in household income impact child outcomes similarly. Björklund and Salvanes (2011) claimed a correlation between the levels of education attained by parents and children. Hertz et al. (2007) provided a comprehensive global review of the intergenerational transmission of education in over 42 countries. The complete review by Holmlund, Lindahl, and Plug (2011) and work by Amin, Lundborg, and Rooth (2015) also showed a significant influence of parental education on children's education, while allowing for heterogeneous effects based on the gender of the parents and children. Other studies focus on specific levels of education, such as a child's decision to pursue post-compulsory education (Chevalier et al., 2013) or a college degree (Haan, 2011).

Although the literature confirms the existence of a 'nurturing effect' of parental education on children's education, few studies focus on the transmission effect on child skills. Lougberg, Plug, and Würtz Rasmussen (2018) focused on intermediate child outcomes, and find that paternal education increased the male child's cognitive and non-cognitive skills in Sweden. Carneiro et al. (2013) found a powerful effect of maternal education on child cognitive skill in the US, and Sacerdote (2000) further explored child cognitive test scores, whereas Dixon et al. (2012) tackled literacy and numeracy skills and Lundborg, Nordin, and Rooth (2011) focused on health.

Scholars apply various estimation techniques to study the causal effect of parental education on a child's education and skills. However, the results vary by country, data source, and methodology used (Holmlund, Lindahl, and Plug, 2011).

The main issue to grapple with is the endogeneity of parental education, which causes potentially biased and inconsistent estimates. Three main identification strategies could minimise the occurrence of such biases.

The primary methods that address endogeneity of parental education concern adoption studies. Plug and Vijverberg (2005) first used data on adopted children to exclude genetic factors as children are not genetically related to their adoptive parents. Scholars consider genetic effects by comparing adopted (nurturing effect) and biological children (nature effect). However, the results of such studies remain inconclusive, as some works find large nurturing effects (see Dearden, Machin, and Reed, 1997; Sacerdote, 2000, 2002, 2004; Plug and Vijverberg, 2005), whereas others find smaller nurturing effects (see Björklund, Lindahl, and Plug, 2006; Sacerdote, 2007); at the same time, Holmlund, Lindahl, and Plug (2011) found that nurturing and nature effects are similar. However, it is difficult to find and access collective datasets such as those used in the adoption studies. When parents are assigned by a non-random sample, there exists a contaminated effect in the correlation between parental and child education via the nurturing effect, namely, parents' unobserved characteristics, such as patience and attitude (Black, Devereux, and Salvanes, 2005).

Next, to eliminate any effects of genetics on child education, Behrman and Rosenzweig (2002) used data from twin parents to determine the relationship between parental and child education. However, Antonovics and Goldberger (2003) raised concerns that the main assumption of this method is unrealistic. Although the twins may only differ in education, we cannot control for other characteristics that could affect their child-rearing behaviour. Bound and Solon (1999) critiqued twin datasets by noting the increased possibility of biases compared with a simple ordinary least squares (OLS) method. Behrman and Rosenzweig (2002) even found no effects of twin parents based on a comparison of their children's educational choices. Hægeland et al. (2010) combined adoption and twin datasets, and find that maternal education dominated the effect on the test scores of adopted children; but find no effects of parental education in the case of twins.

The final and most used strategy in estimating intergenerational transmission of human capital is the instrumental variable approach. This strategy is popularly used in studies of the effect of parental education on child educational outcomes, such as grades (Oreopoulos, Page, and Stevens, 2006), grade repetition (Carneiro, Meghir, and Parey, 2013), and post-compulsory school attendance (Chevalier et al., 2013). The instrumental variable approach, such as policy reform, was used by Chevalier (2004) for the US; Black et al. (2005) for Norway; and Holmlund, Lindahl, and Plug (2011) for Sweden.

Educational reform policy is the most effective instrumental variable for parental education as it is public policy for improving equal opportunity (Black et al., 2003). It not only benefits the targeted generation, but also has significant spillover effects on the next generation. Educational reform policy also exogenously influences parental ability, making it a suitable instrumental variable for studying the effect of parental education on child education. Black, Devereux, and Salvanes (2005) focused on Norway’s policy that increased the minimum number of years of compulsory schooling, while Holmlund, Lindahl, and Plug (2011) look at compulsory schooling reform in Sweden.

In addition to reform policy, Carneiro, Crawford, and Goodman (2007) looked at local tuition fees, unemployment rates, and wages; and Carneiro, Meghir, and Parey (2013) use presence at college in the state of residence and labour market conditions. Finally, Holmlund, Lindahl, and Plug (2011) used all three methods – the adoption dataset, twin dataset, and instrumental variable approach – to claim that differences in the sample and method used yield different results. As discussed earlier, given the dearth of studies based on developing economies (e.g. Celhay and Gallegos, 2015), Thailand could be another important case study to further this line of research. However, as this study cannot use the twin or adoption design due to data limitations, the estimation employs the instrumental variable approach.

3. Data

This study used cross-sectional data for 1985–2017 from the Labor Force Survey of Thailand, a survey conducted quarterly by the National Statistical Office that contains individual data such as age, marital status, education, residence, and relationship to the head of the household. Given the seasonal migration of Thai agricultural workers, this study only covers the third quarter of the year (Sussangkarn and Chalamwong, 1996; Paweenawat and McNown, 2018).

As the survey asks for the relationship of each family member to the head of the household, to construct the sample set, this study uses a household relation code to identify children and parents living in the same household, then matches the children with their parents' information on age and years of schooling using the household identification code and relationship to the household head.

Two samples (Table 1) are used to present a complete picture. The first sample focuses on those aged 25–60 who have worked in the labour market, while the second sample focuses on children aged 18–24 who had not yet completed their post-compulsory education and were either continuing their education or were not studying at university at the time of the survey. Table 1 reports summary statistics for the various demographic and educational characteristics of these two main sample groups.

Table 1: Basic Statistics

	Sample (1) – Child aged 25–60					**Sample (2) – Child aged 18–24**				
	N	**Mean**	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**
Years of schooling	96,935	11.791	4.452	0	23	78,968	11.185	2.828	0	21
Age	96,935	31.997	6.114	25	60	78,968	20.391	2.053	18	24
Max parental years of schooling	96,935	6.112	4.093	0	21	78,968	9.999	3.748	0	21
Maternal years of schooling	96,935	4.785	3.557	0	21	78,968	7.685	4.080	0	21
Paternal years of schooling	96,935	5.707	4.008	0	21	78,968	9.020	4.074	0	21
Maternal age	96,935	58.465	8.356	43	98	78,968	45.606	5.960	36	65
Paternal age	96,935	62.109	8.803	40	98	78,968	49.060	6.719	34	77
Number of household members	96,935	5.326	1.903	3	24	78,968	4.712	1.470	3	24
Gender	96,935	1.520	0.500	1	2	78,968	1.458	0.498	1	2

Max = maximum, Min = minimum, SD = standard deviation.
Source: Author's calculation.

The instrumental variable approach also minimises the bias stemming from the endogeneity of parental education in the OLS estimation. As the instrumental variable, the study uses Thailand's compulsory educational reform policy of 1978, which requires children to start primary school at the age of 8, and to complete 6 years of compulsory schooling (Knodel, 1978; Nakavachara, 2010). Hawley (2004) noted that only 77.4% of children had a primary education in 1961, whereas 99% of primary age children were enrolled in school by 1990. Thailand achieved universal primary education in the 1980s.

Based on the process of matching children with parental information, Sample 1 comprises children older than 25 during 1985–2017, and cohorts of parents born during 1912–1974. Sample 2 comprises children aged 18–24 during 1985–2017 and parents born during 1924–1983. As the reform policy was enacted in 1978, parents affected by the policy would have been born in or after 1970. The binary instrumental variable considers the parents' birth years in the sample: when the parents were born after 1970 and thus affected by the policy, the instrumental variable takes the value of 1; when the parents were born before 1970 and thus unaffected by the policy reform, the instrumental variable takes the value of zero.

Table 2 presents the distribution of education 5 years before and after the policy reform. Based on the current sample (Sample 1), before the reform, 41% of parents had 4 years of schooling, 13%–18% had 6 years, 8%–11% had 9 years, and 18%–22% had more than 10 years. After the reform, years of schooling increased for both parents: the number of those with 4 years of schooling declined, while the number of those with 6, 9, and more years of schooling increased. This demonstrates that the reform did impact parental education, which is the main key variable.

Table 2: Distribution of Education 5 Years Before and After the 1978 Reform

Years of Education	Mother (%)		Father (%)	
	Before	After	Before	After
4	41.24	35.39	41.05	31.83
6	17.64	22.4	12.87	23.51
9	7.81	10.44	10.88	12.01
10+	17.79	21.18	22.72	24.65

Source: Author's calculation.

Next, the study investigates labour market outcomes. The Labor Force Survey includes information for nine occupations and nine industries. However, according to the International Labour Organization (2018), the occupation variable is normally defined as a category, making it impossible to compare occupations directly. Therefore, it was necessary to compile detailed information regarding the task content of occupations and skill requirements for jobs. As Thailand has no information databases such as the Dictionaries of Occupational Titles, also known as O*NET, from the US Department of Labor, this chapter borrows from Rendall (2013) by constructing a brawn skill index based on occupation and industry pairs by matching the data to US job requirements.

To construct this brawn index, the job requirements from the 1991 Dictionaries of Occupational Titles are mapped onto the data for Thailand. Then, assuming that skill requirement ranks for occupations and industries in Thailand are the same as those in the US (Autor et al., 2003), a score between 0 and 1 is assigned to obtain the skill requirements for each industry and occupation, in the ordinal ranks. Following Rendall (2013), the average physical strength requirements and environmental conditions (defining brawn skill measures) are calculated to obtain the brawn skill index.

4. Methodology

First, to identify the intergenerational transmission of education, the model by Black, Devereux, and Salvanes (2005) is used to identify the causal effects of parental education on child education using Sample 1:

$$Y_{ci} = \beta_0 + \beta_1 S_{pi} + \beta_2 X_i + \varepsilon_i \qquad (1)$$

where Y_{ci} is the number of years of schooling for child i; S_{pi} is the number of years of schooling received by the child's parent (either maternal or paternal); and X_i is a set of control variables, namely child's age, parents' age, family size, gender of the child, and five regional dummies.

The estimated coefficient (β_1) represents the average increase in children's years of schooling when parental years of schooling increase by a year; in other words, it represents the degree of association between parental and child education, or shows the extent to which educational outcomes are transmitted from one generation to the next. Solon (1999) concludes that the intergenerational regression coefficient is inversely proportional to intergenerational mobility in a country. A high coefficient (β_1) indicates higher intergenerational transmission (or higher persistence) of education, but lower intergenerational mobility.

The simple pooled OLS regression estimate for Equation 1 is likely to be biased and inconsistent because of the endogeneity of parental education. Parental education is correlated with unobserved and omitted variables, particularly parental ability and childcare record (Checchi, Fiori, and Leonardi, 2013). As explained by Devereux (2020: 3), the 'genetic transmission of abilities or characteristics from parents to children' is the main explanation for intergenerational transmission. Normally, parental ability is positively correlated with their own education, and later with their children's education; thus, the bias tends to be positive, or upwardly biased in OLS estimations. However, as other sources, such as parental childcare record, also cause bias, the sign of the bias is not definite, but can be either positive or negative.

Thus, existing studies use methodologies that eliminate genetic factors from the relationship between parental education and child outcomes. The most common solution found in the literature is to minimise endogeneity through the instrumental variable approach. Note that to avoid including two endogenous variables in the estimated equation (thus worsening the endogeneity of parental education), this study employs either maternal or paternal education to represent parental education.

An instrumental variable needs to meet two basic requirements: a strong correlation with the endogenous variable (parental education), and no correlation with the error term. Because education reform policies are powerful instrumental variables (Holmlund, Lindahl, and Plug, 2011), this study employed the Thai compulsory education reform policy of 1978 as the instrumental variable for parental education. Equation 2 is the first step for determining whether the instrumental variable, education reform (R_{pi}), affects parental education.

$$S_{pi} = \alpha_0 + \alpha_1 R_{pi} + \alpha_2 X_{pi} + \mu_{pi} \qquad (2)$$

where R_{pi} is a dummy variable that equals 1 if the parent was affected by the reform, and 0 if otherwise. The instrumental variable used here meets all conditions of the instrumental variable approach; a series test on the appropriateness of the instrument was performed to establish the validity of the instrument. The possibility of a weak instrument may be excluded, as the F-statistic is larger than the threshold value.

In addition to studying the impact of parental education on child education, this study investigates its impact on children's labour market outcomes by determining the impact on children's skills for use in the labour market. Well-educated parents can devote both time and money to their children, ensuring their success in the labour market (Devereux, 2020). However, past studies have not addressed this issue, owing to limited data.

This study constructs a brawn skill index based on occupation and industry pairs following Rendall (2013). The standard OLS model estimates the relationship between child brawn skill and parents' years of schooling, while controlling for parental age, family size, regional dummies, and gender of the child, following the specification:

$$y_i = \beta_0 + \beta_1 S_{pi} + \beta_2 X_i + \varepsilon_i \qquad (3)$$

where y_i is the brawn skill index of the child; S_{pi} is the number of years of schooling obtained by the child's parent (either maternal, paternal, or the maximum years of schooling of the parents); and X_i controls for age, parental age, family size, regional dummies, and gender of the child. As described above, this study applies the 1978 compulsory education reform as the instrumental variable for parental education (see Equation 2).

Finally, to cover both adolescence and childhood, this study also investigates whether parental education affects the child's decision to study beyond the compulsory level, namely university. While access to basic primary education is almost universal in Thailand, some children still lack opportunities for higher education (World Bank, 2020). To study the effect of parental education on a child's university participation, the probit model is applied to Sample 2:

$$\Pr(Y = 1 \mid X) = f(M_i, X_i), \qquad (4)$$

where y_i is a dummy variable defining the children's participation in university education; M_i is the years of schooling obtained by the children's mother or father; X_i

is a vector of the controlling variables (namely, parental age, five regional dummies, gender of the child, and family size); and ε_i is the random error term. However, the probit model (Equation 4) may be biased because of the endogeneity of parental education. Thus, the instrumental variable probit is applied in this estimation using an instrumental variable similar to that applied in the previous estimation.

5. Results

The overall results for Sample 1[1] (children older than 25 between 1985 and 2017) demonstrate the causal relationship between parental education and child education (Table 3). The education of both parents positively impacts the child's years of schooling. Using the instrumental variable approach, the first stage instrumental variable regression demonstrates the positive impact of the 1978 policy reform on parents' years of education (as shown in Appendix 1).[2][3] All of the test results of the instrumental variable method are presented at the end of each table of estimated results. A comparison of the OLS (columns 1–3) and instrumental variable (columns 4–6) results shows that the coefficients of parental education under the instrumental variable are considerably larger. Thus, a downward bias exists when the model does not control for unobserved individual heterogeneity.

[1] To deal with the cohort effect, this study checks for robustness by adding a control for the children's birth year cohort (as a dummy variable). The results are similar to the main findings (see Appendix 2).
[2] One concern is that the 1978 policy reform may affect only a small group of parents. Thus, the 1960 compulsory reform was used as an alternate instrumental variable, which increased the amount of compulsory education from 4 to 6 years. However, the estimated results for the intergenerational transmission of education are similar in both the sign and magnitude of the coefficient, as compared to the case using the 1978 reform as the instrumental variable (see Appendix 3).
[3] Another concern in using the 1978 policy reform as an instrumental variable is its binary outcome. This study employs the grandparents' years of education as an instrumental variable, as suggested by Lindahl et al. (2014). The outcome is that the sign of the coefficient is positive, but the magnitude is much smaller than when the 1978 and 1960 policy reforms are used (see Appendix 4).

Table 3: The Effect of Parents' Education on Children's Education (Ordinary Least Squares and Independent Variable Estimation Results for Persons Aged 25–60)

	(1) OLS_mom	(2) OLS_dad	(3) OLS_max	(4) IV_mom	(5) IV_dad	(6) IV_max
Maternal years of schooling	0.421***			2.029***		
	(0.004)			(0.089)		
Paternal years of schooling		0.418***			3.376***	
		(0.003)			(0.262)	
Max years of schooling			0.424***			2.099***
			(0.003)			(0.053)
Age	–0.0261***	–0.0419***	–0.0340***	–0.0204***	–0.111***	–0.0642***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.010)	(0.006)
Family size	–0.276***	–0.269***	–0.263***	0.141***	0.542***	0.219***
	(0.007)	(0.007)	(0.007)	(0.026)	(0.075)	(0.020)
Maternal age	–0.00807***		–0.0123***	0.0502***		0.00977*
	(0.002)		(0.003)	(0.005)		(0.006)
Paternal age		0.00262	0.0100***		0.152***	0.0765***
		(0.002)	(0.003)		(0.014)	(0.006)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control for gender: male as the basis for comparison:						
Female	1.842***	1.772***	1.764***	1.312***	0.313**	0.905***
	(0.025)	(0.025)	(0.025)	(0.053)	(0.151)	(0.057)
Observations	96,935	96,935	96,935	96,935	96,935	96,935

Notes: The test of endogeneity rejects the null hypothesis that variables are exogenous (p-value=0) for independent variable estimations. The Wald F-statistic for IV_mom is 491.32, 142.48 for IV_dad, and 1349.30 for IV_max, suggesting that the instrument is not weak. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

The finding that the instrumental variable estimates are much larger than the OLS estimates is consistent with Warunsiri and McNown (2010), who found that the downward bias of the OLS estimation on return to education in Thailand indicates a negative correlation between unobserved ability and education in the country. Individuals with greater ability might experience a higher opportunity cost of studying;

that is, they may not further their studies as the cost of schooling outweighs the benefits of education.

In addition, the downward bias found in this study contradicts the evidence for most developed economies. Black and Devereux (2011) offered some insights on this bias: the use of self-reported data on education attainment might cause a measurement error while measuring years of schooling. Furthermore, the instrument of reform is correlated with unobserved ability. Finally, the higher instrumental variable estimates could be justified by heterogeneous returns to education; that is to say, people affected by the reform are more likely to return to education.

The instrumental variable estimates are consistently larger than the OLS estimates, with the relationship between parental and child education indicating a positive and statistically significant effect overall. The magnitude of the effect of paternal education with the instrumental variable is larger than that of maternal education (3.37 versus 2.02). An extra year of paternal schooling increases the optimal human capital choice for the child. If the parents' years of schooling increase by 1 year, the child's years of schooling correspondingly increase by 2–3 years.

These results indicate high intergenerational transmission of education, but low intergenerational educational mobility in Thailand. Leone (2019) confirmed that intergenerational educational persistence is particularly strong in least developed countries. Neidhöfer (2019) also reported low educational mobility in Latin American countries. Compared with developed economies, parental education has a much greater effect on the child's education (Black, Devereux, and Salvanes, 2005). For example, in Sweden Lundborg, Plug, and Würtz Rasmussen (2018) found that an additional year of paternal schooling increases a child's years of schooling by only 0.07 years.

These results are partly consistent with Chevalier, Denny, and McMahon (2009), whose study of the US and European Union countries found that a high return to education is related to a higher degree of intergenerational educational persistence. Warunsiri and McNown (2010) also measured a higher rate of return to education in Thailand compared with other countries (around 14%–16%). However, the results of this study contradict Chevalier, Denny, and McMahon (2009) in another aspect. Generally, intergenerational transmission is low and intergenerational educational mobility is high in countries highly invested in education. Becker and Tomes (1979; 1986) explained that this is because high public expenditure on education helps to reduce the gap in educational investment between rich and poor families, which can lead to high intergenerational educational mobility.

Although Thailand is unique in its heavy investment in education, the results indicate low intergenerational educational mobility. This could imply ineffective public expenditure on education. The government's large outlays on education may be misallocated or used inefficiently, hindering the intended impact of reducing unequal access to education for Thai children.

The government's high public expenditure on education has not reduced the investment gap in human capital between different parental economic backgrounds (Becker and Tomes, 1979; 1986). Specifically, the cost of private education in Thailand remains high, making it difficult to attain higher education without an additional public subsidy. Although the government has subsidised education considerably, the overall cost remains relatively high, especially when hidden costs are considered (Paweenawat and Vechbanyongratana, 2015).

Furthermore, the spillover effects of education policy interventions in developing economies like Thailand are larger than expected, and almost double the years of required schooling. This emphasises the significance of transmission of parents' educational backgrounds to their children's educational outcomes. The link found in this study is larger and stronger than in developed economies. Devereux (2020) states persuasively that intergenerational transmission effects in most developing countries tend to be larger than in developed countries, because of a dearth of high-quality publicly funded education in developing countries.

In addition, higher intergenerational educational persistence indicates lower intergenerational mobility. Narayan et al. (2018) explained that, in a country with low mobility, an individual's success very much depends on parental background, suggesting resource misallocation in society. Individuals from families with a low socioeconomic status do not have an equal opportunity to utilise their human capital capacity to escape the conditions into which they were born. This could explain the situation in Thailand, where, according to a World Bank report (2020), there is inequality of opportunity for children in different regions of the country because of varying levels of economic development. This leads to unequal educational access in different areas; people living in rural areas are more likely to have limited access to education than those in urban areas. To address this issue, the sample is broken up by living area. The results from the instrumental variable estimates confirm a positive and statistically significant effect of parental education on children's education in both urban and rural areas (Table 4).

Table 4: The Effect of Parental Education on Children's Education – Urban versus Rural

	(1)	(2)	(3)	(4)	(5)	(6)
	Urban			Rural		
	IV_mom	IV_dad	IV_max	IV_mom	IV_dad	IV_max
Maternal years of schooling	0.569***			2.105***		
	(0.043)			(0.144)		
Paternal years of schooling		0.936***			3.595***	
		(0.082)			(0.432)	
Max years of schooling			0.848***			4.134***
			(0.070)			(0.205)
Age	–0.0313***	–0.0577***	–0.0455***	–0.0656***	–0.126***	–0.143***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.015)	(0.014)
Family size	–0.212***	–0.0799***	–0.0946***	–0.0654***	0.194***	0.286***
	(0.017)	(0.030)	(0.027)	(0.024)	(0.069)	(0.044)
Maternal age	0.0192***		–0.0023	0.0699***		0.108***
	(0.003)		(0.004)	(0.010)		(0.015)
Paternal age		0.0484***	0.0433***		0.174***	0.131***
		(0.004)	(0.005)		(0.028)	(0.015)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control for gender: male as the basis for comparison:						
Female	1.768***	1.485***	1.516***	1.424***	0.538***	0.273*
	(0.035)	(0.056)	(0.051)	(0.066)	(0.194)	(0.142)
Observations	57,224	57,224	57,224	39,711	39,711	39,711

Source: Author's calculation.

However, the magnitude of coefficients for both the father (3.59) and mother (2.10) is much higher in rural areas than in urban areas. This indicates that the effect of parental education on children's education is much larger in rural areas. One possible explanation for this is a lack of complete learning facilities in rural areas. In rural areas, 1 more year of parental education leads to a greater increase in the children's number of years of education, relative to urban areas.[4]

This result is consistent with the study by Aydemir and Yazici (2019), who suggested that different conditions of economic development in different areas of Turkey induce different rates of intergenerational transmission; and with that by Chetty et al. (2014), who found that intergenerational mobility in the US differs significantly across different geographical areas. For instance, there is higher inequality in areas with low intergenerational mobility, and children in these communities face difficulties upgrading their status from the level into which they were born.

In the case of Thailand, Warunsiri and McNown (2010) concluded that differences in stages of development between urban and rural areas yield different opportunity costs of study, as well as different rates of return to education in these areas. The study also finds a different rate of intergenerational transmission in different areas across the country, confirming that unequal access to education in different areas is also due to the varying quality of education in Thailand. More specifically, the quality of education in rural areas is lower than in urban areas; for example, some schools have insufficient learning resources and infrastructure, as well as fewer teachers (World Bank, 2020).

Next, in terms of gender, the evidence in Table 5 suggests a positive effect of both paternal and maternal education on the education of both male and female children. However, paternal education has a higher impact on both children than does maternal education (2.7–4.3 versus 1.8–2.3). This result is consistent with Serafino

[4] One more concern is the varying credit market constraints of families in Thailand. Thus, the Student Loan Program initiated in 1996 is examined. This study uses a young generation sample and classifies it into a group that is not affected (born 5 years before 1973) and one that is affected (born 5 years after 1973). By applying the instrumental variable approach using the 1960 reform policy as an instrumental variable, the results show that the group of children who were affected by student loans exhibits low intergenerational persistence, implying that individual welfare is less dependent on parental background, and indicating more equal opportunity in accessing higher education (as shown in Appendix 5).

and Tonkin (2014), indicating that paternal education is the key determinant of children's education. The statistically significant relationship between either parent and either child is larger than in a scenario without the disaggregate. The effect of parental education is slightly larger for the female child than for the male child when using the instrumental variable estimation.

Table 5: The Effect of Parental Education on Children's Education – Sons versus Daughters

	(1) IV_son_ mom	(2) IV_daughter _ mom	(3) IV_son_ dad	(4) IV_daughter _ dad	(5) IV_son_ max	(6) IV_daughter _ max
Maternal years of schooling	1.800***	2.362***				
	(0.093)	(0.182)				
Paternal years of schooling			2.784***	4.381***		
			(0.229)	(0.678)		
Max years of schooling					2.006***	2.205***
					(0.064)	(0.088)
Age	–0.030***	–0.0102	–0.09***	–0.141***	–0.063***	–0.0655***
	(0.006)	(0.008)	(0.011)	(0.023)	(0.008)	(0.008)
Family size	0.134***	0.184***	0.372***	0.879***	0.212***	0.235***
	(0.026)	(0.055)	(0.060)	(0.213)	(0.023)	(0.035)
Maternal age	0.053***	0.051***			0.0171**	0.00288
	(0.006)	(0.009)			(0.008)	(0.009)
Paternal age			0.124***	0.204***	0.0702***	0.0835***
			(0.013)	(0.037)	(0.007)	(0.009)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,547	50,388	46,547	50,388	46,547	50,388

Notes: The test of endogeneity rejects the null hypothesis that variables are exogenous (p-value = 0) for independent variable estimations. The Wald F-statistic for IV_son_mom is 368.81, 156.00 for IV_daughter_mom, 112.68 for IV_son_dad, 36.96 for IV_daughter_dad, 833.35 for IV_son_max, and 551.05 for IV_daughter_max, suggesting that the instrument is not weak. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

Regarding the intergenerational transmission of education across gender, it is premature to conclude which parent's education has more impact on the child (Devereux, 2020). Traditionally, the mother is the homemaker and carer, while the father is the breadwinner. However, the role and function of parenting has been changing over time, and men now participate in childcare and nurturing as well (Lamb, 2010). Sriyasak et al. (2018) suggested that Thai fathers have become more involved in parenting and household work over time.

Furthermore, fathers in Thailand are expected to be leaders and primary income earners (Yoddumnern-Attig, 1992), while mothers are secondary earners; this accords the father more intra-household bargaining power, especially in decisions concerning the children's education.

Next, to investigate the impact of parental education on child skills in the labour market, this study constructs a brawn index that measures brawn skill requirements based on occupation and industry pairs. The higher the index, the higher the brawn skill requirement; for example, farmers require more brawn than do technicians. The significant negative coefficients of parental education suggest that children tend to work in occupations requiring less brawn skill if the parents have more years of schooling. The results of the OLS regression (columns 1–3) in Table 6 show a slightly downward bias compared with the instrumental variable estimation (columns 4–6). The absolute magnitude of the coefficient on paternal education is slightly higher than that on maternal education, which is consistent with Lougberg, Plug, and Würtz Rasmussen (2018). The estimates suggest that increasing parental education by a year reduces the child's brawn index by about 0.03 (i.e. the child is less likely to have a physically demanding occupation).

Table 6: The Effect of Parental Education on Children's Brawn Skill (Independent Variable Estimation Results for Ages 25–60)

	(1) OLS_mom	(2) OLS_dad	(3) OLS_max	(4) IV_mom	(5) IV_dad	(6) IV_max
Maternal years of schooling	–0.022***			–0.0313***		
	(0.000)			(0.002)		
Paternal years of schooling		–0.022***			–0.0381***	
		(0.000)			(0.003)	
Max years of schooling			–0.023***			–0.0352***
			(0.000)			(0.002)
Age	0.0014***	0.003***	0.0020***	0.0014***	0.00292***	0.00214***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Family size	0.0083***	0.007***	0.0074***	0.0059***	0.00340***	0.00385***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Maternal age	0.0006***		0.0013***	0.000295		0.00115***
	(0.000)		(0.000)	(0.000)		(0.000)
Paternal age		–0.0003*	–0.0011***		–0.0011***	–0.00163***
		(0.000)	(0.000)		(0.000)	(0.000)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control for gender: male as the basis for comparison:						
Female	–0.187***	–0.183***	–0.183***	–0.184***	–0.176***	–0.177***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Observations	96,935	96,935	96,935	96,935	96,935	96,935

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

Interestingly, when one matches parent and child in terms of gender, parental education has no effect on the male child's brawn index, but it does impact the female child's index (Table 7). The impact of parental education on brawn skill is significantly negative in the latter case (columns 2 and 4). A 1-year increase in parental education reduces the female child's brawn index by about 0.06–0.07 – the higher the level of parental education, the less likely the female child will work in an occupation or industry requiring brawn skill.

Table 7: The Effect of Parental Education on Children's Brawn Skill (Son/Daughter)

	(1) IV_son_ mom	(2) IV_daughter_ mom	(3) IV_son_ dad	(4) IV_daughter_ dad	(5) IV_son_ max	(6) IV_daughter_ max
Maternal years of schooling	–0.00128	–0.0625***				
	(0.003)	(0.003)				
Paternal years of schooling			–0.00205	–0.0779***		
			(0.004)	(0.004)		
Max years of schooling					–0.00177	–0.0725***
					(0.003)	(0.004)
Age	0.002***	0.000393	0.003***	0.00342***	0.0024***	0.0021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Family size	0.006***	0.005***	0.005***	–0.0019	0.0055***	–0.0010
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Maternal age	0.000239	0.000369			0.00085**	0.0014***
	(0.000)	(0.000)			(0.000)	(0.000)
Paternal age			–0.00027	–0.00225***	–0.0008**	–0.0027***
			(0.000)	(0.000)	(0.000)	(0.000)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,547	50,388	46,547	50,388	46,547	50,388

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

This result confirms that not only does intergenerational transmission of education pass through skills during childhood, but also parental education extends through the child's skills during adolescence, especially for the female child. This result indicates strong role model effects of parents on female children in Thailand. Knodel (1997) mentioned that Thai parents have increasingly become indifferent to gender with respect to schooling. This trend is a result of greater modernisation and, thus, the narrowing gender gap in education. As a result, the role and status of women in the Thai labour market has improved (Paweenawat and McNown, 2018), which explains the result of a significant effect of parental education on the female child's skill during adolescence.

Finally, this study focuses on educational outcomes for children aged 18–24 (Sample 2) to estimate the influence of parental years of education on the probability of post-compulsory schooling, namely university. Using both the probit and instrumental variable probit models, all specifications in Table 8 indicate that parental education has a positive effect on the probability of the child attending university.

Table 8: The Effect of Parental Education on the Probability of University Participation (Independent Variable Estimation Results for Persons Aged 18–24)

	(1) Probit_mom	(2) Probit_dad	(3) Probit_max	(4) IV_mom	(5) IV_dad	(6) IV_max
Maternal years of schooling	0.0310***			0.266***		
	(0.002)			(0.001)		
Paternal years of schooling		0.0290***			0.282***	
		(0.002)			(0.001)	
Max years of schooling			0.0309***			0.276***
			(0.001)			(0.004)
Family size	–0.0154***	–0.0165***	–0.0197***	0.0631***	0.0711***	0.072***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Maternal age	0.0432***		0.0198***	–0.0230***		–0.0172***
	(0.001)		(0.001)	(0.001)		(0.001)
Paternal age		0.0354***	0.0215***		–0.0181***	0.0163***
		(0.001)	(0.001)		(0.001)	(0.001)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control for gender: male as the basis for comparison:						
Female	0.240***	0.231***	0.231***	0.0985***	0.0387***	0.0885***
	(0.011)	(0.011)	(0.010)	(0.009)	(0.008)	(0.011)
Observations	68,478	69,448	78,968	68,478	69,448	78,968

Notes: The Wald's test of exogeneity rejects the null hypothesis (p-value = 0). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

A 1-year increase in parental years of schooling increases this probability by 26%–28% when using the instrumental variable estimation. Paternal education (0.28) has a slightly larger impact than maternal education on the probability of the child attending university; this finding is consistent with Turkey (Tansel, 2015). Further, the effect of parental education is similar for all children disaggregated by gender (Table 9). Paternal education (0.28) has a slightly larger impact than maternal education (0.26–0.27) on the probability of both male and female children attending university, which is partially consistent with Chevalier et al. (2013) on the role of paternal education.

Table 9: The Effect of Parental Education on the Probability of University Participation (Son/Daughter)

	(1) IV_son_mom	(2) IV_daughter_mom	(3) IV_son_dad	(4) IV_daughter_dad	(5) IV_son_max	(6) IV_daughter_max
Maternal years of schooling	0.27***	0.26***				
	(0.002)	(0.003)				
Paternal years of schooling			0.282***	0.281***		
			(0.001)	(0.001)		
Max years of schooling					0.277***	0.274***
					(0.006)	(0.002)
Family size	0.06***	0.0629***	0.066***	0.077***	–0.067***	0.0685***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Maternal age	–0.03***	–0.0169***			–0.021***	–0.0136***
	(0.001)	(0.002)			(0.001)	(0.001)
Paternal age			–0.02***	–0.015***	–0.004***	–0.0038***
			(0.001)	(0.001)	(0.001)	(0.001)
Control for regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37,140	31,338	37,454	31,994	42,834	42,337

Notes: The Wald's test of exogeneity rejects the null hypothesis (p-value = 0). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

6. Conclusion

This study estimated the intergenerational transmission of human capital in Thailand, a country that expends extensive capital on education and has witnessed a marked improvement in overall education standards. Using the instrumental variable approach to address the endogeneity of parental education, the study's main findings confirm the conventional results that parental education is positively associated with child outcomes, particularly for education and skills.

Furthermore, there are significant spillover effects of educational reform in the country, where an additional year of parental education can, over time, almost double the number of years of education attained by the child. Further, parental education increases the probability of the child attending post-compulsory education. Regarding the association between skill formation in the labour market and parental education in Thailand, the study also confirmed that parental education increases the child's skills. Paternal education is the main influencer of child education, indicating the father's greater role in household decision-making within developing economies, contrary to the evidence in developed countries.

The study's findings on the intergenerational transmission of human capital have important policy implications, especially regarding educational reform policies that increase the minimum number of years of schooling as a significant factor for encouraging greater educational participation, as such policy interventions have tremendous intergenerational spillover effects. Thailand's case clearly shows low intergenerational educational mobility, implying that an individual's success still depends heavily on parental education.

The Thai government must implement policies to tackle this issue by weakening this linkage. For example, the government policy removing credit constraints as well as further subsidising education, especially for households with poorly educated parents, seems to reduce the tendency of children to rely on their parental background, and therefore supports equal opportunity and access to education. The main findings show inequalities across Thailand's rural and urban areas. The government must decrease this by improving the learning infrastructure to help disadvantaged groups.

This study also yields gender perspectives within Thai households: as paternal education is the main influencer of children's education, encouraging the maternal role in intra-household decisions should be considered as an important aspect to improve women's position, status, and decision-making role in the household. Finally, this study offers insights for policy strategies aimed at reducing the likelihood that female children will work in occupations requiring high brawn skill; not only will promoting parental education benefit female education directly, but also transmission to the next generation will yield further benefits for society via large spillover effects from maternal education.

References

Amin, V., P. Lundborg, and D. Rooth (2011), 'Following in Your Father's Footsteps: A Note on the Intergenerational Transmission of Income between Twin Fathers and Their Sons', *IZA Discussion Paper*, No. 5990, Bonn: Institute of the Study of Labor.

Amin, V., P. Lundborg, and D. Rooth (2015), 'The Intergenerational Transmission of Schooling: Are Mothers Really Less Important than Fathers?', *Economics of Education Review*, 47, pp.100–17.

Antonovics, K. and S. Goldberger (2003), 'Do Educated Women Make Bad Mothers? Twin Studies of the Intergenerational Transmission of Human Capital', *University of California at San Diego, Economics Working Paper Series*, San Diego, CA: Department of Economics, University of California at San Diego.

Autor, D.H., F. Levy, and R.J. Murnane (2003), 'The Skill Content of Recent Technological Change: An Empirical Exploration', *The Quarterly Journal of Economics*, 118(4), pp.1279–333.

Aydemir, A.B. and H. Yazici (2019), 'Intergenerational Education Mobility and the Level of Development', *European Economic Review*, 116(C), pp.160–85.

Azam, M. and V. Bhatt (2015), ‘Like Father, Like Son? Intergenerational Educational Mobility in India’, *Demography*, 52(6), pp.1929–59.

Becker, G.S. and N. Tomes (1979), ‘An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility’, *Journal of Political Economy*, 87(6), pp.1153–89.

Becker, G.S. and N. Tomes (1986), ‘Human Capital and the Rise and Fall of Families’, *Journal of Labor Economics*, 4(3, Part 2), pp.1–39.

Behrman, J.R. and M.R. Rosenzweig (2002), ‘Does Increasing Women’s Schooling Raise the Schooling of the Next Generation?’, *The American Economic Review*, 92(1), pp.323–34.

Bingley, P., M. Corak, and N. Westergård-Nielsen (2011), ‘Intergenerational Transmission of Employers in Canada and Denmark’, *IZA Discussion Paper*, No. 5993, Bonn: Institute of the Study of Labor.

Björklund, A. and M. Jantti (1997), ‘Intergenerational Income Mobility in Sweden Compared to the United States’, *American Economic Review*, 87(5), pp.1009–18.

Björklund, A. and K. Salvanes (2011), ‘Education and Family Background: Mechanisms and Policies’, in E. Hanushek and F. Welch (eds.) *Handbook of the Economics of Education*. Amsterdam: North Holland, pp.201–47.

Bjorklund, A., K. Eriksson, and M. Jantti (2002), ‘IQ and Family Background: Are Associations Strong or Weak?’, *IZA Discussion Paper*, No. 4305, Bonn: Institute of the Study of Labor.

Björklund, A., M. Lindahl, and E. Plug (2006), ‘The Origins of Intergenerational Associations: Lessons from Swedish Adoption Data’, *The Quarterly Journal of Economics*, 121(3), pp.999–1028.

Black, S. and P. Devereux (2011), ‘Recent Developments in Intergenerational Mobility’, in O. Ashenfelter and D. Card (ed.) *Handbook of Labor Economics*. Amsterdam: North Holland, pp.1487–541.

Black, S.E. and P.J. Devereux (2010), ‘Recent Developments in Intergenerational Mobility’, *National Bureau of Economic Research (NBER) Working Paper*, No.15889. Cambridge, MA: NBER.

Black, S., P. Devereux, and K. Salvanes (2005), ‘Why the Apple Doesn’t Fall Far: Understanding the Intergenerational Transmission of Human Capital’, *The American Economic Review*, 95(1), pp.437–49.

Black, S., P. Devereux, and K. Salvanes (2009) ‘Like Father, Like Son? A Note on the Intergenerational Transmission of IQ Scores’, *Economics Letters*, 105(1), pp.138–40.

Bound, J. and G. Solon (1999), ‘Double Trouble: On the Value of Twins-Based Estimation of the Return to Schooling’, *Economics of Education Review*, 18(2), pp.169–82.

Bratberg, E., A. Nilsen, and K. Vaage (2002), ‘Assessing Changes in Intergenerational Earnings Mobility’, *Working Papers in Economics*, 26(2), Bergen: University of Bergen, Department of Economics.

Cameron J. and J. Heckman (1998), ‘Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males’, *Journal of Political Economy*, 106, pp.262–333.

Carneiro, P. and J. Heckman (2004), ‘Human Capital Policy’, *NBER Working Paper*, No. 9495, Cambridge, MA: NBER.

Carneiro, P., C. Crawford, and A. Goodman (2007), ‘The Impact of Early Cognitive and Non-Cognitive Skills on Later Outcomes’, *Centre for the Economics of Education Discussion Paper*s, No. 0092, London: London School of Economics.

Carneiro, P., C. Meghir, and M. Parey (2013), ‘Maternal Education, Home Environments, and the Development of Children and Adolescents’, *Journal of the European Economic Association*, 11(January), pp.123–60.

Celhay, P. and S. Gallegos (2015), ‘Persistence in the Transmission of Education: Evidence across Three Generations for Chile’, *Journal of Human Development and Capabilities, Issue 3: Inequality and Human Development in Latin America: A Long-Run Perspective*, 16, pp.420–51.

Cesarini, D., L. Erik, Ö. Robert, and W. Björn (2014), ‘Pre-Analysis Plan for Wealth, Health and Child Development: Evidence from Administrative Data on Swedish Lottery Players’, *The Quarterly Journal of Economics*, 131(2), pp.687–738.

Checchi, D., C. Fiorio, and M. Leonardi (2012), 'Intergenerational Persistence of Educational Attainment in Italy', *Economic Letters*, 118, pp.229–32.

Chetty, R., N. Hendren, P. Kline, and E. Saez (2014), 'Where is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States', *Quarterly Journal of Economics*, 129(4), pp.1553–623.

Chevalier, A. (2004), 'Parental Education and Child's Education: A Natural Experiment', *IZA Discussion Paper*, No. 1153, Bonn: Institute of the Study of Labor.

Chevalier, A. (2014). 'Does Higher Education Quality Matter in the UK? *IZA Discussion Paper*, No. 8363, Bonn: Institute of the Study of Labor.

Chevalier, A. and G. Lanot (2002), 'The Relative Effect of Family Characteristics and Financial Situation on Educational Achievement', *Education Economics*, 10, pp.165–82.

Chevalier, A., C. Harmon, V. Sullivan, and I. Walker (2013), 'The Impact of Parental Income and Education on the Schooling of Their Children', *IZA Journal of Labor Economics*, 2(8).

Chevalier, A., K. Denny, and D. McMahon (2009), 'A Multi-Country Study of Inter-Generational Educational Mobility' in P. Dolton, R. Asplundh, and E. Barth (eds.) *Education and Inequality across Europe*. London: Edward Elgar.

Corak, M. (2013), 'Income Inequality, Equality of Opportunity, and Intergenerational Mobility', *Journal of Economic Perspectives*, 27(3), pp.79–102.

Dearden, L., S. Machin, and H. Reed (1997), 'Intergenerational Mobility in Britain', *Economic Journal*, 107, pp.47–66.

Devereux, P. (2020), 'Intergenerational Return to Human Capital', *IZA World of Labor*, Bonn: Institute of Labor Economics.

Dixon, L.Q., J. Zhao, B.G. Quiroz, and J.Y. Shin (2012), 'Home and Community Factors Influencing Bilingual Children's Ethnic Language Vocabulary Development', *International Journal of Bilingualism*, 16, pp.541–65.

Haan, M. (2011), 'The Effect of Parents' Schooling on Child's Schooling: A Nonparametric Bounds Analysis', *Journal of Labor Economics*, 29(4), pp.859–92.

Hægeland, T., L. Kirkebøen, O. Raaum, and K. Salvanes (2010), 'Why Children of College Graduates Outperform Their Schoolmates: A Study of Cousins and Adoptees', *NHH Norwegian School of Economics, Department of Economics Discussion Paper*, No. 2.

Hawley, J.D. (2004), 'Changing Returns to Education in Times of Prosperity and Crisis, Thailand 1985–1998', *Economics of Education Review*, 23, pp.273–86.

Hertz, T., T. Jayasundera, P. Piraino, S. Selcuk, N. Smith, and A. Verashchagina (2007), 'The Inheritance of Educational Inequality: International Comparisons and Fifty-Year Trends', *The B.E. Journal of Economic Analysis and Policy*, 7(2), pp.1–48.

Hjalmarsson, R., H. Holmlund, and M. Lindquist (2015), 'The Effect of Education on Criminal Convictions and Incarceration: Causal Evidence from Microdata', *The Economic Journal*, 125(587), pp.1290–326.

Holmlund, H., M. Lindahl, and E. Plug (2011), 'The Causal Effect of Parents' Schooling on Children's Schooling: A Comparison of Estimation Methods', *Journal of Economic Literature*, 49(3), pp.615–51.

International Labour Organization (2018), *Intergenerational Mobility: A Dream Deferred?* Geneva: International Labour Organization. https://www.ilo.org /wc msp5/groups/
public/---dgreports/---cabinet/documents/publication/wcms_649496.pdf (accessed 10 June 2020).

Knodel, J. (1978), 'Natural Fertility in Pre-Industrial Germany', *Population Studies*, 32(3), pp.481–510.

Knodel, J. (1997), 'The Closing of the Gender Gap in Schooling: The Case of Thailand', *Comparative Education*, 33(1), pp.61–86.

Lamb, M. (2010), *The Role of the Father in Child Development*, 5th Ed. Hoboken, NJ: John Wiley and Sons.

Leone, T. (2019), 'Intergenerational Mobility in Education: Estimates of the Worldwide Variation', *Journal of Economic Development*, 44(4), pp.1–42.

Liao, L. and S. Paweenawat (2019), 'Alternative Boomerang Kids, Intergenerational Co-Residence, and Maternal Labor Supply', *Puey Ungphakorn Institute for*

Economic Research Discussion Papers, No. 108, Bangkok: Puey Ungphakorn Institute for Economic Research.

Lindahl, M., M. Palme, S. Sandgren-Massih, and A. Sjögren (2014), 'A Test of the Becker-Tomes Model of Human Capital Transmission Using Microdata on Four Generations', *Journal of Human Capital*, 8(1), pp.80–96.

Lindqvist, M. and R. Hjalmarsson (2013), 'The Origins of Intergenerational Associations in Crime: Lessons from Swedish Adoption Data', *Labor Economics*, 20(C), pp.68–81.

Lundborg, P., M. Nordin, and D. Rooth (2011), 'The Intergenerational Transmission of Human Capital: Exploring the Role of Skills and Health Using Data on Adoptees and Twins', *IZA Discussion Paper*, No. 6099, Bonn: Institute for the Study of Labor.

Lundborg, P., E. Plug, and A. Würtz Rasmussen (2018) 'Can Women Have Children and a Career? IV Evidence from IVF Treatments', *Working Paper Series*, No. 2, Uppsala: IFAU – Institute for Evaluation of Labour Market and Education Policy.

Maurin, E. and S. McNally (2008), 'Vive la Révolution! Long-Term Educational Returns of 1968 to the Angry Students', *Journal of Labor Economics*, 26(1), pp.1–33.

Nakavachara, V. (2010), 'Superior Female Education: Explaining the Gender Earnings Gap Trend in Thailand', *Journal of Asian Economics*, 21, pp.198–218.

Narayan, A., R. Van der Weide, A. Cojocaru, C. Lakner, S. Redaelli, D.G. Mahler, R.G.N. Ramasubbaiah, and S. Thewissen (2018), *Fair Progress?: Economic Mobility across Generations around the World. Equity and Development*. Washington, DC: World Bank. https://openknowledge. worldbank.org/ handle/10986/28428 License: CC BY 3.0 IGO (accessed 10 June 2020).

Neidhöfer, G. (2019), 'Intergenerational Mobility and the Rise and Fall of Inequality: Lessons from Latin America', *Journal of Economic Inequality*, 17, pp.499–520.

Organisation for Economic Co-operation and Development/United Nations Educational, Scientific and Cultural Organization (2016), *Education in*

Thailand: An OECD-UNESCO Perspective, Reviews of National Policies for Education. Paris: Organisation for Economic Co-operation and Development Publishing.

Oreopoulos, P., E. Page, and H. Stevens (2006), 'The Intergenerational Effects of Compulsory Schooling', *Journal of Labor Economics*, 24(4), pp.729–60.

Paweenawat, S.W. and R. McNown (2018), 'A Synthetic Cohort Analysis of Female Labour Supply: The Case of Thailand', *Applied Economics*, 50(5), pp.527–44.

Plug, E. and W. Vijverberg (2005), 'Does Family Income Matter for Schooling Outcomes? Using Adoptees as a Natural Experiment', *The Economic Journal*, 115(506), pp.879–906.

Rendall, M. (2013), 'Structural Change in Developing Countries: Has It Decreased Gender Inequality?', *World Development*, 45, pp.1–16.

Sacerdote, B. (2000), 'The Nature and Nurture of Economic Outcomes', *NBER Working Papers*, No. w7949, Cambridge, MA: NBER.

Sacerdote, B. (2004), 'What Happens When We Randomly Assign Children to Families?', *NBER Working Papers*, No. 10894, Cambridge, MA: NBER.

Sacerdote, B. (2007), 'How Large Are the Effects from Changes in Family Environment? A Study of Korean American Adoptees', *The Quarterly Journal of Economics*, pp.119–57.

Serafino, P. and R. Tonkin (2014), *Intergenerational Transmission of Disadvantage in the UK and EU*. London: Office for National Statistics. http://www.ons.gov.uk/ons/rel/household-income/intergenerational-transmission-of-poverty-in-the-uk---eu/2014/blank.html (accessed 23 September 2020).

Shrestha, V. and R. Shrestha (2019), 'Multigenerational Effects of Education Reform: Mother's Education and Children's Human Capital in Nepal', *The World Bank Economic Review*, lhy036.

Solon, G. (1999), 'Intergenerational Mobility in the Labor Market', in O. Ashenfelter and D. Card (eds.) *Handbook of Labor Economics*, 3(A). Amsterdam: Elsevier, pp.1761–800.

Sriyasak, A., A. Almqvist, C. Sridawruang, W. Neamsakul, and E. Häggström-Nordin (2018), 'The New Generation of Thai Fathers:

Breadwinners Involved in Parenting', *American Journal of Men's Health*, 12(5), pp.1368–78.

Sussangkarn, C. and Y. Chalamwong (1996), 'Thailand Development Strategies and Their Impacts on Labour Markets and Migration', in D. O'Connor and L. Farsakh (eds.) *Development Strategy, Employment, and Migration*. Paris: Organisation for Economic Co-operation and Development.

Tansel, A. (2015), 'Intergenerational Educational Mobility in Turkey', *IZA Discussion Paper*, No. 9590, Bonn: Institute of the Study of Labor.

Thompson, O. (2014), 'Genetic Mechanisms in the Intergenerational Transmission of Health', *Journal of Health Economics*, 35(C), pp.132–46.

Warunsiri, S. and R. McNown (2010), 'The Returns to Education in Thailand: A Pseudo Panel Approach', *World Development*, 38(11), pp.1616–25.

World Bank (2020), *Taking the Pulse of Poverty and Inequality in Thailand*. http://pubdocs.worldbank.org/en/149501583303319716/WB-Poverty-Report-Thailand-2020-Low-res.pdf (accessed 10 June 2020).

Yoddumnern-Attig, B. (1992, 'Thai Family Structure and Organization Changing Roles and Duties in Historical Perspective', in B. Yoddumnern-Attig, K. Richter, A. Soonthorndnada, C. Sethaput, and A. Pramuatratana (eds.) *Changing Role and Statuses of Women in Thailand*. Nakhon Pathom: Mahidol University, Institute for Population and Social Research.

Appendix

Table A1: The First Stage Instrumental Variable Regression of the 1978 Policy Reform

	Maternal education	Paternal education	Max education
All	0.574***	0.350***	1.092***
	(0.026)	(0.029)	(0.030)
Son	0.690***	0.450***	1.188***
	(0.036)	(0.041)	(0.041)
Daughter	0.464***	0.256***	1.003***
	(0.037)	(0.042)	(0.042)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

Table A2: Estimated Results from Controlling for Children's Birth Year Cohorts

	(1) IV_mom	(2) IV_dad	(3) IV_max
Maternal years of schooling	4.269***		
	(0.177)		
Paternal years of schooling		3.778***	
		(0.151)	
Max years of schooling			3.716***
			(0.149)
Age	–0.129***	–0.157***	–0.148***
	(0.018)	(0.017)	(0.018)
Family size	0.784***	0.690***	0.733***
	(0.057)	(0.052)	(0.054)
Maternal age	0.0735***		0.0281**
	(0.010)		(0.013)
Paternal age		0.136***	0.107***
		(0.010)	(0.012)
Control for birth year cohorts	Yes	Yes	Yes
Control for regional dummies	Yes	Yes	Yes
Control for gender: male as the basis for comparison:			
Female	0.624***	0.200	0.185
	–0.127	–0.131	–0.132
Observations	67,230	67,230	67,230

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

Table A3: Estimated Results Using the 1960 Policy Reform as the Instrumental Variable

	(1) IV_mom	(2) IV_dad	(3) IV_max
Maternal years of schooling	1.013***		
	(0.045)		
Paternal years of schooling		1.571***	
		(0.091)	
Max years of schooling			1.459***
			(0.082)
Age	–0.0240***	–0.0687***	–0.0526***
	(0.003)	(0.005)	(0.004)
Family size	–0.122***	0.0471*	0.035
	(0.014)	(0.027)	(0.025)
Maternal age	0.0134***		0.00133
	(0.003)		(0.004)
Paternal age		0.0610***	0.0511***
		(0.005)	(0.005)
Control for regional dummies	Yes	Yes	Yes
Control for gender: male as the basis for comparison:			
Female	1.647***	1.204***	1.234***
	(0.032)	(0.059)	(0.056)
Observations	96,935	96,935	96,935
Wald F stat.	831.55	278.30	300.54
First stage results			
IV	1.022***	0.672***	0.718***
	(0.036)	(0.040)	(0.041)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

Table A4: Estimated Results Using Grandparents' Years of Education as the Instrumental Variable

	(1) IV_mom	(2) IV_dad	(3) IV_max
Maternal years of schooling	0.419***		
	(0.042)		
Paternal years of schooling		0.461***	
		(0.046)	
Max years of schooling			0.433***
			(0.043)
Age	0.00172	–0.0179	–0.00922
	(0.017)	(0.017)	(0.017)
Family size	–0.295***	–0.295***	–0.298***
	(0.035)	(0.035)	(0.034)
Maternal age	0.0138		0.00793
	(0.013)		(0.017)
Paternal age		0.0210*	0.0144
		(0.011)	(0.015)
Control for regional dummies	Yes	Yes	Yes
Control for gender: male as the basis for comparison:			
Female	1.648***	1.576***	1.532***
	(0.124)	(0.124)	(0.124)
Observations	3,218	3,218	3,218

Notes: The test of endogeneity rejects the null hypothesis that variables are exogenous (p-value = 0) for instrumental variable estimations. The Wald F-statistic for IV_mom is 464.72, 312.46 for IV_dad, and 342.15 for IV_max, suggesting that the instrument is not weak.
Source: Author's calculation.

Table A5: Estimated Results on the Effect of Student Loan Program (Using the 1960 Policy Reform as the Instrumental Variable)

	(1) Affected	(2) Not affected
Max years of schooling	1.199***	3.982**
	(0.109)	(1.876)
Age	0.0127	–0.243*
	(0.011)	(0.138)
Family size	–0.0535	0.558
	(0.034)	(0.428)
Maternal age	–0.0165**	0.0652
	(0.008)	(0.045)
Paternal age	0.0344***	0.156*
	(0.007)	(0.081)
Control for regional dummies	Yes	Yes
Control for gender: male as the basis for comparison:		
Female	1.410***	–0.275
	(0.091)	(1.070)
Observations	19,273	15,914

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Author's calculation.

ERIA Discussion Paper Series

No.	Author(s)	Title	Year
2020-26 (no. 353)	Nobuaki YAMASHITA and Trong-Anh TRINH	The Effects of Prenatal Exposure to Plentiful Rainfall on Cognitive Development in Viet Nam	December 2020
2020-25 (no. 352)	Han PHOUMIN, Fukunari KIMURA, and Jun ARIMA	Potential Renewable Hydrogen from Curtailed Electricity for ASEAN's Clean Energy: Policy Implications	November 2020
2020-24 (no.351)	Takahiro AKITA and Sachiko MIYATA	Measuring the Pro-Poorness of Urban and Rural Economic Growth in Indonesia, 2004-2014	November 2020
2020-23 (no.350)	Takahiro ONO and Venkatachalam ANBUMOZHI	Effects of Business Continuity Planning on Reducing Economic Loss due to Natural Disasters	November 2020
2020-22 (no.349)	HAN Phoumin, Fukunari KIMURA and Jun ARIMA	Energy Reality and Emission in ASEAN: Energy Modelling Scenarios and Policy Implications	November 2020
2020-21 (no.348)	Bin NI and Ayako OBASHI	Robotics Technology and Firm-level Employment Adjustment in Japan	November 2020
2020-20 (no.347)	Pavel CHAKRABORTHY and Prachi GUPTA	Does Change in Intellectual Property Rights Induce Demand for Skilled Workers? Evidence from India	November 2020
2020-19 (no.346)	Makoto IKEDA and Thawatchai PALAKHAMARN	Economic Damage from Natural Hazards and Local Disaster Management Plans in Japan and Thailand	October 2020
2020-18 (no. 345)	Tony CAVOLI and Ilke ONUR	Financial Inclusion, Active Bank Accounts and Poverty Reduction in India	October 2020
2020-17 (no. 344)	Rashesh SHRESTHA, Samuel NURSAMSU	Financial Inclusion and Savings in Indonesia	September 2020
2020-16 (no.343)	Kimty SENG	The Poverty-Reducing Effects of Financial Inclusion: Evidence from Cambodia	September 2020
2020-15 (no. 342)	Rajabrata BANERJEE, Ronald DONATO, Admasu Afsaw MARUTA	The Effects of Financial Inclusion on Development Outcomes: New Insights from ASEAN and East Asian Countries	September 2020
2020-14 (no. 341)	Rajabrata BANERJEE and Ronald DONATO	The Composition of Financial Inclusion in ASEAN and East Asia: A New Hybrid Index and Some Stylised Facts	September 2020
2020-13 (no. 340)	Tony CAVOLI and Rashesh SHRESTHA	The Nature and Landscape of Financial Inclusion in Asia	September 2020
2020-12 (no. 339)	Han PHOUMIN, TO Minh Tu, THIM Ly	Sustainable Water Resource Development Scenarios and Water Diplomacy in the Lower Mekong	September 2020

		Basin: Policy Implications	
2020-11 (no. 338)	Kiki VERICO and Mari Elka PANGESTU	The Economic Impact of Globalisation in Indonesia	August 2020
2020-10 (no. 337)	Yuziang YANG and Hongyong ZHANG	The Value-Added Tax Reform and Labour Market Outcomes: Firm-Level Evidence from China	August 2020
2020-09 (no. 336)	Juthathip JONGWANICH, Archanun KOHPAIBOON, Ayako OBASHI	Technological Advancement, Import Penetration, and Labour Markets: Evidence from Thai Manufacturing	August 2020
2020-08 (no. 335)	Duc Anh DANG and Thu Thu VU	Technology Imports and Employment in Developing Countries: Evidence from Viet Nam	August 2020
2020-07 (no. 334)	Hiroaki ISHIWATA, Hiroyuki WADA, Koji SUZUKI, Makoto IKEDA, Naoto TADA	A Quantitative Analysis of Disaster Risk Reduction Investment Effects for Sustainable Development: Indonesia Case Study	June 2020
2020-06 (no. 333)	Dao Ngoc TIEN, Nguyen Quynh HUONG	Assessment of Industrial Cluster Policies in Viet Nam: The Role of Special Economic Zones in Attracting Foreign Direct Investment	June 2020
2020-05 (no. 332)	Ayako OBASHI and Fukunari KIMURA	New Developments in International Production Networks: Impact of Digital Technologies	June 2020
2020-04 (no. 331)	Upalat KORWATANASAKUL, Youngmin BAEK, Adam MAJOE	Analysis of Global Value Chain Participation and the Labour Market in Thailand: A Micro-level Analysis	May 2020
2020-03 (no. 330)	Ha Thi Thanh DOAN and Huong Quynh NGUYEN	Trade Reform and the Evolution of Agglomeration in Vietnamese Manufacturing	April 2020
2020-02 (no. 329)	Kazunobu HAYAKAWA, Tadashi ITO, Shujiro URATA	Labour Market Impacts of Import Penetration from China and Regional Trade Agreement Partners: The Case of Japan	April 2020
2020-01 (no. 328)	Fukunari KIMURA, Shandre Mugan THANGAVELU, Dionisius A. NARJOKO, Christopher FINDLAY	Pandemic (COVID-19) Policy, Regional Cooperation, and the Emerging Global Production Network	April 2020

ERIA discussion papers from the previous years can be found at:

http://www.eria.org/publications/category/discussion-papers