ESSAYS IN APPLIED MICROECONOMICS

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Abstract

My thesis includes three chapters in applied microeconomics. Chapter 1 provides evidence on the multigenerational impacts of educational expansion in Vietnam. The expansion raises schooling years and educational levels, literacy, non-agricultural economic activity, earnings as well as the intergenerational educational mobility while it improves marriage rates and fertility at an extensive margin, but reduces fertility at the intensive margin for the *directly affected generation*. It also improves human capital investments for the *children* of the directly affected generation and the general health of the *parents* of the directly affected generation.

Chapter 2 examines the causal effect of cultural heritage on modern-day educational success focusing on Confucian culture in Vietnam. The results show robust positive effects of longer historical exposure to Confucian culture on schooling years and degree achievements for adults as well as school enrollment and standardised test scores for children. These effects are found to work through increases in a positive preference and towards schooling and a belief about the importance of obtaining high education as well as increased educational investments.

Chapter 3 explores the effect of a welfare reform on mental health by estimating the effect of entering unemployment and claiming Universal Credit (UC) on mental health in the United Kingdom. The results show that the welfare reform under the UC system exaggerates mental health problems of unemployed individuals. The mediation analysis reveals that the indirect effects via changes in two mediators including a cut in income and a reduction in the number of benefits claimed contribute to about 15% of the total treatment effect. These findings suggest that the costs of a welfare reform are underestimated if the mental health costs are not taken into account.

To my beloved family

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Declaration

I certify that the thesis I have presented for examination for the PhD degree in economics of the University of York is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it). This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

I confirm that Chapter 1 is jointly co-authored with Thomas Cornelissen, and I contributed 50% of this work.

I confirm that I am the sole author of Chapter 2.

I confirm that Chapter 3 is jointly co-authored with Mike Brewer and Emma Tominey, and I contributed 50% of this work.

Thang Dinh Dang

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Introduction

This thesis comprises three chapters in applied microeconomics. The first two chapters contribute to the economics of education by studying the causes and consequences of schooling using the data and context from a developing country, Vietnam. The third chapter contributes to the public and health economics literature by exploring the relationship between welfare reform and mental health using the policy context and data from a developed country, the United Kingdom.

Policymakers around the world strongly believe that education can be a powerful tool for fighting against poverty and improving human well-being (World Bank, 2018). Governments and international organisations have spent enormous resources to improve educational attainment worldwide, especially in developing countries where there is still a relatively low schooling level compared to developed countries. An annual public expenditure of nearly one trillion USD has been invested by governments from developing countries on education, making considerable progress in improving educational attainment in many parts of the poor world over the last few decades (Glewwe and Muralidharan, 2016; World Bank, 2018). However, despite such an improvement, many poorest regions such as Sub-Saharan Africa still face a high rate of school dropouts even for the fundamental level of primary education. Only 40 over 145 developing countries completed the goal of universal primary education in 2015 when the United Nation's Millennium Development Goals was completed (World Bank, 2016). The recent statistics still indicate a very low level of school attendance, for example, only 59% of primary school completion in low-income countries (UNESCO, 2019) and about 260 million school-aged children were not at school in 2018 (World Bank, 2018).

Many governments and international organisations believe that delivering educational policies and programmes that create considerable educational expansion in developing

countries is essential in the years to come. One important question asks whether it is worth implementing such policies and programmes. In other words, how large are the benefits of educational expansion? Comprehensive answers to these questions would provide insights into the rationale for implementing educational policies and programmes.

The returns to schooling in general and the benefits of exposure to an educational expansion, in particular, has traditionally focused on the private benefits of those who are directly exposed to schooling. Economists traditionally focused on wage or earnings when looking at the relationship between education and economic outcomes using the canonical Mincer equation (Mincer, 1974). Although the Mincer approach was very abstract in capturing the reliable causal link between schooling and earnings, it has placed a very crucial cornerstone for studying the returns to schooling which has become an important topic in labour economics (Lemieux, 2006). Over the last two decades, the economics literature has witnessed the development of econometric methods combined with improved-quality data that help push forward our understanding of the causal effects of schooling (Card, 2001). Moreover, economists have expanded knowledge about the individual benefits of schooling by investigating the effects on different non-economic outcomes that go beyond labour markets outcomes such as family, health, political and criminal outcomes. The literature has shown that education creates huge benefits such as stable marriage, reduced fertility, reduced mortality, increased health, increased political participation, and reduced criminal activities. These findings provide a rationale for delivering schooling to all children to achieve the goals of poverty reduction and improved human wellbeing.

However, it would be a fundamental mistake if the returns to schooling are only drawn on the individual benefits. This is because education might generate the intergenerational spillover effects on other generations such as the children's generation (Currie and Moretti, 2003; Suhonen and Karhunen, 2019) and the parents' generation (De Neve and Fink, 2018;

Lundborg and Majlesi, 2018; Ma, 2019). Although the private benefits of schooling have been well-documented in economics, little is known about the intergenerational benefits, especially those running from children's education to parental outcomes. Given a fact that the family is a key peer group within which the spillovers of education can eventuate (Kuziemko, 2014), studying the intergenerational benefits in addition to the individual benefits of schooling would provide more comprehensive insights into the returns to schooling. Chapter 1 aims to fulfil this research gap by providing evidence on the multigenerational impacts of educational expansion in Vietnam. To the best of my knowledge, Chapter 1 provides the first comprehensive evaluation of the causal effects of an educational policy on various outcomes of three generations: the directly affected generation, the children's generation, and the parents' generation. I particularly exploit the 1991 compulsory schooling reform that mandated children aged 14 and younger to complete primary school to create the treatment and control groups for the educational expansion. The reform led to heterogeneity in increases in primary school completion across regions in which the expansion would be stronger for the regions with a low pre-reform level of primary school completion than for those with already a high level of primary school completion before the reform came into effect. The nature of changes in primary educational attainment induced by the reform allows me to construct a set of treatment regions that had experienced large changes in primary school completion and a set of control regions with little or no changes in primary school completion. I then apply a difference-in-difference method for the estimation using a combination of large-scale Census and household survey data.

The results in Chapter 1 show that exposure to the educational expansion improves the schooling outcomes such as the probability of completing primary and lower secondary school for the directly affected generation. It also improves economic outcomes such as literacy skills, non-agricultural economic activities, earnings, and family outcomes such as the probability of

being married, the schooling of marital partners, residential stability for the directly affected generation. Moreover, the educational expansion increases the likelihood of having a child but reduces the number of children for a woman who was directly exposed to the reform. Importantly, the educational expansion exposure helps promote intergenerational educational mobility for the directly affected generations. Chapter 1 further reveals that the benefits of exposure to the educational expansion in Vietnam can reach both the next and previous generations. School-aged children of the reform-exposed parents enjoy a higher probability of school enrolment and larger investments in school and learning activities than children of the parents who were not affected by the reform. I also find a considerable reduction in child labour which can be treated as a human capital investment in the context of developing countries for children of the reform-exposed parents compared to the counterpart children. The directly affected generation's reform exposure further improves the health of their parents in old age such as reduced sick days and improved self-reported health. These effects mainly work through increased financial resources, increased access to better health insurance and decreased unhealthy behaviours for old age parents of the directly affected generation. By showing the positive effects of an educational policy on three generations, Chapter 1 shows that the returns to education might be considerably larger than what we have previously understood. The larger benefits an educational policy generates can be a more convincing rationale for implement educational policies and programmes worldwide, especially in developing countries as an effort to fight against poverty and to improve human welfare.

Given the huge benefits of education, understanding its causes is of importance for initiating efficient related policies. Economists have long been interested in exploring factors deciding educational outcomes such as family background (Björklund and Salvanes, 2011; Black et al., 2005; Dizon-Ross, 2019), school quality and resources (Case and Deaton, 1999; PopEleches and Urquiola, 2013; Laliberté, 2021), policies and interventions (Meghir and

Palme, 2005; Angrist and Krueger, 1991), technology (Muralidharan et al., 2019), neighbourhood effects (Åslund et al., 2011), public welfare programmes (Aizer et al., 2016), and environmental factors (Ebenstein et al., 2016). While Chapter 1 focuses on the role of a compulsory schooling policy in promoting educational attainment among school-aged children in Vietnam, Chapter 2 moves to another potential factor in explaining disparities in schooling outcomes that is culture. While culture has been long discussed as a key determinant of schooling by researchers from other social science disciplines, it has been recently received an increasing interest among economists. However, disentangling the causal paths of the cultural effects can be challenging as numerous aspects including but not limited to genetics, family background and socio-economic characteristics, and natural conditions among other unobservable factors can also determine schooling outcomes (Becker et al., 2020). Chapter 2 aims to answer the questions of whether and how a historical pro-schooling culture causally affects educational attainment and academic performance in present-day society. Answering these questions would help understand inequalities in schooling across socio-demographic groups or across regions both within and across countries. The questions would also provide policy implications in the sense that if culture matters for schooling, policymakers can deliver some interventions helping develop or foster positive beliefs or preferences towards schooling, especially for socio-economic groups or geographic regions with traditionally less focus on education.

To study the cultural determinants of schooling in Chapter 2, I examine the causal effects of Confucian cultural heritage on educational outcomes in Vietnam. Confucianism is well known for valuing education. During the historical times, Confucianism inspired historical states to develop meritocratic institutions using academic performance on imperial civic examinations to recruit and allocate public servants. Educational achievement, therefore, played a very fundamental role in deciding whether a person, regardless of their initial status

such as social class or family background, would become a state bureaucrat and enjoy huge benefits from this career. The coevolution between Confucianism and exam-based meritocracy helped root Confucian values on schooling into local societies and importantly transmit these values across generations making them influentially alive in present-day societies.

To identify the causality of the relationship between Confucian cultural heritage and modern-day educational success, Chapter 2 exploits a unique territorial expansion of pre-modern Vietnam in which the spread of Confucianism and meritocratic institutions was staggered across locations over time. Historical Vietnam with Confucianism was initially located in Northern Vietnam today. The historical state of Vietnam known as Dai Viet gradually expanded its territory between the 11th and 19th century from the North to the South, exporting Confucian culture into newly conquered lands. This process induced differences in historical exposure to Confucian culture across locations from the North to the South of modern-day Vietnam. Moreover, to control for potential confounding factors, that is a region with a stronger influence of Confucianism also differs from other regions by climate and socioeconomic characteristics, Chapter 2 employs a spatial regression discontinuity design and focuses on a narrow geographic area around the second-to-last historical boundary, which was established in 1698. The 1698 boundary divided the surrounding area into two geographic parts: one part with 160 years of historical exposure to Confucianism and meritocracy and another part with only 25 years of exposure. I particularly compare a schooling outcome in regions with 160 years of exposure to the outcome in regions with 25 years of exposure.

The results in Chapter 2 show that longer exposure improves educational attainment and degree achievement for adults, and also improves post-compulsory enrolment and standardised test scores for children. For the main mechanisms, the results indicate that people exposed to Confucian culture have a higher preference for having better educational attainment and they are more likely to have a belief about the importance of access to higher education beyond

compulsory schooling. Chapter 2 further shows the positive causal effects of Confucian culture on investments in children's school and learning activities. Moreover, I find that Confucian culture promotes intergenerational schooling mobility by reducing the dependence of child schooling on parental schooling. Chapter 2 would contribute to a limited but growing literature in economics studying the causal effects of culture on education. Previous studies mostly focus on cultural practices such as bequest and marriage norms but my research is more interested in the direct values and beliefs towards education. My findings also help understand cross-country differences in educational outcomes by focusing on a pro-schooling culture. Finally, my research relates to the literature of the long-run effects of historical institutions on economic development by showing the importance of the meritocratic character of historical institutions which has been ignored from the economics literature.

Importantly, Chapter 1 and Chapter 2 reveal the moderating roles of compulsory schooling laws and culture in reducing the dependence of inequality in schooling across generations. These findings contribute to the growing literature on the determinants of intergenerational mobility (Bütikofer and Salvanes, 2020; Bütikofer et al., 2018; Carneiro et al., 2021; Chetty and Hendren, 2018a, 2018b; Chetty et al. 2014; Chetty et al. 2017a; Chetty et al., 2017b; Chetty et al., 2020).

While the two first chapters of my thesis focus on the causes and consequences of schooling in Vietnam, Chapter 3 investigates the effect of a welfare reform on mental health using data from the United Kingdom. Welfare reform comes up regularly on the agenda of many governments around the world as tax-benefit systems adjust to changing economic conditions. Understanding the costs and benefits of a welfare reform is crucial for policy makers who plan changes to existing social benefit systems. On the one hand, a welfare reform is expected to make the social benefits system more efficient in protecting vulnerable people from negative shocks, encouraging those from a low socio-economic background to join the labour

market, reducing poverty rates, and using public resources economically. On the other hand, there are the reform costs, including unintended consequeces of poor mental health and crime (d'Este and Harvey, 2020; Giulietti and McConnell, 2020; Tuttle, 2019; Watson et al., 2019). This has sparked a debate on whether the benefits of a welfare reform sufficiently outweigh the costs (Blank, 1997, 2002).

Chapter 3 provides evidence on the mental health costs of implementation of a new welfare system - Universal Credit (UC) - in the UK. The aim of this chapter is not only to estimate the effect of entering unemployment and claiming UC on mental health but also to decompose the main treatment effect into the direct effect and the indirect effects working through various mediators. The UK Welfare Reform Act 2012 introduced UC, which has been recognised as the most radical social security reform over the last 60 years of British history, replacing the existing "legacy" system (Dwyer and Wright, 2014). This vital overhaul of the welfare system was implemented by simplyfing the applications of six legacy benefits (including Income Support, Income Based Jobseeker's Allowance, Income-Related Employment Support Allowance, Housing Benefit, Child Tax Credit and Working Tax Credit) into only one application of UC. This simplification may reduce the adminstrative procedures and also time for claimants' benefit application, but in contrast it may trigger financial difficulties for claimaints due to the loss of the application diversity, that is if a claimant were to fail in applying UC he would have no other sources of benefit income. There is also a considerable increase in the digitalisation level of the application procedure (for example, using apps in mobile phones, managing applications via a computer) under UC compared to the former legacy system. These changes in the application procedures likely have impacts on claimants' mental health. Furthermore, there are changes in the payment, including the way from weekly or bimonthly to monthly leading to at least 5 weeks between approval and payment, and paying benefits for housing and council tax to the claimant rather than the tenant

or council. All these changes in the payment are likely to cause changes in income claimants can receive. Equally importantly, unemployed or low income claimants must meet work-related requirements that mandated to fulfill intensive job search of up to 30 hours per week among others. All changes in policy rules under the new UC system potentially affect the mental health of claimants.

The results in Chapter 3 show that claiming UC has a negative impact on the mental health for unemployed individuals compared to claiming previous legacy benefits. Entering unemployment under the UC system has a worse mental health than under the legacy system by 26% of a standard deviation of the poor mental health score. The mediation analysis finds that the indirect effects via a reduction in income and the number of benefits claimed can explain up to 15% of the total treatment effect. These findings indicate a considerable mental health cost of the UC welfare reform in the UK.

Chapter 1

The Multigenerational Impacts of Educational Expansion: Evidence from Vietnam

This chapter is jointly co-authored with Thomas Cornelissen

Abstract

We exploit a compulsory schooling reform in Vietnam to investigate the multigenerational effects of public primary school expansion. In the directly affected generation, the expansion increases educational attainment, literacy, non-agricultural economic activity, earnings and the intergenerational educational mobility. It increases marriage rates and fertility at the extensive margin but reduces fertility at the intensive margin. The expansion increases human capital investments in the children of the directly affected generation, with increased educational expenditures, school enrolment, and health investments, and a reduction in child labour. Finally, the expansion improves the health in old age of the parents of the directly affected generation. They benefit from improved general health, but not mental health, as well as improved financial resources, access to private health insurance and reduced alcohol consumption.

JEL codes: I15, I21, I25, I26, I28, J13, J14, J21, J22, J24, O12, N35

Keywords: Primary school expansion; Compulsory schooling; Multigenerational impacts; Intergenerational spillovers; Human capital investments; Child labour; Old age health; Vietnam

1.1 Introduction

Expansion and promotion of primary schooling have been shown to affect long-term individual economic and financial outcomes (Duflo, 2001; Ajayi and Ross, 2020), fertility decisions (Keats, 2018; Osili and Long, 2008), political engagement (Larreguy and Marshall, 2017), and pro-social behaviors (Chankrajang and Muttarak, 2017), amongst others.[1] Yet, due to spillovers and external effects of education, the *full* social returns of such policies could be far higher than this literature suggests with impacts going far beyond the generally well-documented effects on the individuals directly affected by the policy change. In particular, given that the *family* is an important peer group within which spillovers of education policies are likely to materialize (Kuziemko, 2014), educational expansion is likely to have impacts on the children of the directly affected generation (*downward* intergenerational spillovers) and on their parents (*upward* intergenerational spillovers; De Neve and Kawachi, 2017).

Downward intergenerational spillovers are suggested by a large body of literature documenting a strong dependence of educational attainment and success later in life on parental education and family background (Björklund and Salvanes, 2011; Black and Devereux, 2011; Carneiro et al., 2013; Currie and Moretti, 2003; Holmlund et al., 2011; Lundborg et al., 2014), although the precise degree of causality is a matter of debate and varies by context (Holmlund et al., 2011). Evidence is also starting to accumulate about the effects of parental education on children's long-run health outcomes (Huebener 2018, 2019; Lundborg et al., 2014).

Upward intergenerational spillovers have been less well documented. But several arguments suggest that children's education may affect parental health and well-being in old

[1] A related strand of the literature analyzes the effect of policies to promote primary schooling on primary school enrolment and completion (Deininger, 2003; Lucas and Mbiti, 2012). There is also a large literature documenting the effects of compulsory schooling laws in developed countries (see Angrist and Krueger, 1991; Harmon and Walker, 1995; Devereux and Hart, 2010; Black et al., 2008; Oreopoulos et al., 2006), in which these compulsory schooling laws usually operate at the secondary school level rather than the primary school level as is often the case in developing countries.

age through several channels. First, well-educated children might invest greater resources to improve their parents' living standards (Friedman and Mare, 2014; Lavy et al., 1996). Second, higher educated children may provide their parents with more knowledgeable advice or help to make better decisions about healthcare, nutrition, lifestyle choices, and access to social services (Berniell et al., 2013; Kuziemko, 2014; Lundborg and Majlesi, 2018). Third, well-educated offspring may positively influence their parents' health behaviors, lifestyles and attitudes (Friedman and Mare, 2014; Torssander, 2013). Finally, parents of well-educated children may have less necessity to engage in work and may be able to retire earlier. These channels are particularly relevant in lower income countries where parents are more likely to co-reside and to share resources with their adult children (Cameron and Cobb-Clark, 2008; De Neve and Fink, 2018), while social insurance systems are less developed (Bloom et al., 2011), prompting elderly people to work at an advanced age often under poor conditions (Cai et al., 2012; Cameron and Cobb-Clark, 2008). Evidence on such upward spillovers is still scant, and prior estimates of the relationship between children's education and parents' outcomes are mostly correlational rather than causal (De Neve and Harling, 2017; Friedman and Mare, 2014; Torssander, 2013).

In this study, we investigate the multigenerational impacts of educational expansion in a developing country context. We analyze the effects of a compulsory primary schooling reform in Vietnam on individuals of the *directly affected generation*, investments in the human capital of their *children*, and health outcomes in old age of their *parents*. The reform, introduced in 1991, mandated for the first time that Vietnamese children aged 14 or younger complete at least five years of primary education. The reform strongly increased primary school completion in regions with initially low levels of primary schooling (i.e., treatment regions), but had little impact in regions in which primary school completion was already high (i.e., control regions). The identification strategy consists of a difference-in-differences estimator based on a combination of large-scale data from Vietnam's 2009 Population and Housing Census, several

waves of the Vietnam Household Living Standards Survey and the 2011 Vietnam Aging Survey.

We find that the reform has a strong positive effect of 10 percentage points on primary and secondary school completion of the *directly affected cohorts*. Through this effect, the reform increases the intergenerational educational mobility. Reform exposure also increases literacy, economic activity outside the agricultural sector, and earnings. It raises residential stability, the probability of being married, the level of education of the marital partner, and increases fertility at the extensive margin, while reducing it at the intensive margin. In terms of *downward spillovers*, we find effects on the directly affected cohorts' investments in their *children's* human capital. The results indicate that parental exposure to the reform raises children's school enrolment at ages 6-17 by about 9 percentage points. Spending on tuition fees increases by 14-24% of a standard deviation and other education-related spending, such as on books and learning materials, by 14-20% of a standard deviation. Moreover, we find evidence for an increase in health investments, with higher per capita food consumption, less exposure to smoking in the household, and more expenditure on preventive health visits in the private health sector, resulting in fewer hospitalizations. We further find a reduction in child labour, suggesting that downward intergenerational spillover effects or primary school expansion may be particularly beneficial in developing countries. Heterogeneity analysis by gender reveals that the effects are concentrated more on sons than on daughters. In terms of *upward spillovers*, we find that the primary school expansion improves several measures of general health in old age of the *parents* of the directly affected generation, but no effect on mental health. In terms of potential channels, we document effects on improved financial resources in old age, access to private health insurance and reduced alcohol consumption.

Our contributions are as follows. We provide first comprehensive causal evidence on the multigenerational impacts (including *both* downward and upward intergenerational spillovers)

of primary school expansion. Besides strong educational, financial and economic returns to the directly affected generation, we document important impacts on the next generation's health and human capital and on the previous generation's health. Through these spillovers, enacting and enforcing compulsory schooling laws has high social returns. These findings are particularly policy relevant in low-income countries where primary school enrolment is still far below universal (World Bank, 2016).[2]

Our research contributes to a sparse literature on intergenerational spillover effects in human capital in developing countries (Assaad and Saleh, 2018; Grépin and Bharadwaj, 2015; Hahn et al., 2018; Keats, 2018).[3] The studies most closely related to ours is the work by Akresh et al. (2018) and Mazumder et al. (2019), who investigate downward intergenerational spillovers from primary school construction in Indonesia on educational attainment and health of the second generation. We are able to extend their results by looking at a wider set of second-generation outcomes, including not only school enrolment but also a wide range of household expenditures on education, health outcomes, and child labour. We believe our study to be the first to document effects of parental exposure to primary school expansion on reductions in child labour among their children. Child labour is still widespread in low-income countries with a prevalence rate of roughly 19% (ILO, 2017).[4] While its reduction over the last few decades has been linked to numerous interventions (see Dammert et al., 2018 for a review), our results suggest that improved parental education is an important but so far neglected causal contributor.

[2] As of the end of the United Nation's Millennium Development Goals in 2015, only 40 over 145 developing countries achieved the goal of universal primary education (World Bank, 2016). The recent rates of primary school completion in low-income countries are still very low with only 59% (UNESCO, 2019).

[3] There is also an extensive literature on downward intergenerational spillovers in developed countries (Currie and Moretti, 2003; Dickson et al., 2016; Heckman and Karapakula, 2019a, 2019b; Huebener, 2018, 2019; Lindeboom et al., 2009; Lundborg et al., 2014; Meghir et al., 2012; Oreopoulos et al., 2006).

[4] This compares to an incidence rate of 9% in lower-middle-income countries, 7% in upper-middle-income countries, and 1% in upper-income countries (ILO, 2017). See also Basu (1999) and Edmonds and Pavcnik (2005) for economic surveys on child labour.

Our study also extends a nascent literature on causally identified upward human capital spillovers (De Neve and Fink, 2018; Lundborg and Majlesi, 2018; Ma, 2019; Potente et al., 2020). While Lundborg and Majlesi (2018) and De Neve and Fink (2018) focus on parental survival as the main outcome of interest, in Sweden and Tanzania respectively, Ma (2019) examines the effects on parental health and cognitive ability in China. While these studies tend to find positive effects of children's schooling on parental health, Potente et al. (2020) find limited and small causal effects on parental outcomes of health and mortality in the United Kingdom. We build on these studies by significantly extending the range of outcomes and investigating important channels of the effects.

Furthermore, we make a range of contributions to a wider set of literatures. We contribute to the literature on the determinants of parental investments in children's human capital (Attanasio, 2015; Brown, 2006; Strauss and Thomas, 1995) by showing that exposure to stricter compulsory schooling laws has a causal effect on a range of specific human capital investments. We also complement a comparatively sparse literature on the mediating channels of the intergenerational transmission of education (Carneiro et al., 2013; Piopiunik, 2014) by showing that direct monetary investments in children's health and human capital play an important role in downward intergenerational spillovers.

Furthermore, we contribute to a growing literature documenting substantial heterogeneity in intergenerational social and economic mobility across time (Chetty et al. 2017a), space (Chetty et al. 2014), and socio-economic background (Chetty et al., 2020). Prior research has documented the importance of the neighborhood conditions during childhood (Chetty and Hendren, 2018a, 2018b), type of college education (Chetty et al., 2017b), income shocks (Bütikofer et al., 2018), disease control (Bütikofer and Salvanes, 2020), and the timing of parental income during childhood (Carneiro et al., 2021). Our findings suggest that well-implemented compulsory schooling laws, by equalizing opportunities of access to basic

schooling for all children, increase intergenerational educational mobility.[5] Finally, our findings of the effects of the human capital of the younger generation on the later-life health of parents contributes to a growing literature that seeks to identify a broad range of social and economic determinants of health in old age (Antman, 2010; Atalay et at., 2019; Barnay and Juin, 2016; Bhalotra et al., 2017; Böhme et al., 2015; Case and Paxson, 2009; De Nardi et al., 2009; Fabrizio and Franco, 2017; Fetter and Lockwood, 2018; Salm, 2011).

The remainder of our paper is structured as follows. Section 2 provides the institutional background and data. Section 3 discusses our empirical strategy, and Section 4 presents our results including the main causal effects, heterogeneity and potential mechanisms. Section 5 concludes our paper.

1.2 Institutional background and data

1.2.1 The Vietnamese 1991 compulsory schooling reform

Until 1991, there was no minimum level of compulsory schooling in Vietnam, and primary school completion rates were low and heterogeneous across regions (Glewwe and Jacoby, 1998; National Committee for EFA Assessment, 1999). In order to raise education levels in the economy, the Vietnamese government introduced a law on compulsory schooling, the Law on Universal Primary Education (LUPE). The law came into effect in 1991 and stated that with immediate effect all children aged 14 or younger had to complete five years of primary school. Consequently, children born before 1977 were not affected by the reform, while children born in 1977 and onwards were, in principle, affected. However, the implementation of the reform was "piecemeal rather than comprehensive" across the country, requiring years of preparation (MOET and JICA, 2002). Moreover, children aged 14 or younger in 1991 could have left school

[5] Our results complement findings by Demirel and Okten (2020), who document that an increase in compulsory schooling in Turkey (from 5-8 years) reduced gender differences in intergenerational educational persistence.

already and thus would have been unlikely to return to school even if technically required by the LUPE. Therefore, in our analysis, we allow up to four years for the reform to be effective and define individuals born between 1977 and 1980 as phase-in cohorts. We treat children born in 1981 and onwards as fully exposed to the reform.

The reform triggered substantial investments in primary education (Nguyen, 2004), with a significant increase in public expenditures devoted to constructing new schools, training additional teachers with enhanced qualifications and providing scholarships and financial aid to students from disadvantaged families or remote regions. These investments were financed by a mix of increased contributions and investments by the private sector and international aid from governmental and non-governmental organizations (Dang and Glewwe, 2018; Glewwe and Patrinos, 1999). As a result, infrastructure and human resources employed in primary education in Vietnam expanded considerably. From 1991 to 1998, 11,334 new schools were constructed and close to 50,000 new primary school teachers were hired, leading to an expansion of primary school classes from 262,686 to 316,968 (MOET, 1998).

Due to these developments, primary school attendance increased greatly. The aggregate number of students enrolled in primary school increased from roughly 8.1 million in 1986 to nearly 9.1 million in 1995, and primary school completion rates rose from 81% in 1979 to nearly 100% in the 2000s (World Bank, 2018). Thanks to the reform, primary school enrolment rates in the 2000s were higher in Vietnam than in other comparable countries (Dang and Glewwe, 2018).

1.2.2 Data

Our study is based on three nationally representative data sources for Vietnam. The first data source is a 15% sample of the 2009 Population and Housing Census of Vietnam (hereafter "the Census"). It is one of the largest existing micro datasets for Vietnam, covering 14 million individuals from 3.5 million households. It contains basic information on demographics,

education, employment, mortality and housing. The second data source are the 2010, 2012 and 2014 waves of the Vietnam Household Living Standards Survey (VHLSS). This is a biannual household survey consisting of roughly 40,000 individuals from 9,000 households, drawn from the Census population. The third data source is the 2011 Vietnam Aging Survey (VNAS). It contains information on demographic characteristics, housing and assets, employment, social protection and inclusion, physical and mental health, and emotional well-being from 4,007 individuals aged 50 years old and over from 12 provinces across all of 6 Vietnamese economic zones.

We restrict the Census and VHLSS data to the 1974-1984 birth cohorts to construct our samples of the directly affected generation. From the Census we extract key variables such as birth year, residential location (district and urban indicators) and educational attainment to identify treatment and control regions for our analysis. We further extract a range of outcomes for the directly affected generation from both Census and VHLSS. These consist of educational outcomes (primary and secondary school completion, years of schooling, and literacy), economic outcomes (being economically active, working in a non-agricultural sector, and the logs of real earnings), family outcomes (being lived in the same municipality over the last 5 years, being married, spouse's years of schooling, having at least one child, being experienced child mortality, and number of children conditional on having at least one child), and parental years of schooling (used for exploring intergenerational educational persistence).

To estimate the effect of parental exposure to the reform on investments in their children's human capital, we use the VHLSS and restrict the sample to children aged 6-17 who were born to parents from the 1974-1984 birth cohorts. For these children, we then construct three sets of dependent variables for parental investments in their children's human capital: educational investments, child labour outcomes, and health investments. We extract information on children's school enrolment, parental expenditures on school-related activities (school tuition,

books and learning materials, learning tools and instruments, private tutoring, and total overall spending on education), and expenditures on children's books and maganizes and toys. We use information on children's employment to construct three measures for child labour: working for the household, working for earnings and hours of work for earnings. For investments into children's health, we extract information on household expenditures on food and children's health and healthcare utilization to construct the following outcomes: monthly per capita household spending on food consumption, monthly household spending on tobacco and cigarettes, the child's health insurance coverage, number of preventive health visits, expenditures on preventive health care for public and private health services, and probability of hospitalization over the last 12 months. Monetary expenditures are measured in 1,000 Vietnam Dong (VND) in 2010 prices, with the exchange rate equaling roughly 20,000 VND per 1 U.S. Dollar in 2010.

We use the VNAS to estimate the effects of the reform on the health in old age of the *parents* of the directly affected generation. One of the most important advantages of the VNAS compared to other Vietnamese data surveys is that it includes all children of the respondents, not only co-resident children but also those living outside the household, allowing us to estimate a full sample of children and thus to avoid potential sample selection bias. We exploit information on physical health, mental health, and emotional well-being to construct five measures for the health of the parents in old age over the past 12 months. These include the number days of sickness, self-reported health status (absolute and relative to others in the same age group), depression, sleep problems, and general life satisfaction. We additionally exploit information on household economic conditions and individual behaviors of the parents to construct multiple measures for potential mechanisms used to explain the main effects, spanning from financial mechanisms (dummies for poverty, income and savings, satisfaction with financial status, private health insurance, home improvements) to behavioural health

mechanisms (smoking, drinking, social activities, grandchildren, and the number of children-in-law). We present summary statistics of all variables in Table A.1 in Appendix A.

1.3 Empirical strategy

1.3.1 Definition of treatment and control regions and event study of pre-trends

Before the reform, educational attainment was heterogeneous across different regions in Vietnam (Dang and Glewwe, 2018). This was due to differences in schooling preferences between local populations (Anh et al., 1998) and in regional economic development (Dell et al., 2018; Nguyen et at., 2007). Given that the compulsory schooling law mandated all regions to achieve universal primary schooling, regions with lower initial levels of primary school completion experienced a stronger expansion. Based on this idea, we define treatment regions as those with low initial school enrolments and comparison regions as those with high initial enrolments. We define regions by the interaction of districts with an urban indicator.[6] We then define the initial level of primary education (hereafter "the initial level") as the region's average rate of primary school completion for the 1977 birth cohort using the Census sample. We define treatment regions as those with a below-median initial level and comparison regions as those with an above-median initial level. Among a total of 1,272 included regions, 636 are defined as treatment regions and 636 as comparison regions. For the treatment region definition, and in order to assign treatment status to individuals observed in our data, we rely on the region of residence observed for adults in the respective data waves (between 2009 and 2014) as a proxy for their region of residence when they were at school age. As has been argued by Dell et al. (2018), supported by several empirical sources, residential mobility has traditionally been low in Vietnam. Our own calculations from Census data reveal a 5-year residential mobility rate

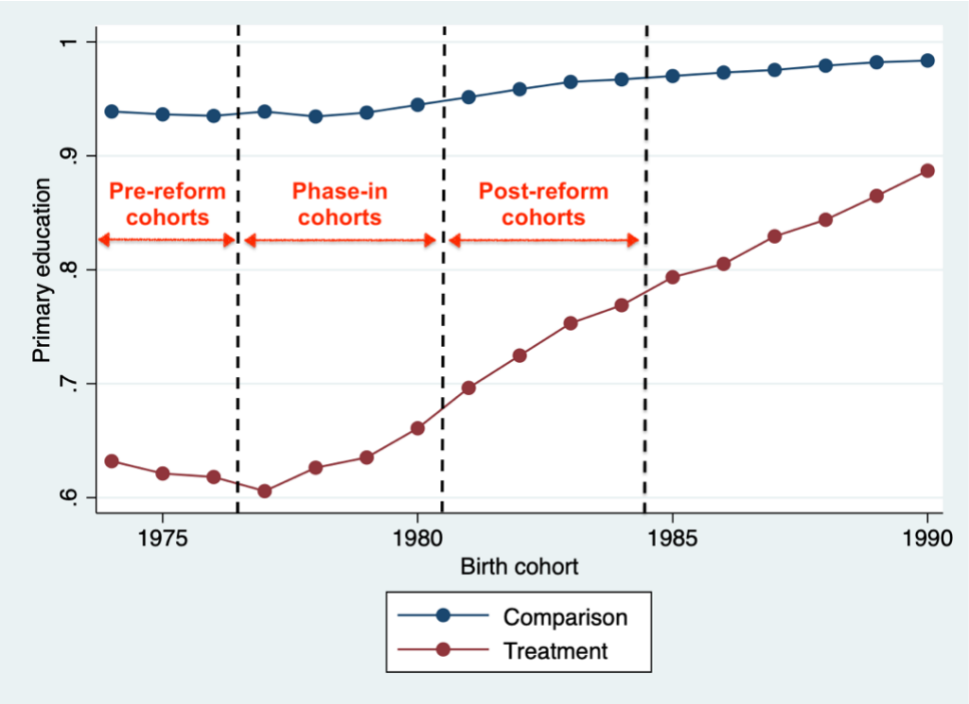
[6] A district is a medium administrative unit in Vietnam, which is smaller than a province but larger than a commune. Vietnam has 696 districts with an average population of roughly 125,000 people (CPHCSC, 2010).

across districts of 6.3%. While this rate does not appear excessively large, and not every move changes the treatment status, it would introduce some misclassification error into our treatment status definition. To the extent that residential mobility is random, we would expect it to cause attenuation bias into our estimates, meaning that we can interpret our results as lower bound estimates.

Figure 1.1 illustrates the evolution of primary school completion rates across the cohorts born from 1974-1990 separately for treatment and comparison regions. The vertical bars illustrate the pre-reform, phase-in and post-reform cohorts, as defined in Section 1.2.1. By definition, comparison regions initially had considerably higher primary schooling rates than treatment regions, but trends are fairly parallel over pre-reform cohorts. However, this pattern gradually changes for cohorts affected by the reform. While rates in comparison regions are highly stable, rates in treatment regions increase considerably from phase-in cohorts to post-reform cohorts and then almost completely catch up with rates in the comparison regions for the youngest cohorts. The primary school completion rate in comparison regions increased by only about 3 percentage points between the pre-reform and post-reform cohorts. However, it increased by about 13 percentage points in the treatment regions, suggesting a difference-in-difference reform impact on primary school completion of roughly 10 percentage points.

Given that we have access to several pre-reform cohorts, we can check for diverging pre-trends using an event study approach. We do this for the primary school completion rate of the directly affected generation, for schooling and child labour outcomes of their children, and health status of their parents. We regress each of the outcomes on treatment status, birth cohort dummies of the directly affected generation, and the corresponding cohort dummies interacted with treatment status (omitting the first phase-in cohort of 1977 as the reference group). For each cohort we then plot the coefficients of the treatment-cohort interaction terms in the event study graphs of Figure 1.2.

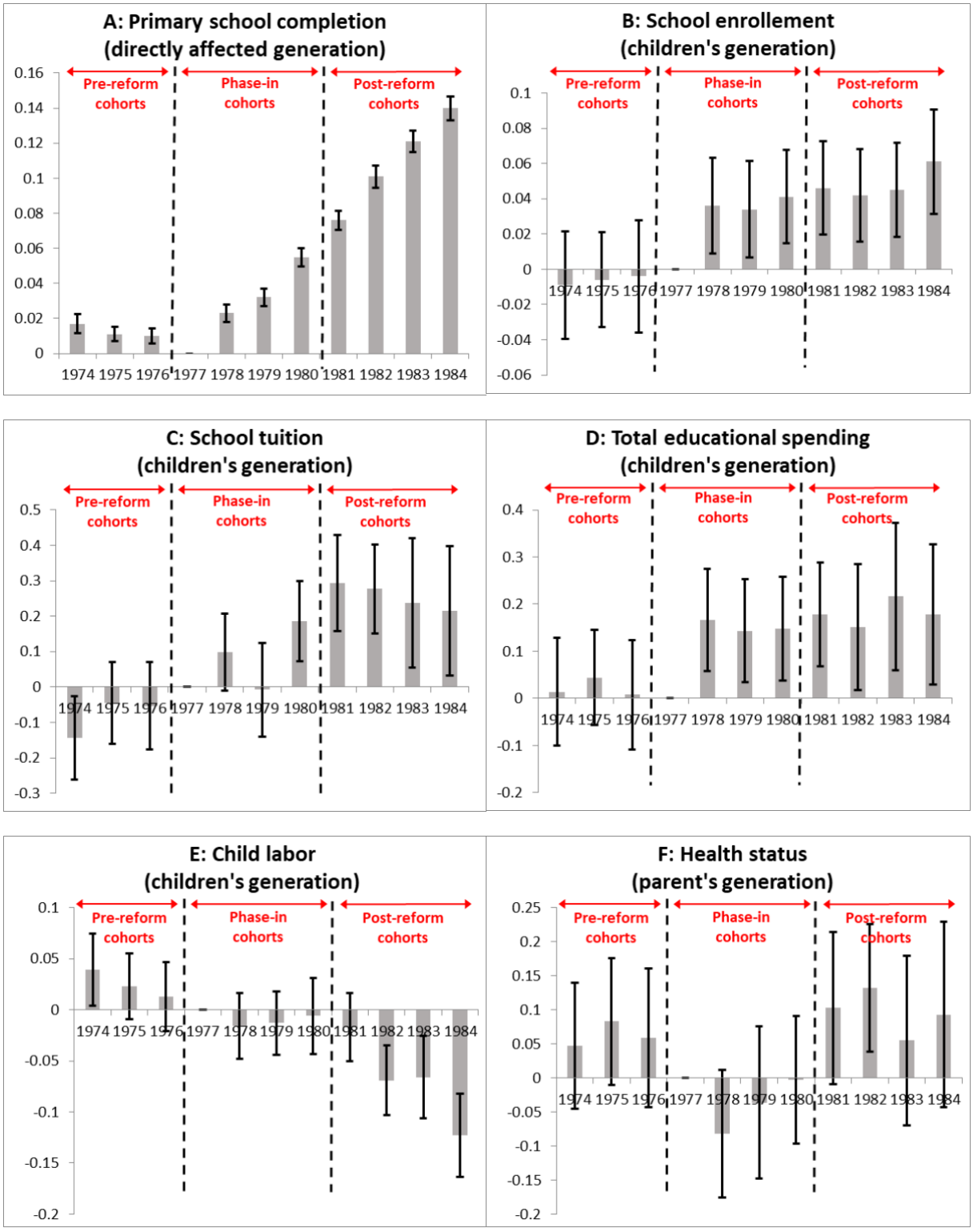
FIGURE 1.1: PRIMARY SCHOOL COMPLETION RATE BY COHORT FOR TREATMENT AND COMPARISON REGIONS



Data source: Population and Housing Census of Vietnam (2009, 15% sample).

Across all outcomes there are small pre-treatment differences, moderate differences opening up in the phase-in cohorts, and more substantial differences emerging in the post-reform cohorts. Importantly, differences in pre-trends are mostly insignificant, with the main exception of the primary school completion rate of the directly affected generation, where even very small differences are statistically significant because of the large sample size of the Census (1.6 million observations). While the absence of strong pre-trends is encouraging, we make our regression models robust against a range of differential trends. As we explain in more detail below, our regressions will allow for cohort dummies to vary by province, and we will show that our results are robust against allowing for differential time trends by rural and urban areas. We further probe the validity of our identification strategy in the next section, and present placebo tests at the end of Section 1.3.3.

FIGURE 1.2: EVENT STUDY GRAPHS



Data source: Population and Housing Census of Vietnam (2009, 15% sample); Vietnam Household Living Standards Survey (2010, 2012 and 2014); Vietnam Aging Survey (2011).

1.3.2 Exogeneity of the treatment

In this section, we provide evidence of how treatment and control regions differ in terms of their observed characteristics. We also conduct balancing tests to check the degree to which the identifying region-by-cohort variation in primary school completion correlates with trends in observables.

Table 1.1 presents the results of cross-sectional, region-level regressions of regions' treatment statuses on their average observed characteristics. These characteristics include the age of the population, the composition of the population in terms of ethnicity and religious affiliation, an urban indicator, and the location of the region in Vietnam's six major economic zones (Southeast, Red River Delta, Mekong River Delta, Northern and Southern Central Coast, Central Highlands and Northern Midlands and Mountains). As expected and by construction, the treatment status of a region is strongly affected by its initial primary school completion rate across all specifications. Among the remaining regressors in column 2, the most significant associations are with the major economic zone dummies, and one ethnicity dummy appears weakly significant. Overall, this suggests relatively few systematic differences in observables apart from the initial primary school completion rate and broad geographic location.

The results in Table 1.1 help us understand how treatment and comparison regions differ. Yet, it is important to note that even if there were differences in time-constant regional characteristics, they would be taken into account by our difference-in-difference identification strategy in which we condition on region and cohort fixed effects (see Section 1.3.3).

In the following we establish that the differential expansion of primary school completion across regions, which we use to identify the reform effect, is unrelated to trends in other observables. For this purpose, we regress the region-by-cohort share of primary school completion on region-by-cohort specific observables, conditioning on cohort and region fixed effects. Given that the Census data is from 2009, we must be careful not use observables that

are likely to be outcomes of the reform, such as education, earnings or employment. We therefore use demographic characteristics of ethnicity and religious affiliation that can change in a region over time but are unlikely to change at the individual level in response to the reform.

TABLE 1.1: DETERMINANTS OF THE TREATMENT STATUS

	(1)	(2)
Initial level of primary education (percent)	-2.19928***	-1.99516***
	(0.03799)	(0.075384)
Age (years)		0.03102
		(0.02719)
Rural (dummy)		0.00008
		(0.00017)
Kinh ethnicity (percent)		-0.00041
		(0.00062)
Tay ethnicity (percent)		0.00214**
		(0.00101)
Thai ethnicity (percent)		0.00068
		(0.00071)
Other ethnicities (percent)		reference
Buddhism affiliation (percent)		-0.00139
		(0.00091)
Other religious affiliations (percent)		0.00114
		(0.00077)
No religious affiliation (percent)		reference
Southeast (dummy)		0.00148***
		(0.00039)
Red River Delta (dummy)		-0.00008
		(0.00024)
Mekong River Delta (dummy)		0.00190***
		(0.00038)
Northern and Southern Central Coast (dummy)		0.00067***
		(0.00025)
Central Highlands (dummy)		0.00159***
		(0.00036)
Northern Midlands and Mountains (dummy)		reference
Constant	2.21983***	1.07733
	(0.03211)	(0.80133)
Observations	1,272	1,272

Notes: This table reports a regression of treatment region status (dummy) on the initial level of primary education for the 1977 cohort (column 1), and some regional characteristics (column2). The initial level of primary education is measured by the primary education completion rate for the 1977 cohort. Observations are at the regional level. Robust standard errors clustered at the district level are in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Data source: Population and Housing Census of Vietnam (2009, 15% sample)

As shown in Table 1.2, the only covariate that is statistically significantly correlated with the region-by-cohort share of primary school completion is the Tay ethnicity. Yet, this is with such a negligibly small effect size that it is unlikely to be of practical relevance.[7] We thus conclude that our identifying variation is not related to demographic trends in ethnicity or religious affiliation. We discuss further placebo tests and robustness checks to underpin the causal interpretation of our results at the end of the following section.

TABLE 1.2: BALANCING TEST

Dep. variable: Region-by-cohort share of primary school completion	
Kinh ethnicity (percent)	0.00009
	(0.00023)
Tay ethnicity (percent)	-0.00154**
	(0.00061)
Thai ethnicity (percent)	-0.00039
	(0.00039)
Other ethnicities (percent)	reference
Buddhism affiliation (percent)	0.00013
	(0.0003)
Other religious affiliations (percent)	-0.00062
	(0.0004)
No religious affiliation (percent)	reference
Constant	0.75196***
	(0.02041)
Dummies for cohorts	Yes
Dummies for regions	Yes
p-value for joint significance of covariates	0.3141
Observations	13,990

Notes: Observations are measured at the region-by-cohort level for individuals of the birth cohorts 1974-1984. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Population and Housing Census of Vietnam (2009, 15% sample)

[7] In 98% of the regions, the Tay ethnicity share changed by less than 6 percentage points between the pre-reform cohorts (1981-1984) and the post-reform cohorts (1974-1976). The coefficients of -0.0015 (Table 1.2) would suggest that the extreme event of a 6-percentage point increase in the Tay ethnicity share would affect the primary school completion rate by only 0.9 percentage points (-0.0015*6=-0.009), which is about one tenth of the reform effect we show in Table 1.3.

1.3.3 Estimation methods

Our empirical strategy is based on generalized difference-in-differences regressions that compare across regions and cohorts, controlling for region and cohort effects, and letting cohort effects vary across provinces. The implementation of the regression differs according to whether we estimate effects on the generation directly affected by the reform, their children's generation, or their parents' generation. The three respective approaches are the following.

Effects on individuals from the directly affected generation

For an outcome Y_{irct}, such as primary school completion, of an individual i of the directly affected generation, living in region r within province $p(r)$, belonging to birth cohort c, and surveyed in year t, we run the regression:

$$\begin{aligned} Y_{irct} = \quad & \alpha_1 + \alpha_2 Treat_{ir} \times Phasein_{ic} + \alpha_3 Treat_{ir} \times Post_{ic} + \alpha_4 \boldsymbol{X'}_{irct} \\ & + \theta_t + \varphi_r + \omega_c \times \pi_{p(r)} + \zeta_{irct} \end{aligned} \quad (1.1).$$

$Treat_{ir}$ is a dummy variable indicating whether region r where individual i lives is a treatment region. $Phasein_{ic}$ is a dummy variable indicating whether the individual belongs to the phase-in birth cohort (1977-1980). $Post_{ic}$ is a dummy variable indicating whether the individual belongs to the post-reform birth cohort (1981-1984). $\boldsymbol{X'}_{irct}$ is a control vector for individual characteristics, including dummies for gender and ethnicity (Kinh, Tay, Thai and other ethnicities). For the Census data, we also add religious affiliations (Buddhism, other religions and no religions) into the set of controls. θ_t, φ_r and ω_c are fixed effects for the survey year, region and birth cohort, $\pi_{p(r)}$ are dummies for 63 provinces, and ζ_{irct} is the error term. The survey year fixed effect θ_t controls for potential time trends across survey years, and is dropped in specifications using the Census data consisting of one year only. The region fixed effect φ_r controls for time-invariant regional characteristics and the birth cohort fixed effect ω_c controls for cohort trends in the outcome. The joint inclusion of region and cohort fixed effects turns Equation (1.1) into a generalized difference-in-differences regression, in which α_3 is the effect

of exposure to the reform on the outcome. The interaction of birth cohort with province dummies, $\omega_c \times \pi_{p(r)}$, allows trends across cohorts to vary in unrestricted ways across provinces.

Effects on the children of directly affected individuals

To explore how reform exposure of individuals affects their *children*, indexed j, we focus on children observed in the VHLSS survey in year t (2010, 2012 and 2014). We run regressions of the type:

$$Y_{jrt} = \beta_1 + \beta_2 Treat_{jr} \times ParentPhasein_j + \beta_3 Treat_{jr} \times ParentPost_j + \beta_4 \boldsymbol{X'}_{jrt} + \theta_t + \varphi_r + \omega^{cm} \times \pi_{p(r)} + \omega^{cp} \times \pi_{p(r)} + \varepsilon_{jrt} \quad (1.2).$$

Y_{jrt} is an outcome, such as an investment into child j's human capital. $\boldsymbol{X'}_{jrt}$ includes ethnicity, age, age squared and gender of the child. ε_{jrt} is the error term. As before, $Treat_{jr}$ is a dummy variable indicating whether region r where child j lives is a treatment region. $ParentPhasein_j$ is a dummy variable indicating whether *at least one of the parents* of child j belongs to the phase-in birth cohort (1977-1980). $ParentPost_{ic}$ is a dummy variable indicating whether *at least one of the parents* of child j belongs to the post-reform birth cohort (1981-1984). θ_t and φ_r are survey year and region fixed effects. Maternal birth cohort fixed effects, ω^{cm}, and paternal birth cohort fixed effects, ω^{cp}, are interacted with province dummies $\pi_{p(r)}$. To avoid losing children in single-parent households, we imputed the maternal/paternal birth cohort variable of a missing parent by setting it to a mid-point value (1980), and introduced two dummies in $\boldsymbol{X'}_{jrt}$ indicating the observations with a missing value for maternal or paternal birth cohort (which applies to 4.5% of the children's sample).

We specify treatment as *at least one of the parents* being exposed to the reform, instead of separate indicators for father being exposed and mother being exposed, for the following reasons. First, our indicator can be constructed for single-parent households. Second, maternal

and paternal exposure do not have a lot of independent variation. In 80 percent of families in our sample, the husband is older than the wife, implying that if the father is treated, the then the mother is in most cases also treated.[8]

We ruled out using separate samples of mother-child pairs and father-child pairs to get separate estimates of maternal of paternal exposure, because these estimates would be confounded by the exposure of the respective other parent, which would act as an omitted variable in this approach. We also ruled out pooling together mother-child pairs and father-child pairs into a combined sample, as this would have inflated our numbers of observations by double-counting children of two-parent households.

Effects on the parents of directly affected individuals

To explore how reform exposure of individuals affects their *parents*, indexed k, we focus on parents from the 2011 VNAS survey who have at least one child born in the 1974-1984 period. We run regressions of the type:

$$Y_{krc} = \gamma_1 + \gamma_2 Treat_{kr} \times ChildPhasein_k + \gamma_3 Treat_{kr} \times ChildPost_k + \gamma_4 \boldsymbol{X'}_{krc} + \varphi_r + \omega_c \times \pi_{p(r)} + \sum_{\tau} \rho_\tau NC_\tau + \epsilon_{krc} \quad (1.3).$$

Y_{krc} is an outcome, such as health status of a parent k. $\boldsymbol{X'}_{krc}$ includes ethnicity and gender of the parent, and ϵ_{krc} is the error term. As before, $Treat_{jr}$ is a dummy variable indicating whether region r where parent k lives is a treatment region. $ChildPhasein_k$ is a dummy variable indicating whether *at least one of the children* of parent k belongs to the phase-in birth cohort (1977-1980). $ChildPost_k$ is a dummy variable indicating whether *at least one of the children* of parent k belongs to the post-reform birth cohorts (1981-1984). As before, φ_r are region fixed

[8] We tried the approach of including 'one parent treated' and 'both parents treated' variables and did not find evidence that effects amplify if both parents are treated. However, interpretation is complicated by the fact that the indicator for both parents being treated is highly collinear with a maternal treatment indicator. Ideally, one would want to estimate separate effects for: only the father being treated, only the mother being treated, and both parents being treated. But these indicators do not have sufficient independent variation in our sample.

effects, and $\omega_c \times \pi_{p(r)}$ is an interaction between parent k's birth cohort and province dummies.[9] Finally, NC_τ is the number of children born in year τ to control for family size and age structure of the children, with associated regression coefficients ρ_τ.[10]

For most variables in our analysis, missing values are rare, and we therefore proceed with a complete case analysis. The only exceptions are information on income from the VHLSS and information on parents' occupations from the Census. For these two variables, substantial shares of observations are missing, and we impute missing values with the mean value. This imputation cannot drive any of the reform effects because the mean of the variable is absorbed by the regression constant. However, the imputation has the advantage of making use of the full sample for the other variables in the regression model.

For a more straightforward interpretation of the regression analysis, unless otherwise stated, we standardise continuous variables with a mean of 0 and a standard deviation of 1. Moreover, standard errors are clustered at the district level to account for potential correlations across birth cohorts within the same district (Bertrand et al., 2004). For effects with a clear prediction of their sign from economic theory, we use one-sided hypothesis testing (Heckman and Karapakula, 2019a, 2019b), otherwise we use two-sided hypothesis testing. Table notes indicate which type of testing is used.

Causal interpretation, placebo tests and robustness

Interpretation of α_3, β_3 and γ_3 as causal effects of primary school expansion requires the parallel trends assumption to hold. In other words, there should be no diverging cohort trends in the outcomes between treatment and comparison regions that would lead to nonzero estimates of α_3, β_3 or γ_3 in the absence of the reform. This assumption is supported by our

[9] Because parents' birth cohorts are less densely populated, differently from the previous equations, in Equation (1.3) birth cohort c is measured in 5-year intervals.

[10] To be precise, τ indexes every single birth year from 1974 to 1984 as well as the categories of before 1974 and after 1984.

discussion in Section 1.3.1 where we found no strong pre-trends in Figure 1.2, and by the evidence of uncorrelatedness of the identifying variation with trends in observables demonstrated in Section 1.3.2. Nevertheless, as shown in Equations (1.1), (1.2) and (1.3), we include birth cohort effects interacted with province dummies throughout our analysis to allow cohorts trends to vary in unrestricted ways across provinces. This is possible because the treatment-by-post indicators vary within province-cohort cells as provinces include both treated and untreated regions.

Moreover, for a range of robustness checks presented in Appendix A (Tables A.3, A.7-A.13) we augment Equations (1.1)-(1.3) by allowing for linear cohort trends interacted with an urban-rural indicator to control for the possibility of a general catch-up of rural areas. Our results are remarkably robust against this inclusion, suggesting that a general catch-up of rural areas is not driving our results. We also conducted placebo tests to further verify the validity of the common trends assumption. In Appendix A, Table A.2, panel A, we use the occupation of the parents of the directly affected generation as a placebo outcome. We use an indicator variable equal to 1 if the parent holds a highly skilled occupation, and equal to 0 otherwise. Since parents' occupational choices were shaped before the reform, there should be no reform effect on this outcome. The results confirm that the reform has no effect on parents' occupation. Furthermore, we defined a placebo reform that assumes the reform took place in 1982, nine years prior to the actual reform in 1991. We estimate a similar model as Equation (1.1) using only the 1965-1975 pre-reform birth cohorts, neither of which was affected by the real reform.[11] The results in panel B of Appendix A, Table A.2 show that exposure to the placebo reform has no effect on the probability of completing primary school for both males (columns 1-2) and

[11] In the placebo reform, the pre-placebo cohorts include individuals born between 1965-1967, the phase-in cohorts include individuals born between 1968-1971, and the post-placebo reform cohorts include those born between 1972-1975. The regions' primary school completion rates for the 1968 cohort are used as the initial level to define the placebo treatment and comparison regions, as done with the real reform. For the estimation, we obtain in total a sample for fathers of 726,409 observations and a sample for mothers of 748,326 observations from the Census data. The placebo reform cannot be applied to child outcomes, because children of the placebo reform cohorts may well be affected by the actual reform.

females (columns 3-4). Overall, the results of these robustness checks and placebo tests make us confident that our findings are indeed driven by the real reform, not by violations of the common trends assumption due to diverging trends in unobservables.[12]

1.4 Results

1.4.1 Reform effect on the directly affected generation

We start by presenting the effect of exposure to the reform on the *directly* affected generation in Table 1.3, using a mix of outcomes from both the Census and VHLSS datasets. The results are based on regression Equation (1.1) with additional interaction effects by gender in order to separate effects for men and women. Panel A of the table reports results on educational and economic outcomes.

The results in columns 1-3 of panel A show that for both males and females exposure to the reform increases the probability of completing primary and secondary by about 10 percentage points, and that this translates into roughly one additional year of schooling. To further verify whether this affects their actual skills, we estimate effects on an indicator for literacy (the full ability to read and write) in column 4 of panel A. Exposure to the reform improves literacy by about 1.2 percentage points for both males and females. This effect is highly statistically significant. Compared to the baseline illiteracy rate of 3.3% for pre-reform cohorts in treatment regions (own calculations from Census data) this is a sizable effect, implying that reform exposure almost halved the illiteracy rate.

[12] It may be tempting to use the compulsory schooling reform as an instrumental variable (IV) to estimate the causal effect of primary school education on investments in children's human capital and on parental health. We refrain from implementing such an IV strategy because, as pointed out by Holmlund et al. (2011), the compulsory schooling reform is unlikely to meet the exclusion restriction that is required for it to be a valid instrument. This is because not only will a given focal individual gain a higher level of schooling with the reform, but also will other individuals of the same generation in the same regions. And these other individuals could directly or indirectly affect the children or the parents of the focal individual, violating the IV exclusion restriction.

TABLE 1.3: REFORM EFFECTS ON THE DIRECTLY AFFECTED GENERATION

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A. Education and economic outcomes						
	Primary school completion	Secondary school completion	Years of schooling	Literacy	Economically active	Non-agricultural sector	Log earnings
Treat*Post*Female	0.094***	0.106***	0.909***	0.012***	0.005**	0.068**	0.214*
	(0.003)	(0.005)	(0.047)	(0.001)	(0.003)	(0.032)	(0.131)
Treat*Post*Male	0.102***	0.116***	0.974***	0.012***	0.044***	0.069***	0.269**
	(0.004)	(0.006)	(0.049)	(0.001)	(0.003)	(0.028)	(0.148)
Data source:	*Census*	*Census*	*Census*	*Census*	*Census*	*VHLSS*	*VHLSS*
Observations	1,656,579	1,656,579	1,656,579	1,656,579	1,656,579	17,471	17,471
	Panel B. Family outcomes						
	Lived in same municipality past 5 years	Married	Spouse's years of schooling	At least one child	Experienced child mortality	No. of children|>0	
Treat*Post*Female	0.071***	0.030***	0.524***	0.065***	-0.071***	-0.091***	
	(0.004)	(0.006)	(0.028)	(0.007)	(0.007)	(0.015)	
Treat*Post*Male	0.029***	0.114***	0.811***	*n.a.*	*n.a.*	*n.a.*	
	(0.004)	(0.007)	(0.029)				
Data source:	*Census*	*Census*	*Census*	*Census*	*Census*	*Census*	
Observations	1,656,579	1,656,579	1,656,579	832,706	832,706	832,706	
	Panel C. Intergenerational persistence						
Dep. variable:	*Years of schooling of directly affected generation*						
Sample:	Child-parent	Son-mother	Daughter-mother	Son-father	Daughter-father		
Parental schooling	0.391***	0.363***	0.397***	0.391***	0.399***		
	(0.007)	(0.010)	(0.015)	(0.009)	(0.015)		
Treat*Post*Parental schooling	-0.084***	-0.069***	-0.070***	-0.027**	-0.011		
	(0.010)	(0.015)	(0.023)	(0.014)	(0.023)		
Data source:	*Census*	*Census*	*Census*	*Census*	*Census*		
Observations	415,370	236,127	91,600	187,957	71,804		

Notes: All specifications include fixed effects for cohorts-by-province, region, and (for VHLSS data) survey year. Further control variables are dummies for gender and ethnicity (Kinh, Tay, Thai and others). For the Census data, dummies for religious affiliations (Buddhism, others and no religious affiliations) are included into the set of control variables. Earnings are measured by the log of Vietnam Dong 1,000 (in 2010 prices). The sample includes individuals born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Population and Housing Census of Vietnam (2009, 15% sample); Vietnam Household Living Standards Survey (2010, 2012 and 2014)

In the remainder of panel A, we present results for economic activity, economic sector, and earnings. As shown in column 5, reform exposure increases the probability of being economically active by half a percentage point for women, and 4.4 percentage points for men. For both men and women, it increases the probability of being active in the non-agricultural sector by 7 percentage points (column 6). Moreover, there is a strong increase in earnings of about 20-25 log points, which is slightly stronger for men (column 7). This is a sizable effect compared to conventional returns to schooling estimates. However, differently from conventional returns to schooling, our earnings effect includes a labour force participation effect because economically inactive individuals are included in the earnings variable with zero earnings.[13] Moreover, reform exposure affects earnings not only through an individual's own education, but potentially also through spillovers from the fact that many individuals in a local region are treated by the reform.

In panel B of Table 1.3, we investigate a range of family outcomes. We start with an indicator of having lived in the same commune over the past 5 years (an inverse measure of migration). Reform exposure makes it more likely for individuals to have remained resident in the same commune by 7 percentage points for women, and 3 percentage points for men (column 1). This could be a result of a stronger local economy due to higher local levels of education and economic activity and expansion of the non-agricultural sector. As columns 2 and 3 show, it also increases the probability of being married (3 percentage points for women, 11 percentage points for men), and it raises the average quality of the spouse as proxied by their years of schooling (half a year for women, 0.8 years for men). This latter finding is in line with previous findings from both developed and developing countries (Hahn et al., 2018; Pencavel, 1998). These factors might be related, as the availability of spouses of higher quality in the local region might induce couples to marry earlier, and as a result be more likely to settle down in the local

[13] The log transformation of earnings is then performed after adding a constant of one.

geographic area. This process might also partly explain the higher likelihood for women of having at least one child (6.5 percentage points – column 4). Another contributing factor to this could be the decrease in having experienced child mortality by 7 percentage points, as shown in column 5. If we control for having at least one child, on the other hand, we find that reform exposure *reduces* the number of children by approximately 0.1 (column 6). Positive fertility effects at the extensive margin and negative effects at the intensive margin can be rationalized by the theory developed in Aaronson et al. (2014). As these authors show, interventions that decrease the cost of investing in child quality, for example because of increased access to schooling or decreased child mortality, have positive fertility effects at the extensive margin, because taking advantage of the increased opportunities to invest in child quality requires having at least one child. At the intensive margin, such policies have negative effects, in line with the traditional quantity-quality tradeoff.[14] One caveat to bear in mind when interpreting these findings is that the sample includes individuals aged 25-35. The marriage and fertility effects are therefore not necessarily 'completed' effects, and they might result from changes in marriage and birth timing.

We further examine the reform effects on the intergenerational persistence of schooling between individuals of the directly affected generation and their parents. Our estimation is based on an augmented version of Equation (1.1) with years of schooling of an individual of the directly affected generation on the left hand side. The right-hand side is augmented by adding parental years of schooling and its interactions with $Treat \times Post$, $Treat \times Phasein$, $Treat$, $Post$ and $Phasein$. While the coefficient for parental schooling indicates the baseline intergenerational persistence of schooling, the coefficient for $Treat \times Post \times Parental\ Schooling$ measures how exposure to the reform affects the intergenerational

[14] The reform we study not only potentially lowers the cost of investing in child quality, but it also provides improved earnings and employment opportunities for mothers, from which one would expect a negative extensive margin effect (Aaronson et al., 2014). Our empirical results suggest that the positive extensive margin effect outweighs the negative one.

persistence. The coefficient in panel C of Table 1.3 on parental schooling indicates a baseline IGE of about 0.4 years of schooling.[15] The interaction effect shows that reform exposure reduces the dependence of schooling of the directly affected generation on their parents' schooling. The coefficient in column 1 shows a reduction of approximately 0.08 for the overall child-parent pairs. The four remaining columns of panel C in Table 1.3 show the results broken down by child and parental gender pairs. These differences should be interpreted cautiously due to two kinds of sample selection. Father-child pairs are less frequently observed than mother-child pairs because if children reside with a single parent, then this is more likely to be the mother. Second, daughter-parent pairs are less frequently observed than son-parent pairs because daughters are more likely to leave the parental home to live with their in-laws. With these caveats in mind, we find the reduction of the intergenerational persistence to be about 0.07 for both son-mother and daughter-mother pairs in columns 2 and 3 (both statistically significant at the 1% level), and about 0.03 for son-father pairs in column 4 (statistically significant at the 5% level), with no significant moderating effect for daughter-father pairs (column 5).

Overall, our results suggest that the directly affected generation benefitted from the reform through increased educational attainment, literacy, and economic activity (with a shift away from agriculture), as well as higher labour market earnings. It also increased the likelihood of being married, the quality of the marital partner, and the probability of having children. Conditional on having children, however, it decreased family size. Moreover, the reform increased intergenerational educational mobility for the directly affected generation. In

[15] For column 1, we measure parental education by the highest level of education obtained by one of the parents. One caveat for our analysis is that child-parent pairs can only be observed in the Census if they live in the same household. As sons are more likely to live with their parents than daughters, our sample includes more sons. The data also contains more mother-child pairs than father-child pairs because of the higher life expectancy of females. Nevertheless, the magnitude of our IGE estimate is broadly in line with international evidence. For earlier birth cohorts (1929-1978), Hertz et al. (2007) find a higher estimate of 0.6 for Vietnam and they document a falling trend over cohorts. Our smaller value of 0.4 estimated on later birth cohorts therefore seems very plausible.

Appendix A,Table A.3, we find these effects to be highly robust against adding a linear cohort trend interacted with a rural indicator.

1.4.2 Intergenerational spillover effects on the children's generation

The reform effects documented in the previous section might generate spillover effects on school attainment and investments into the human capital of the *children* of the generation directly affected by the reform. The improved education and skills may enable the directly affected generation to better understand the importance of human capital investments for their children's long-term success (Lundborg et al., 2014, 2018) and the implications for their children's ability to support parents in old age (Becker et al., 2016). Better education may also lead to being better informed about school choices and enrolment processes, and it may foster attitudes and values in favor of educational investments (Figlio et al. 2019, Piopiunik 2014). The increased probability of economic activity and higher earnings might allow the directly affected generation to invest more monetary resources into their children (Bruins, 2017; Calero, 2009).[16] This effect could be amplified by the decreased family size (conditional on having children), as the theory of quantity-quality trade-offs would suggest (Hanushek, 1992; Rosenzweig and Zhang, 2009). Our finding that the directly affected individuals also choose higher educated marital partners could further amplify downward spillover effects, given that higher educated spouses may increase their partner's own economic outcomes (Huang et al., 2009; Lefgren and McIntyre, 2006) and contribute directly to overall household resources. In this section we therefore explore downward intergenerational spillover effects on school attainment and investments into the human capital of the children of the directly affected generation. We start with the main results, followed by gender heterogeneity.

Main results

[16] This mechanism may work stronger in developing countries where numerous children reside in financially restricted families while there have been typically insufficient public investments (Strauss and Thomas, 1995).

We derive the effects of exposure to the reform on investments into children's human capital, based on regression Equation (1.2). In Table 1.4 we investigate school enrolment, school tuition, and other educational expenditures and, in Table 1.5 child labour, and in Table 1.6 health investments.

Column 1 in Table 1.4 displays the effects of exposure on school enrolment for children aged 6-17. Exposure of at least one parent to the reform increases the probability of a child's school enrolment by 8.7 percentage points (column 1), an effect that is highly statistically significant at the 1% level. We verified that this effect operates entirely via secondary school attendance, as one would expect because primary school is compulsory for everyone in the children's generation.[17] Given very high levels of school attendance at baseline (just above 90% of children of pre-reform parents in treatment regions), the effect size implies that the reform brought school attendance of the children's generation at primary and secondary school to a universal level.

Reform exposure of at least one parent also increases payments for children's school tuition, by 23.7% of a standard deviation, statistically significant at the 1% level (column 2). A range of school types in Vietnam, such as semi-public and private schools, charge higher tuition fees than traditional public schools, and are thought to be of higher quality in terms of skill development, educational services, teaching resources and facilities (Glewwe and Patrinos, 1999). In principle, the increase in tuition fees could reflect parents choosing higher quality schools, holding enrolment constant. But it could also be simply driven by the increase in enrolment itself, given that non-enrolled children pay zero tuition fees. To check this, estimate the tuition equation conditional on enrolment (column 3), and we find that there is still a weakly statistically significant effect of 14% of a standard deviation on tuition fees.

[17] We found that effects for children of primary and lower secondary school age are close to zero and statistically insignificant, while the effect at upper secondary school age is 0.097 and statistically significant at the 1%-level.

TABLE 1.4: REFORM EFFECTS ON THE CHILDREN'S GENERATION: INVESTMENTS INTO SCHOOLING AND LEARNING

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		School related expenditures						Home expenditures	
	School enrolment	Tuition	Tuition, conditional on enrolment	Books and learning materials	Learning tools and instruments	Private tutoring	Total school related spending	Children's books and magazines	Children's toys
At least one treated parent*Post	0.087***	0.237***	0.142*	0.194**	0.215**	-0.015	0.217**	0.149*	0.171*
	(0.027)	(0.093)	(0.092)	(0.093)	(0.123)	(0.100)	(0.105)	(0.106)	(0.120)
Observations	9,237	9,237	8,694	9,237	9,237	9,237	9,237	9,237	9,237

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. Expenditure variables are based on log expenditure (in 2010 prices), standardised into a mean of 0 and a standard deviation of 1. The sample includes children aged 6-17 of parents born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

Looking at further types of educational expenditure in the remaining columns of Table 1.4, we find that reform exposure of at least one parent increases spending on children's books and learning materials, learning tools and instruments, and total school-related spending. Effect sizes are roughly similar around 20% of a standard deviation and statistically significantly at the 5% level. There is no effect, however, on private tutoring. While private tutoring has been found to be effective in improving children's academic performance in developing countries (Banerjee et al., 2007; Dang and Rogers, 2008), it has traditionally been uncommon in many areas in Vietnam (Dang, 2007). Increased parental exposure to compulsory schooling in our treatment regions does not seem to have noticeably increased this practice. The last two columns of Table 1.4 include results on educational expenditures related to the home rather than school. They show weakly statistically significant effects on children's books and magazines (14.9% of a standard deviation) and toys (17.1% of a standard deviation).

TABLE 1.5: REFORM EFFECTS ON THE CHILDREN'S GENERATION: CHILD LABOUR OUTCOMES

	(1)	(2)	(3)
	Working for the household	Working for earnings	Hours of work for earnings
At least one treated parent*Post	-0.018	-0.019*	-0.282**
	(0.034)	(0.012)	(0.131)
Observations	9,237	9,237	9,237

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. The sample includes children aged 6-17 of parents born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

In Table 1.5, we investigate child labour. We interpret it as a negative investment in children's human capital, as it has been shown to be detrimental to educational attainment (Beegle et al., 2009), academic performance (Goulart and Bedi, 2008) and health (O'Donnell et al., 2005). Column 1 shows no effect of parental reform exposure on the probability that their children work for the household. In column 2, we find that children of parents who were

exposed to the reform are also less likely to have a paid job outside of the household, with an effect size of 1.9 percentage points, statistically significant at the 10% level. Finally, as column 3 shows, parental exposure also reduces children's daily hours of paid work, by close to 0.3 hours (statistically significant at the 5% level).

In Appendix A, Table A.4 we show that these effects also exist for children aged 6-14, below the legal minimum age of 15 for labour market participation. We find that, although the effects are smaller than in the overall sample (slightly smaller for the probability of working for earnings, and nearly half for the hours or work), parental exposure continues to have statistically significant effects.

Health is an important component of human capital and ill-health can hinder school attendance and skill acquisition. In Table 1.6 we explore how parents' exposure to the school expansion reform affects investments into their children's health. Given that children's malnutrition has negative effects on long-run outcomes and is still a concern in developing countries (Currie and Vogl, 2013; Strauss and Thomas, 1998), we start by considering the household's per capita food consumption as our first proxy for health investments and find a strongly significant positive effect of 23% of a standard deviation (column 1). In column 2, we find a reduction in household spending on tobacco and cigarettes (14% of a standard deviation, weakly statistically significant). Given that parental smoking is harmful to child health because of second-hand smoke (Adda and Cornaglia, 2010; Cawley and Ruhm, 2011), this reduction can be interpreted as a positive health investment. Our findings are consistent with previous evidence on the tradeoff between household expenditures on food consumption and those on smoking products important in developing countries (Block and Webb, 2009; Wang et al., 2006).

TABLE 1.6: REFORM EFFECTS ON THE CHILDREN'S GENERATION: INVESTMENTS INTO HEALTH

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Per capita household spending on food consumption	Household spending on tobacco and cigarettes	Health insurance coverage	Number of preventive health visits	Preventive health care expenditure - Public	Preventive health care expenditure - Private	Hospital-ization
At least one treated parent*Post	0.228***	-0.141*	0.037	0.202	-0.136	0.142*	-0.026*
	(0.097)	(0.103)	(0.040)	(0.217)	(0.128)	(0.106)	(0.017)
Observations	9,237	9,237	9,237	9,237	9,237	9,237	9,237

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. Expenditure variables are based on log expenditure (in 2010 prices), standardised into a mean of 0 and a standard deviation of 1. The sample includes children aged 6-17 of parents born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

In columns 3 and 4 we investigate the child's health insurance coverage, and the number of preventive health visits to health centers. While we find positive point estimates for both, these are not statistically significant. Columns 5 and 6 reveal no statistically significant effect on preventive *public* health care expenditures (although point estimates point to a decrease) and a positive effect on preventive *private* health care expenditures (statistically significant at the 10% level). This points towards parents spending more on their children's health within the private health care system which is reputed as having a higher quality than the public system, particularly in Vietnam (Nguyen and Wilson, 2017). Finally, we look at the probability of the child having been hospitalized within the past year. Acute ill health requiring hospitalization may in parts be caused by a lack of parental health investments, and hospitalization potentially involves absenteeism from school. For these reasons we interpret the reduction in hospitalizations of 2.6 percentage points (column 7, weakly statistically significant) as a beneficial effect on health investments.

In Appendix A, we present additional evidence to rule out that the effects presented in this section are affected by differences in children's ages. If exposure to the compulsory schooling reform causes parents to postpone or speed up childbearing, the children of treated and untreated parents would have a different age at the time of the survey. If educational investments or incidences of child labour vary by child's age (e.g., are higher in secondary than in primary school), this could affect or even drive our results. Reassuringly, as we show in Appendix A, Table A.5, parental exposure to the reform has no effect on children's age at the time of the survey.

Heterogeneity by gender

We now investigate whether the results reported so far are heterogeneous by the children's gender. Improving understanding of sex differences in parental investments in children's human capital is important as it may help explain gender gaps in social and economic

outcomes in adulthood (Baker and Milligan, 2016; Booth and Nolen, 2012; Brenøe and Lundberg, 2018).

In Table 1.7, we focus on a selection of the outcomes from the previous Tables 1.4-1.6. A more comprehensive analysis for all outcomes is in Appendix A, Table A.6. While point estimates show beneficial effects of parental exposure to the reform for children of both genders, it is striking that effect sizes are relatively larger for sons than for daughters. For school enrolment (column 1), the effect for sons exceeds that for daughters by a factor of 1.4. For school tuition, educational spending and private health expenditures this rises to a factor of 1.5-2, and for child labour and hospitalizations to a factor of 3. Furthermore, the effects on total educational spending, child labour, and the health outcomes are statistically significant for boys only. The third row of coefficients in Table 1.7 reports the differences in the effects between sons and daughters. With the exception of total school related spending, we cannot reject the hypothesis that the effects are equal between genders. Nevertheless, it is intriguing that all effect differences point to the same direction, favoring boys.

These imbalances may well reflect preferences for sons in Asian cultures such as Vietnam (Bharadwaj and Lakdawala, 2013), which may affect how parents choose to distribute additional monetary investments between sons and daughters (Barcellos et al., 2014; Choi and Hwang, 2015; Jayachandran and Kuziemko, 2011).[18] In the last row of coefficients in Table 1.7 we show, however, that the (unconditional) pre-reform difference in these investments was not in all cases skewed in favor of boys. Prior to the reform boys experienced lower school enrolment and school-related spending, and more hours of child labour. Judging from the point estimates, the reform effects would then have over-compensated these differences leading to post-reform outcomes in favor of boys.

[18] In other cultural settings, the results may be different. For example, Baker and Milligan (2016) find that parents spend time on teaching activities more with daughters than with sons in Canada, the United States and the United Kingdom.

Overall, we conclude from this section that the compulsory schooling reform not only improved the quantity and quality of schooling of the *children* of the directly affected generation, as well as the monetary investments in their education, but also had a significant preventative effect on child labour, and positive effects on health investments. Moreover, these effects tend to be larger for sons compared to daughters. To our knowledge, such comprehensive intergenerational spillover effects of primary school expansion have not been shown in the literature before. In further robustness checks presented in Appendix A, Tables A.7-A.10, we show that the results presented in this section are highly robust against allowing for different linear paternal and maternal cohort trends between rural and urban areas.

1.4.3 Intergenerational spillover effects on the parent's generation

Previous literature has argued that having more children contributes to economic security in old age due to integenerational support from offspring to parents (Banerjee et al. 2010; Chen and Fang, 2018; Oliveira, 2016). Recent studies have emphasized that the *quality* of children (e.g., their level of schooling) also matters for upward intergenerational support and thus may affect the later-life outcomes of parents (De Neve and Fink, 2018; Lundborg and Majlesi, 2018; Ma, 2019). The role of children for old-age parents is likely to be particularly strong in developing countries where social security systems are poorly functioning and financial markets are underdeveloped. In this section we investigate upward intergenerational spillover effects, on old age health outcomes of the *parents* of the generation directly affected by the reform. We start with the main results, followed by an analysis of mechanisms.

Main results

Table 1.8 presents effects of exposure to the reform on one's parents' old age health outcomes based on regression Equation (1.3). We present the baseline effect in panel A and heterogeneity by parental gender in panel B. The age range of parents included in the sample is from 60 to 91, with an average age of 68.5.

TABLE 1.7: REFORM EFFECTS ON THE CHILDREN'S GENERATION: HETEROGENEITY BY CHILD GENDER

	(1)	(2)	(3)	(4)	(5)	(7)
	School enrolment	School tuition	Total school related spending	Hours of work for earnings	Preventive health care expenditure - Private	Hospital-ization
At least one treated parent*Post*Daughter	0.069**	0.168*	0.126	-0.114	0.095	-0.013
	(0.031)	(0.104)	(0.115)	(0.155)	(0.121)	(0.034)
At least one treated parent*Post*Son	0.096***	0.298***	0.302***	-0.365***	0.204*	-0.045*
	(0.028)	(0.112)	(0.114)	(0.147)	(0.127)	(0.035)
Effect difference (son-daughter)	0.027	0.130	0.176*	-0.251	0.109	-0.032
	(0.027)	(0.108)	(0.094)	(0.159)	(0.121)	(0.033)
Unconditional pre-reform gender difference	-0.022***	-0.027	-0.076***	0.121***	0.033	0.007
(son-daughter)	(0.006)	(0.023)	(0.023)	(0.036)	(0.023)	(0.004)
Observations	9,237	9,237	9,237	9,237	9,237	9,237

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. Expenditure variables are based on log expenditure (in 2010 prices), standardised into a mean of 0 and a standard deviation of 1. The sample includes children aged 6-17 of parents born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

With respect to the *general* health outcomes in the first three columns, we find that having at least one child exposed to the reform reduces the annual days of sickness by 10 days (column 1). We also find a roughly 10 percentage points increase in general self-reported health, both absolute (column 2) and relative to peers of the same age range (column 3). With respect to *mental* health outcomes in the last three columns, panel A shows no overall effects on depression, sleep problems, or general life satisfaction. With respect to the gender of the parent, Panel B shows that even though there are some gender differences for specific outcomes there is no general pattern that would indicate that the effects benefit only mothers or only fathers. The difference in the effects for mothers and fathers are not statistically significant, except for sleep problems, where there is a beneficial effect for fathers but not for mothers of treated children (column 5, panel B). To sum up, we find positive overall effects on *general* health, and some indication of a beneficial mental health effect for fathers.

Mechanisms

One important mechanism why old age parents could be in better health if their children had access to better education is an improved financial situation, which could allow them access to better health care or earlier retirement. A second important class of mechanisms are better health behaviors (Ma, 2019). According to these broad classes of mechanisms, we split our analysis up into *financial* mechanisms (Table 1.9) and *behavioural* mechanisms (Table 1.10).

With regards to the overall effects in panel A of Table 1.9, we find no reform effects on indicators for poverty, for whether the income meets personal needs, or whether parents receive income support from their children, although these estimates all point into the direction of improvement. We do however find positive effects in columns 4-6 on an indicator for having savings, on household assets (an index summing up items such as having a refrigerator, a water heater, an improved sanitation, etc.) and on satisfaction with the financial status. One reason why assets and financial satisfaction might be improved despite no significant improvements

in income could be if better educated children require less financial support from their parents, allowing the parents to increase savings and other assets. Column 7 further shows an effect of 1.7 percentage points on having a private health insurance which is expected to provide the elderly with better health care compared to a public health insurance. Heterogeneity results in panel B suggest that these effects are not statistically significantly different by parental gender.

TABLE 1.8: REFORM EFFECTS ON THE PARENT'S GENERATION: HEALTH OUTCOMES

	(1)	(2)	(3)	(4)	(5)	(6)
	Days of sickness	Good self-reported health status	Relative good health status (compared to others)	Depression	Sleep problems	Satisfied with life
	Panel A. Baseline					
At least one treated child*Post	-10.031**	0.088***	0.120***	-0.001	-0.020	0.042
	(5.634)	(0.036)	(0.048)	(0.003)	(0.042)	(0.048)
	Panel B. Heterogeneity by parental gender					
At least one treated child*Post*Mother	-7.683**	0.075**	0.076***	-0.001	0.025	0.039
	(3.389)	(0.034)	(0.032)	(0.003)	(0.040)	(0.042)
At least one treated child*Post*Father	-3.553	0.082*	0.141***	0.002	-0.127***	0.063
	(5.782)	(0.053)	(0.054)	(0.006)	(0.050)	(0.054)
Effect difference (father-mother)	4.130	0.007	0.065	0.003	-0.152**	0.024
	(6.350)	(0.068)	(0.064)	(0.007)	(0.067)	(0.067)
Unconditional pre-reform gender difference	4.552	0.101***	0.097***	0.003	-0.087***	-0.061**
(father-mother)	(2.880)	(0.025)	(0.027)	(0.004)	(0.023)	(0.025)
Observations	1,818	1,818	1,818	1,818	1,818	1,818

Notes: All specifications include fixed effects for region and five-year-age-interval-by-province (age intervals defined as 60-64, 65-69, 70-74, 75-79, and ≥80 years old). Control variables: gender, ethnicity (Kinh), and dummies indicating the number of children by birth cohort category (before 1974, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, and after 1984). Sample includes the individuals aged 60 and above who have children born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Aging Survey (2011)

Looking at behavioural mechanisms, Table 1.10 reveals no effect on smoking of old age parents, but very sizable reductions in alcohol consumption, driven entirely by fathers. As columns 2-4, panel B, show, the probability of both moderate and daily alcohol consumption reduces by 10 percentage points for fathers. In the remaining columns we investigate social contacts within and outside the family, which may affect mental health (Meng and Xue, 2020). There is evidence for an increase in social activities outside the house for fathers of treated children (column 5, panel B). Finally, while there is no effect on having at least one grandchild, there is an increase in the number of children in law (i.e., one's children being married). This result matches the positive effect on the marriage probability of the directly affected generation (Table 1.3 above). A higher number of children in law might affect parental outcomes positively in line with the strong evidence on the positive effects of the number of own children on old-age support (Oliveira, 2016).

To sum up, we find some positive effects of the primary school expansion on the old age health of the parents of the directly affected generation. These appear to be primarily physical rather than mental health effects, and relevant mechanisms include a better financial situation, private health insurance and, for fathers, reduced drinking and improved social activities. In Appendix A (Tables A.11-A.13), we find the results presented in this section to be highly robust against allowing age effects to differ between rural and urban areas.

TABLE 1.9: REFORM EFFECTS ON THE PARENT'S GENERATION: POTENTIAL FINANCIAL MECHANISMS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Poverty	Income meets personal needs	Regular income support from children	Savings	Household assets	Satisfied with financial status	Private health insurance
	Panel A. Baseline						
At least one treated child*Post	-0.003	0.059	0.019	0.088***	0.203**	0.066**	0.017*
	(0.039)	(0.050)	(0.040)	(0.027)	(0.089)	(0.030)	(0.012)
	Panel B. Heterogeneity by parental gender						
At least one treated child*Post*Mother	0.009	0.024	0.018	0.034*	0.130**	0.034*	0.010
	(0.030)	(0.042)	(0.037)	(0.023)	(0.071)	(0.026)	(0.012)
At least one treated child*Post*Father	0.025	0.058	-0.029	0.071**	0.123*	0.069**	0.020**
	(0.039)	(0.050)	(0.060)	(0.032)	(0.096)	(0.035)	(0.012)
Effect difference (father-mother)	0.016	0.034	-0.047	0.037	-0.007	0.035	0.010
	(0.050)	(0.063)	(0.073)	(0.036)	(0.115)	(0.041)	(0.015)
Unconditional pre-reform gender difference	-0.042**	0.039	-0.073***	-0.014	0.081	0.049***	-0.002
(father-mother)	(0.020)	(0.026)	(0.026)	(0.016)	(0.069)	(0.018)	(0.006)
Observations	1,818	1,818	1,818	1,818	1,818	1,818	1,818

Notes: All specifications include fixed effects for region and five-year-age-interval-by-province (age intervals defined as 60-64, 65-69, 70-74, 75-79, and ≥80 years old). Control variables: gender, ethnicity (Kinh), and dummies indicating the number of children by birth cohort category (before 1974, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, and after 1984). Sample includes the individuals aged 60 and above who have children born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Aging Survey (2011)

TABLE 1.10: REFORM EFFECTS ON THE PARENT'S GENERATION: POTENTIAL BEHAVIOURAL HEALTH MECHANISMS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Alcohol consumption, at least…						
	Smoking	2-3 times per week	4-6 times per week	once per day	Social activities	At least one grand-child	Number of children-in-law	Household size
	Panel A. Baseline							
At least one treated child*Post	-0.018	-0.059**	-0.055**	-0.038*	-0.019	0.007	0.273***	0.129
	(0.035)	(0.026)	(0.027)	(0.026)	(0.049)	(0.012)	(0.099)	(0.209)
	Panel B. Heterogeneity by parental gender							
At least one treated child*Post*Mother	-0.017	-0.003	0.005	0.015	-0.034	0.001	0.291***	-0.028
	(0.026)	(0.019)	(0.017)	(0.017)	(0.037)	(0.014)	(0.089)	(0.150)
At least one treated child*Post*Father	-0.048	-0.103***	-0.128***	-0.114***	0.075*	0.006	0.142*	0.159
	(0.043)	(0.043)	(0.044)	(0.041)	(0.056)	(0.011)	(0.093)	(0.195)
Effect difference (father-mother)	-0.031	-0.100*	-0.133***	-0.129***	0.109*	0.005	-0.149	0.187
	(0.050)	(0.053)	(0.051)	(0.048)	(0.060)	(0.017)	(0.127)	(0.250)
Unconditional pre-reform gender difference (father-mother)	0.327***	0.279***	0.234***	0.216***	-0.065**	-0.002	0.132	0.070
	(0.021)	(0.018)	(0.017)	(0.017)	(0.027)	(0.006)	(0.112)	(0.116)
Observations	1,818	1,818	1,818	1,818	1,818	1,818	1,818	1,818

Notes: All specifications include fixed effects for region and five-year-age-interval-by-province (age intervals defined as 60-64, 65-69, 70-74, 75-79, and ≥80 years old). Control variables: gender, ethnicity (Kinh), and dummies indicating the number of children by birth cohort category (before 1974, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, and after 1984). Sample incluses the individuals aged 60 and above who have children born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Aging Survey (2011)

1.5 Discussion and conclusion

We have studied the multigenerational effects of primary school expansion in Vietnam sparked by the country's 1991 schooling reform. Our results show that the reform had a strong positive effect of 10 percentage points on primary and secondary school completion of the *directly affected cohorts*. Through this effect, the reform increased the intergenerational educational mobility. Reform exposure also increased literacy, economic activity outside the agricultural sector, and earnings. It raised residential stability, the probability of being married, the level of education of the marital partner, and it increased fertility at the extensive margin, while reducing it at the intensive margin. In terms of *downward spillovers*, we document effects on the affected cohorts' investments in their children's human capital. The results indicate that parental exposure to the reform raised children's school enrolment and parental spending on school-related expenses (tuition fees, textbooks) and other educational spending (children's books and magazines, toys). Moreover, we find evidence for an increase in health investments and a reduction in child labour. Most of these downward spillover effects benefit sons more than daughters. This may be a driver of gender gaps in achievement in adulthood (Barcellos et al., 2014; Chetty et al., 2016), and the gender pattern mirrors results reported in causal studies on the intergenerational transmission of human capital (Black et al., 2005; Lundborg et al., 2014). Our findings complement a comparatively sparse literature on the mediating channels of the intergenerational transmission of education. While we focus on monetary investment in children's health and human capital, Carneiro et al. (2013) focus on the home environment and parental investments in children's cultural knowledge, musical skills, reading ability, computer skills, and joint home activities. Piopiunik (2014) isolates the degree to which parents value education as an important channel. By showing that *downward* intergenerational spillovers operate through parental investments in their children's human capital, we also contribute to the literature on the determinants of parental investments (Attanasio, 2015). The evidence

available on the link between parental schooling and their investments in child human capital is mainly correlational (Brown, 2006; Strauss and Thomas, 1995). The literature has highlighted determinants such as child endowments (Adhvaryu and Nyshadham, 2016), parental beliefs (Kinsler and Pavan, 2016), fertility (Rosenzweig and Zhang, 2009), gender and race (Jayachandran and Kuziemko, 2011; Thompson, 2018), household characteristics (Newman and Holupka, 2014), and labour market conditions (Majlesi, 2014). Our results suggest exposure to primary school expansion as an additional causal determinant of investments into one's children's human capital through the various channels we identify.

In terms of *upward spillovers*, we find that the primary school expansion had positive general health effects in old age for the *parents* of the directly affected generation. As potential channels of these effects, our results indicate improved financial resources in old age, access to private health insurance and reduced alcohol consumption. Prior research on the causal determinants of health in old age has emphasized the roles of economic conditions (De Nardi et al., 2009), early-life conditions (Bhalotra et al., 2017; Case and Paxson, 2009), retirement decisions (Atalay et at., 2019; Fabrizio and Franco, 2017), child migration (Antman, 2010; Böhme et al., 2015), home care (Barnay and Juin, 2016), social pensions and government assistance programmes (Fetter and Lockwood, 2018; Salm, 2011). Our results add to this literature by focusing on the human capital of the younger generation as an important driver of the old age individuals' health and well-being.

While educational attainment has long been recognized as one of the most powerful and sustainable tools for transforming human lives and promoting economic development (Krueger and Lindahl, 2001; Manuelli and Seshadri, 2014; Oreopoulos and Salvanes, 2011), fully understanding the social returns of educational policies is very much a matter of ongoing research. Prior literature has often emphasized spillovers on economic outcomes, including aggregate productivity and economic growth (Lange and Topel, 2006; Moretti, 2004a). Micro-

level studies have documented spillovers on plant productivity (Moretti, 2004b), crime (Lochner and Moretti, 2004), and voter participation (Moretti et al., 2003). Our paper shows that the *family* is an important social group in which spillovers materialize across generations, including on non-economic outcomes such as health.

Our findings show that downward and upward intergenerational spillover effects constitute important components of the social returns of compulsory schooling policies such as primary school expansion. Moreover, we show that in a developing country, increased monetary investments in children's health and education and decreased instances of child labour may be important drivers of the downward spillover effect, while the upward spillover effect on parental health seems to be driven by both financial resources and health behaviors. These channels have received little attention in the literature trying to disentangle the channels of intergenerational spillover effects of human capital.

Overall, our findings imply that through both long-term effects on the directly affected generation and external effects within families on the next and the previous generation, enacting and enforcing compulsory primary schooling has high social returns. Given recent estimates for low-income countries that put the average primary school completion rate at 59% (UNESCO, 2019) and the prevalence rate of child labour at 19% (ILO, 2017), our results carry particular policy relevance for those countries and call for increased efforts in achieving universal primary school completion. More generally, however, given that positive externalities of education are among the predominant economic rationales for the provision of publicly funded education (Hanushek, 2002), our results reinforce the economic rationale for providing free compulsory primary school education, irrespective of the particular context.

Chapter 2

The Cultural Origins of Educational Success

Abstract

I exploit exogenous variation in regional exposure to Confucian cultural heritage by drawing on a unique historical evolution in Vietnam and employ a spatial regression discontinuity design to estimate the causal effect of culture on educational success. My results show that exposure to Confucian cultural heritage increases schooling years and degree achievement for adults as well as school enrolment and test scores for children. I provide evidence to suggest that these effects work through positive cultural values and beliefs towards schooling and increased human capital investments. Exposure to Confucian cultural heritage further ameliorates intergenerational educational mobility.

JEL codes: I21, I28, N35, N45, O53, Z10

Keywords: Cultural heritage; Confucianism; Meritocracy; Education; Vietnam

2.1 Introduction

While education generates considerable economic and nonpecuniary returns (Angrist and Krueger, 1991; Card, 1999, 2001; Clark and Royer, 2013; Duflo, 2001; Heckman et al., 2018; Oreopoulos and Salvanes, 2011), it varies substantially across various ethnic groups and geographic regions both across and within countries (Barro and Lee, 2013; Lee and Lee, 2016). Understanding what fundamentally affects schooling outcomes is therefore indispensable to account for inequalities in socioeconomic outcomes. Economists have focused on multiple economic factors and educational policies to explain disparities in educational success such as income, family background, school resources and policies, and institutions among others (Björklund and Salvanes, 2011; Black et al., 2005; Case and Deaton, 1999; Hanushek and Woessmann, 2011; Meghir and Palme, 2005; Woessmann, 2016). However, these determinants are not arguably fully satisfied in explaining the robustly exceptional success of Vietnam on the Programme for International Student Assessment (PISA)[19] in comparision with other countries when relating income to academic performance.[20]

Scholars from other disciplines such as psychology, sociology, and education have long recognized the importance of culture for educational achievement.[21] Yet, it is challenging to identify the causality of this relationship because an ethnic group or a region with a culture that likely drives schooling outcomes typically differs from other groups or regions along climate, historical, institutional, and socioeconomic characteristics.

[19] PISA measures the academic performance of 15-year-old students across the globe in an internationally comparable way.

[20] On both the 2012 and 2015 PISA waves, Vietnam was in among the top-ranked participating countries and was considerably higher than all other developing countries despite a fact that this country was among one of the poorest countries. Vietnamese students even performed better the counterparts from several developed countries including the USA and the UK (see Dang et al., 2020).

[21] Culture is defined as beliefs, values, and preferences shared by individuals within communities or ethnic groups (Fernández 2011; Tabellini, 2008).

In this paper, I explore a unique historical setting in Vietnam to study the effect of Confucian cultural heritage on present-day educational success. Confucianism, which originated in ancient China and is named after the scholar Confucius,[22] represents a compilation of ancestral philosophical thoughts on political, social, and family values. Due to its dominant influence throughout regional history, Confucianism has been recognized as the fundamental component creating the Northeast Asian culture up until present times (Kim et al., 2017; Bell, 2010; Paramore, 2016).[23] Confucianism is particularly well-known for its emphasis on education (Tan, 2017), and its positive values towards schooling are presumed to have persisted into modern society, strongly affecting people's preferences and beliefs (Wang, 2016). Inspired by Confucianism, historical states developed meritocratic institutions, such as using academic performance on imperial civic examinations to recruit and allocate public servants. Educational achievement, therefore, played a crucial role in deciding whether a male, regardless of his initial status or social class, would become a state bureaucrat and enjoy the immense benefits and respects that this career entailed. Cultural values towards education were therefore firmly established and rooted in Northeast Asian societies due to the extended joint evolution of Confucianism and exam-based meritocratic institutions (Chen et al., 2020). As a result of one millennium years of Chinese occupation between 111 B.C. and 938, Chinese culture and institutions were imported and rooted into pre-modern Vietnamese society, which was aboriginally established by the Kinh people[24] in the region known as Northern Vietnam today

[22] Although Confucius or *Kong-Fuzi* in Chinese (551-479 B.C.) was the formal founder and also the initial instructor of Confucianism, he was not the original inventor of what made up Confucianism which was already present before the time he had lived. Confucius was actually the first person systematically collecting and documenting traditional philosophical wisdoms and thoughts of his past generations, who was followed by other two influential Confucian philosophers Mencius (371-289 B.C.) and Xunzi (310-235 B.C. or 314-217 B.C.) among others to compose Confucian texts which have been well-known as *Four Books and Five Classics* (Yao, 2000).

[23] The term 'Confucianism' was invented by the 16th century Jesuit missionaries in pre-modern China when they started to fully acknowledge the focal position of Confucius amongst the intellectual traditions of ancient China. Confucianism is typically mentioned as *Rujiao* in Chinese, *Jukyo* in Japanese, *Yukyo* in Korean, and *Nho giao* in Vietnamese, which all approximately convey a message of *the teaching of traditional scholars* (Goldin, 2014; Yao, 2000).

[24] The Kinh people is the ethnic majority in Vietnam's today, which amounts to about 89% while other remaining 62 ethnicities only occupy 11% of the total population (Population and Housing Census, 2009).

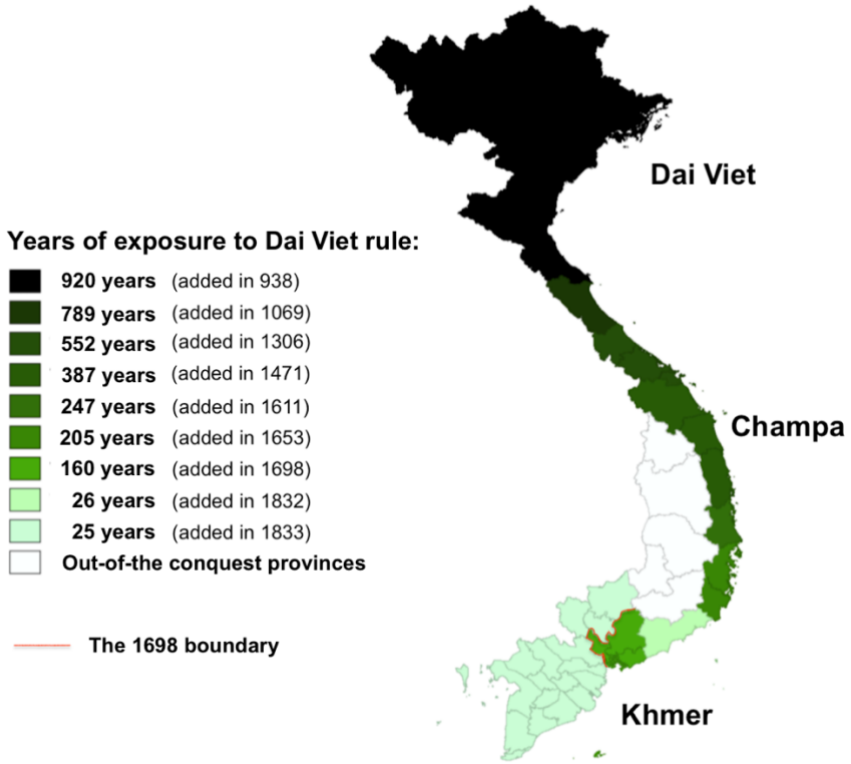
(Thuc, 1967; Whitmore, 1997). After gaining self-rule in 938, the Kinh people formally assumed the colonial legacy of Chinese culture and institutions to construct their historical state of Dai Viet.[25] Confucianism was not only formally accepted as the state ideology but also actively promoted and expanded in parallel with the meritocratic institutions used for public personnel recruitments in the Dai Viet kingdom.

Based on a similar approach as the one developed in Dell et al. (2018), my study draws on marked cultural and institutional differences in the 10th century between the historical states of what is today Northern and Southern Vietnam. As demonstrated in Figure 2.1, the territory of today's Vietnam comprised three kingdoms in the 10th century: Dai Viet, Champa, and Khmer, which were respectively located in the northern, middle, and southern parts of modern-day Vietnam. While Dai Viet possessed all the necessary characteristics to be identified as one of the Sinic states of Confucianism-based Northeast Asian societies, Champa and Khmer belonged to Southeast Asian states of the Indic cultural trajectory, which were not influenced by ancient Chinese culture and institutions. Between the 11th and 19th century, Dai Viet engaged in a politically idiosyncratic process of southward territorial expansion, exporting its Confucian culture and meritocratic institutions to Champa and then Khmer. Due to the gradual southward conquest, different parts of modern Vietnam were exposed to the Dai Viet culture and institution for varying amounts of time ranging from 25 to 920 years. This is depicted in Figure 2.1, in which the differently shaded areas which were generated by different historical boundaries established at different times mark different lengths of rule by the Confucian Dai Viet kingdom. Years of exposure to the Dai Viet rule are calculated as the time span between

[25] Dai Viet, which has a meaning of 'Great Viet', was the name used for the longest time (732 years) among the names the pre-modern Vietnamese states used between 938 and 1858 compared to other short-time names such as Tinh Hai Quan (30 years), Dai Co Viet (86 years), Dai Ngu (7 years), Giao Chi (20 years), Viet Nam (35 years) and Dai Nam (19 years). For that reason, I use the name of Dai Viet to mention all Vietnamese states throughout pre-modern times for the purpose of simplification.

when an area was first annexed by Dai Viet and the start of French colonization in 1858 when the Western-style institution used for exploitation colonialism replaced Dai Viet rule.

FIGURE 2.1: DAI VIET'S SOUTHWARD EXPANSION AND THE 1698 BOUNDARY



Source: This figure is created by the author based on Taylor (2013); Quoc Su Quan Trieu Nguyen (1972); Ngo et al. (2001)

Although Dai Viet's historical ideology of Confucianism and its inspired exam-based meritocracy do not formally exist in modern times, their legacies may still be surviving through Confucian cultural heritage bequeathed from generation to generation. However, Confucian cultural inheritance would have different levels of concentration in different parts of modern-day Vietnam, and it would be expected to be more intensive in regions with longer exposure times to Dai Viet rule. Motivated by the strong positive relationship between years of exposure to Dai Viet rule and contemporary educational outcomes, as illustrated in Figure 2.2, my study seeks to answer the questions of whether and how Confucian cultural heritage causally improves educational outcomes in modern-day Vietnam. To control for potential confounding

factors[26] along with the treatment of Confucian cultural heritage, my empirical strategy relies on a spatial regression discontinuity design (SRDD) by exploiting the second-to-last historical boundary of Dai Viet's southward expansion, which was formed in 1698 as depicted in Figure 1. As I discuss in Section 2.4, the 1698 boundary was arbitrarily established as a result of exogenous political shocks within both the Dai Viet and Khmer kingdoms, dividing the southernmost region of today's Vietnam into two distinct parts in terms of the duration of exposure to Dai Viet's culture and institution: the right-hand side part having nearly 160 years and the left-hand side part having only 25 years. The differences in length of annexation led to differences in the strength of Confucian culture, given that a culture can be expected to become more deeply rooted into local society with increased exposure time (Alesina et al., 2013; Giuliano and Nunn, 2020; Voigtländer and Voth, 2012). I, therefore, use the region to the right of the boundary to construct my treatment regions of Confucian cultural heritage, with the regions to the left of the boundary acting as control regions more strongly influenced by Khmer rather than Dai Viet culture. Focusing on a narrow geographic area around the 1698 boundary allows my empirical analysis to disregard confounders stemming from differences in regional characteristics.[27]

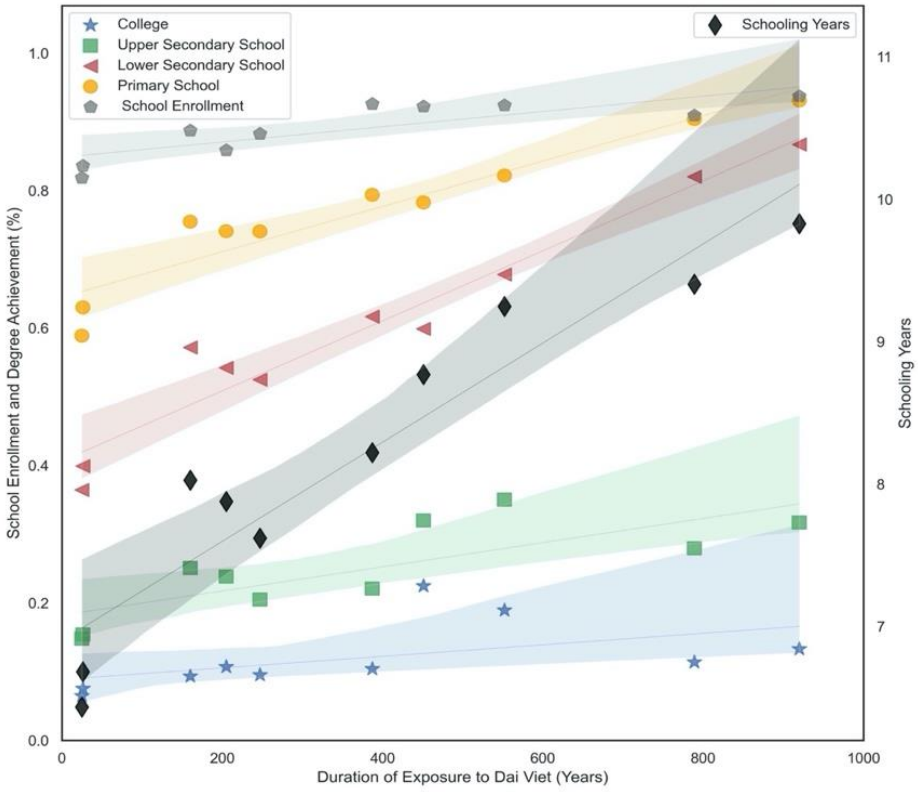
I find robust positive effects of Confucian cultural heritage on modern-day educational outcomes. It increases adults' educational attainment by 0.7 schooling years and also increases their degree achievement by 4 percentage points for completing primary school, 8 percentage points for completing lower secondary school, 6 percentage points for completing upper-secondary school, and nearly 3 percentage points for obtaining a college degree. Confucian

[26] This is because various parts of today's Vietnam, spanning from northern to southern regions, have different characteristics in terms of climate, demographic traits, historical formation, local labour markets, and economic development.

[27] In Section 2.4, I provide evidence that potential confounding factors are smooth at the 1698 boundary, lending support to the spatial regression discontinuity design.

cultural heritage increases children's post-compulsory school enrolment by 5.8 percentage points and improves test scores for high school graduates on their national high school exams.

FIGURE 2.2: CORRELATIONS BETWEEN DURATION OF EXPOSURE TO DAI VIET AND CONTEMPORARY SCHOOLING OUTCOMES



Notes: This figure shows the correlations between years of exposure to Dai Viet and contemporary educational outcomes. The outcomes include schooling years, educational level completion rates (primary school, lower secondary school and upper secondary school) and rate of a college degree for adults aged 25-64, and school enrollement rate for children aged 6-17. Shaded areas represent 95% confidence intervals.

Data source: Vietnam Population and Housing Census (2009, 15% sample)

To interpret these results, I analyse several channels. First, I show that Confucian cultural heritage improves positive values and beliefs towards schooling. Individuals living in treatment regions particularly show stronger preferences towards aspiring to additional education and are more likely to have positive beliefs regarding the importance of higher education beyond compulsory schooling for their lives than those living in control regions. Second, I show that Confucian cultural heritage raises human capital investments, which have been well documented as being a vital determinant of long-run educational achievement. In particular,

school-aged children in treatment regions enjoy higher investments in their school and learning activities than those in control regions. Moreover, I find that Confucian cultural heritage enhances social mobility across generations by helping reduce the dependence of child education on parental education, suggesting a favourable effect on intergenerational educational mobility.

My paper has several key contributions. First, it contributes to a body of literature exploring the causal link between culture and schooling outcomes which has been understudied but received an increasing interest from economists. The psychology, sociology, and education literatures have long recognized that learning aspirations, study effort, educational attainment, and academic performance of students are related to cultural background (for example, Li, 2012; King and McInerney, 2014; Sullivan, 2001). However, these studies have been suggestive without having established causal links between culture and educational outcomes.[28] A rare study in economics by Tramonte and Willms (2010) provides a largely correlational analysis pointing towards positive associations between parental cultural behaviours and children's educational performance. Recent causal works in economics (Ashraf et al., 2020; La Ferrara and Milazzo, 2017) show that *visible* cultural practices in the areas of bequests and marriages affect educational decisions. My research is more interested in the direct role of cultural values and beliefs *towards* education in shaping educational outcomes which has been rarely investigated (Becker et al., 2020; Figlio et al., 2019). My paper further makes a broader contribution in advancing our understanding of how culture in which traits have been shown to be persistent across centuries (Alesina et al., 2013; Giuliano and Nunn, 2020; Voigtländer and Voth, 2012) interacts with economics (Eugster and Parchet, 2019; Eugster et al., 2017;

[28] An exception is Jæger (2011), who uses household panel data to net out family fixed effects and finds evidence for a positive relationship between culture and academic achievement. By focusing on within-family differences between siblings, this analysis may however miss important dimensions of cultural background that differ between families.

Fernández, 2008; Fernández and Fogli, 2006; Guiso et al., 2006; Lowes et al., 2017; Nunn, forthcoming).

Second, my paper provides evidence to help understand the role of cultural values towards schooling in explaining cross-country differences in academic performance. An intriguing example is the PISA results in which students from Confucianism-originated countries such as South Korea, Hong Kong, China, Taiwan, Japan, Macao, Singapore, and Vietnam are surprisingly consistently among the top-ranked positions (see Appendix Table A.1. for the top ten-performing countries across the PISA waves).[29] Their PISA success stories have received enormous attention from both academics and policymakers around the world but have not been fully understood. Casual observation and anecdotal evidence suggest that Confucian cultural heritage in which high value is placed on education may be a factor in helping to explain PISA results (Jerrim, 2015; Jerrim and Choi, 2014).[30] Yet, whether such cultural differences causally affect test scores is largely unknown. My findings support the hypothesis that Confucian cultural heritage likely plays an important role in accounting for Northeast Asian success.

Third, my paper contributes to another literature strand that documents the long-run effects of historical institutions on contemporary economic development (Dell et al., 2018; Nunn, 2007, 2020; Michalopoulos and Papaioannou, 2020). My paper suggests that a pro-schooling-culture-inspired institution may contribute to long-run development via the human capital channel. A paper close to mine is one by Dell et al. (2018), which shows that historical exposure to the Dai Viet kingdom has positive effects on Vietnam's modern-day economic development. The authors argue that these benefits originated from Dai Viet's strong historical institutions of village-level local governance, which created persistent norms in favour of

[29] Northeast Asian students are also ranked at top positions in other competitions such as the Trends in International Mathematics and Science Study (see Provasnik et al., 2016).

[30] Public discussions also mentioned Confucian culture as a potential driver of the Northeast Asian success. For instance, the Economist (in 2016) and the Guardian (in 2014) respectively ran articles "Culture or policy? What the world can learn from the latest PISA test results," and "Culture, not just curriculum, determines East Asian school success."

cooperation and community engagement that favour economic development today. My study complements their findings through an in-depth analysis of the effects of Dai Viet exposure on modern-day educational outcomes. Differently from their paper, I highlight the *meritocratic* character of Dai Viet's institution as an important factor. Since I document the roots of these institutions in ancient Confucian culture and philosophy and argue that the persistent effects are based on the transmission of cultural values and beliefs, I interpret my results as the effects of culture on educational outcomes. Given that recent evidence in economics suggests that culture and institutions evolve jointly, influence each other over time, and likely affect long-run development (Nunn, 2012; Bisin and Verdier, 2017; Alesina and Giuliano, 2015; Lowes et al., 2017; Tabellini, 2010), fully disentangling the effects of historical culture from those of historical institutions is, however, typically unfeasible.

The remainder of my paper is structured as follows. Section 2.2 provides the cultural and historical background. Section 2.3 describes the data, and Section 2.4 discusses my empirical strategy. Section 2.5 presents the empirical results, while Section 2.6 explores the potential mechanisms. Section 2.7 provides results on intergenerational educational mobility. Section 2.8 concludes my paper.

2.2 Cultural and historical background

2.2.1 Confucianism and its emphasis on education

Confucianism arose as one of many doctrines of thought for constructing society under the Zhou dynasty (1046-256 B.C.) in ancient China. Confucianism was formally chosen as the imperial ideology which played the role of providing philosophical keystones for governing society (Kung and Ma, 2014). Rulers invested large amounts of resources to root Confucian

traditions into social life by spreading Confucian knowledge to local communities via teaching Confucian lessons and constructing Confucian temples in villages.

Confucianism particularly highlighted the role of education as being essential for societal transformation and advancement (Dutton et al., 2012).[31] It firmly valued high standards for the ruling class's competence, demonstrating that rulers and bureaucrats should be distinguished from commoners through their par excellence scholarship with the highest moral merits (Confucius, 1993). Confucianism valued educational success not only for the ruling class but also among males from lower social classes who, in the Confucian perspective, should achieve educational success through rigorous schooling to pursue a public service career (Tan, 2017). While Confucianism highlighted educational success as a core ethical conformity for any male in society, it promoted an equal openness of access to schooling because 'in education, there are no class distinctions' (de Bary and Bloom, 1960, IV, pp. 38). The emphasis on education has, therefore, been well-established as one of the central values of Confucianism (see Appendix B1 for the Confucian perspective on education).

In pre-modern independent Vietnam, since defeating ancient Chinese colonists, the historical state of Dai Viet used Confucianism as a formal imperial doctrine for constructing its monarchical regime's ethical, political, and social orders throughout its ruling times spanning from the late 10th to early 20th century (Duiker and Spielvogel, 2008; Kiernan, 2017; Kim, 1971). Dai Viet's Confucianism-inspired rulers valued the quality of state officials and thus education for the state's development.[32] Dai Viet, therefore, invested in its educational system as a fundamental means for creating the state's talents (Mo, 2003). Governors constructed

[31] Confucius once said, 'by nature men are pretty much alike, it is learning and practice that set them apart' and 'education breeds confidence, confidence breeds hope, hope breeds peace' (de Bary and Bloom, 1960, XVII, pp. 2).

[32] Emperor Le Thanh Tong once said that 'mandarins are the fundamental origin of the order or the disturbance. Virtuous and talented people holding state positions would make society in order. Otherwise, immoral and untalented people would cause a disordered society' and 'therefore, it is necessary for any emperors in any dynasties to emphasize training the talented, recruiting the intellectuals, and growing the national vitality' (Quoc Su Quan Trieu Nguyen, 1998).

systems of universities and schools in both the capital and localities to educate people as well as extensively opened access to school not only for royal clans and noblemen but also for those among talented commoners without discrimination based on a person's background (Thang, 2005).[33] Moreover, learning societies were developed across Dai Viet due to informal teaching activities in villages (Hong, 1992).

2.2.2 Exam-based meritocracy

Confucian ideology manifested its meritocratic essence by using talents for social governance (Elman, 1991). Being inspired by Confucianism, monarchical rulers used educational performance shown via imperial civic exams to recruit well-learned males to serve in the bureaucracy (Elman, 1991). The first exam-based meritocratic institution that initiated in ancient China was known as *keju*, the oldest exam-based meritocratic institution in the world, which was then spread to neighbouring states, including pre-modern Vietnam (Chen et al., 2020).[34]

Imperial civic exams which were broadly accessible to all males (but not for female candidates) regardless of a male's origin and social status would, to a large extent, provide talented citizens with significant 'equality of opportunity' to become bureaucrats and receive large material benefits and the prestigious reputation entitled with a public servant position. A paper by Chen et al. (2020) has found that this meritocratic institution promoted

[33] In 1070, Dai Viet established the Temple of Literature (*Van Mieu*) in the capital of Thang Long, which was known as the imperial temple presenting the statues of Confucius and his following intellectuals to manifest Dai Viet's recognition of Confucian values towards learning and education and also to encourage citizens acquiring knowledge (Son, 1968; Vien Khoa hoc Xa hoi Vietnam, 2001). Subsequently, Dai Viet constructed the first university of the empire the Imperial Academy (*Quoc Tu Giam*) in 1076 and the National Institute of Learning (*Quoc Hoc Vien*) in 1253 to establish key infrastructures for education at the central government level.

[34] Prior to exam-based meritocracy, public official vacancies were mainly chosen via an aristocratic mechanism in which the elite class with advantaged background and political connection occupied most of appointments. Such an aristocratic institution strongly violated Confucian perspective on fairness and efficiency in selecting civil servants. Identifying these problems, Emperor Wu of the Han dynasty (141-87 B.C.) in ancestral China was the first ruler to initiate imperial exams to select the best talents for governmental officials, opening a new era using the exam system as a key means for recruiting public servants.

intergenerational economic mobility in historical China. The benefits of exam success are evocatively illustrated in the poem '*Advice on Studying*' written by Emperor Zhenzong (968-1022) of the Song dynasty (920-1279); this poem aimed to encourage the emperor's citizens to join exams:

> *There is no need to buy land to make the family rich, for there are tons of grains in the books. There is no need to set the frame to build a house, for there are golden places in the books. There is no need to feel sorry for the lack of matchmakers for marriage, for there are jade-like beauties in the books. There is no need to worry about having no followers, for there are carriages and horses in the books. To fulfill his life ambition, men should bend over to the Confucian classics in front of the window* (Gu, 2014, pp. 106).

Given strong economic motivation, the exams were competitive with large numbers of participants. The exam system was thus a focal point in political and social life, making it exceptional as a key *meritocratic* character of historical institutions in Northeast Asia. Exam-based meritocracy and Confucianism jointly evolved in a two-way interaction in which meritocracy was initiated via the inspiration of Confucianism, and meritocracy, in turn, helped strengthen the roots of Confucianism in social life. As the exam curricula mainly relied on Confucian texts such as *Four Books and Five Classics*, learning and teaching activities of Confucian knowledge were substantially expanded. Confucian values would therefore lead to the forming of positive beliefs about the importance of schooling among not only exam takers but also the general population. This process repeated across generations for a long time and thus made Confucian values towards education prevalent during lengthy historical time periods (Elman, 1991).

Dai Viet developed its Confucian examination system to serve as the key means for public official recruitment which was highly similar to the Chinese system in terms of its format,

curricula, and admissions. The system lasted over 844 years starting in 1075 under the rule of the Ly dynasty and ending in 1919 under the rule of the last Nguyen dynasty[35] (see Appendix B2 for a description of Dai Viet's exam system structure).

When the French colonists arrived in Vietnam, Confucianism and its inspired exam-based meritocracy were formally removed until today. Yet, Confucianism and its exam-based meritocratic institutions continue to be mentioned as the 'national essences' characterizing Vietnamese culture and traditions (Dinh, 1969, 1970; Nghia, 2005; Kim, 1971). Historians and anthropologists strongly believe that, although Confucianism and exam-based meritocracy are no longer formally present in present-day Vietnam, their legacies are nonetheless alive through cultural values towards education that were created and have persisted over time to influence current generations' educational decisions (Anh, 1950; Thuc, 1967; Dinh, 1970; Giau, 1988; Khieu, 1997; Truong et al., 2016).

2.2.3 Khmer's culture and institution

The Khmer culture and institutions were markedly different from those of Dai Viet (Whitmore, 1997; Wolters and Wolters, 1999). While Dai Viet was a Sinic-style state of Northeast Asia, Khmer belonged to the Indic civilization of Southeast Asia (Lieberman, 1993). Khmer's culture was strongly influenced by the Indian religions of Buddhism and Hinduism, making it an intensively religious society (Hansen, 2004). The influence of Indian culture on the Khmer kingdom has been revealed through not only religion, ways of life, social norms, language, and arts but also architecture, all being imported from India and amended with local traditions (Tully, 2006).[36]

[35] Dai Viet's exam-based meritocracy was gradually replaced by other institutions since the French commenced in 1858.

[36] For example, Angkor Wat, which was constructed by the Khmer King Suryavarman II in the early 12th century in Yaśodharapura, the capital of the Khmer kingdom, is so far the greatest Hindu temple in the world.

In the religiously driven society of Khmer, education was not the focal point of social life. Educational activities were narrowly related to Buddhist monastic education, which was typically delivered by monks at temples (Kalab, 1976). Moreover, monastic education was only available to a limited number of people because the main role of temples was to manage elites' economic resources (Hall, 2010). Importantly, individuals from low social classes had fewer opportunities to access schooling because Khmer was predominantly influenced by 'the Indian traditions that remove ordinary people from literary consideration' (Chandler, 2018, p. 83).

Khmer's political institution relied on a decentralized system in which semi-independent administrative systems at the local level were mainly used by the central government in royal courts as bureaucratic tax collectors (Lieberman, 1993; Tarling, 1999; Woodside, 1971). Given such a decentralized regime, to maintain the central government's political control over local authorities, Khmer applied aristocratic rule for political appointments as well as public servant positions in which personal relationships with the kings and rulers played a key role (Chandler, 1983; Hall, 2010; Osborne, 1969). In such an aristocracy, the members of the royal family and the religious orders (Brahman priests) particularly enjoyed the highest chances of being chosen as governors and bureaucrats, while ordinary individuals were generally excluded from public positions (Tully, 2006, p. 39). This aristocracy was in contrast to the meritocracy of Dai Viet.

2.2.4 Dai Viet's southward advance and the 1698 boundary

Between the 11th and 19th centuries, Dai Viet engaged in a southward conquest to expand its territory by taking over the Champa and Khmer empires (Taylor, 1993, 2013; Quoc Su Quan Trieu Nguyen, 1972; Ngo et al., 2001). The conquest process, which occurred through multiple waves of territorial annexation in different times, was completed in 1833 when Emperor Minh Mang of the Nguyen dynasty accomplished the final conquest of the easternmost part of the Khmer empire, which is the southernmost part of today's Vietnam and is additionally known as the Mekong River Delta. Figure 2.1 depicts the complete process of Dai Viet's southward

expansion. Historians strongly emphasize that idiosyncratic political conditions independent of climate, geographic, and socioeconomic issues influenced the timing of Dai Viet's conquest process and southernmost borders (Taylor, 1993, 2013). Civil conflicts between two ruling families, the Trinh and the Nguyen, that started in the late 1620s divided the state into two rival governments, including the Trinh in the north and the Nguyen in the south (Taylor, 2013, p. 307; Sakurai, 2004, p. 40). The Nguyen attempted to expand its land southwardly; however, periodic fighting against the Trinh reduced its capacity to conquer Champa and Eastern Khmer by the late 17th century.

The focus of my study is on the second-to-last boundary, which was established in 1698 and separated the area around the boundary into two geographic regions with a gap of 135 years of exposure to Dai Viet culture and institutions before the commencement of French occupation in 1858. This boundary was originally derived from a defense treaty between the Nguyen and Khmer in early 1620 which helped both governments to have additional resources to fight against their rivals. Based on this treaty, the Nguyen married Princess Ngoc Van to King Chey Chetta II of Khmer and provided Khmer with naval armed forces to combat its western neighbouring state of the Siam kingdom. In exchange, Khmer granted the Nguyen the right to collect taxes for five years in Khmer's easternmost counties of Prei Nokor and Kampong Krabei,[37] which were later formally organized into Dai Viet's territory in 1698 (named as Gia Dinh in Vietnamese). Khmer planned to retrieve these counties after five years. However, the unexpected death of Chey Chetta II in 1628 caused this plan to fail (Vo, 2011). The Nguyen broke the treaty's initial term of returning Prei Nokor and Kampong Krabei back to Khmer. Then, with significant support from Ngoc Van[38] within Khmer's royal, the Nguyen successfully seized these counties and added them to Dai Viet, thus formally establishing the new

[37] The Nguyen was not allowed to make any interventions on formal governance in these counties during these years.

[38] Ngoc Van was appointed as Khmer's Queen. After Chey Chatta II died, Ngoc Van became Khmer's Queen Mother, who had a strong political influence within Khmer's royal.

administrative province of Gia Dinh in 1698 (Taylor, 2013; Vo, 2011). The Nguyen then reorganized this new land in a traditional Dai Viet manner by organizing a collective society that was based on Confucianism and northern institutions (Kiernan, 2017; Taylor, 1993; Wook, 2004).

The boundary became a formal state border between Dai Viet and Khmer from 1698 until 1833. Although the Nguyen was ambitious in capturing all the remaining parts of Eastern Khmer, its involvement in civil wars prevented it from completing this plan around 1698. When the Trinh-Nguyen civil war ended in the late 17th century through a ceasefire agreement, the Nguyen persisted in involving itself in a new war with the Tay Son family, which arose from peasant revolts against the ruling class in the late 1770s. In Northern Dai Viet, the Tay Son defeated the Trinh in the late 1780s. In Southern Dai Viet, a series of periodic conflicts between the Nguyen and the Tay Son made the southward expansion process stall at the 1698 boundary. Moreover, given the lack of resources for directly conquering the entire eastern part of Khmer, the Nguyen changed its strategy by cultivating patrons within the Khmer's royal court to maintain its political influence (Chandler, 2018). In 1802, the Nguyen finally defeated the Tay Son to reunify the entire country and become the only political holder in Dai Viet. After this, with all political powers, the Nguyen expanded its southward conquest directly. It finally organized the remaining territory of Champa in 1832 and the remaining counties of Easternmost Khmer in 1833, closing Dai Viet's nine-century 'March-to-the South' process.

2.2.5 Qualitative evaluation of the validity of the 1698 boundary

I rely on the 1698 boundary to construct my treatment status of Confucian cultural heritage. In this section, I provide several qualitative arguments supporting this boundary being the ideal choice for constructing the treatment and applying a SRDD approach. First, rich historical evidence marks the fact that the 1698 boundary was established as a result of exogenous

political circumstances within both the Dai Viet and Khmer kingdoms rather than as a result of climate, natural environment, or socioeconomic reasons, as discussed in Section 2.4.

Second, available historical and archaeological studies document similarities in natural environmental conditions and socioeconomic characteristics between the two sides of the 1698 boundary before its establishment (Marchand et al., 2014; Nguyen, 1971; Sakurai, 2004; Taylor, 2013). Before being conquered by Dai Viet, the entire area around the boundary was highly identical in terms of natural conditions. The area was particularly described as a backwater with highly scattered settlements of local people (Biggs, 2005; Nguyen, 1971; Sakurai, 2004). Furthermore, both sides of the boundary were uniquely under Khmer rule. As an easternmost part of Khmer located relatively far from the capital of Angkor, this area was less developed compared to other regions around the capital. Local livelihoods on both sides of the 1698 boundary mainly relied on agriculture with homogeneous cultivation techniques as well as productivity. As Khmer was a weak state with an insignificant focus on education, public investments in schooling were relatively trivial for regions that were distant from the central government. For that reason, educational activities were rare on both sides of the boundary before 1698 (Nguyen, 1971; Sakurai, 2004).

Third, both treatment and control communes in my study area experienced the same institutions during colonial and post-colonial times (Taylor, 2013). These institutions included French Cochinchina (1862-1945), the Empire of Vietnam (1945-1954), the Republic of Vietnam (1955-1975), and the Socialist Republic of Vietnam (1975-present). Treatment and control communes received similar policies and rules during these times, making both treatment and control communes highly comparable in terms of other characteristics except for their years of exposure to Dai Viet.

Fourth, the 1698 boundary provided control regions with the shortest duration (25 years) of exposure to Dai Viet, making them tenuous regarding the influence of Confucian culture

compared to the treatment regions while nonetheless satisfying other key requirements as discussed above. The geographic area, which was added into Dai Viet in 1832, as depicted in Figure 2.1, could be considered for another potential set of control regions, as it nearly provided the shortest time of exposure to Dai Viet (26 years) as well. However, both its northeast and southwest boundaries were the same administrative borders of the Champa kingdom before the area was conquered by Dai Viet (Taylor, 2013; Quoc Su Quan Trieu Nguyen, 1972; Ngo et al., 2001), violating the assumption of exogeneity of the treatment.

All of these qualitative arguments support the validity of the 1698 boundary for creating the exogenous treatment of exposure to Confucian cultural heritage for the SRDD analysis. In Section 2.4.2, I further provide quantitative and causal evidence that other climate and socioeconomic characteristics apart from the treatment were not statistically different between the treatment and control communes.

2.3. Data

2.3.1 Main analysis data

I use several datasets for my main analysis. These include the 15% sample of the 2009 Vietnam Population and Housing Census (hereafter 'Census') and the 2016 Vietnam National High School Completion Examination Scores (hereafter 'Exam Scores'). In order to hold the ethnic background constant throughout my study, I restrict the samples to individuals of Kinh ethnicity, who, on average, make up 86% of the population. Table 2.1 presents the summary statistics for the samples.

The Census is one of the largest micro datasets in Vietnam containing information about demographics, schooling, and housing for approximately 14 million observations from approximately 3.5 million households surveyed across the country. I exploit its schooling

section to construct educational measures, including schooling years and degree achievement (primary, lower secondary, and upper secondary school diploma, and a college degree) for adults and school enrolment for school-aged children.

I restrict the adult sample to those aged 25-64[39] and the children sample to those aged 15-17.[40] My final adult and child samples respectively contain 341,930 and 42,028 observations. panel A of Table 2.1 presents the summary statistics for this sample, with 9.3 average years of schooling, 82% of primary school completion, 68% of lower secondary school completion, 38% of upper secondary school completion, and 17% of college degree attainment. Children's post-compulsory school enrolment is nearly 71%.

The Exam Scores dataset is the administrative data containing the test scores of core subjects (including compulsory and selective ones) which are annually taken by *all* 12th-grade Vietnamese students at their national high school completion examinations among other types of students such as part-time students.[41] I exploit the 2016 Exam Scores data to construct the test score outcomes for compulsory subjects (mathematics, literature and English) and selective subjects (physics, chemistry and biology). I restrict the sample to 12th-grade students of the 1998 birth cohort, which account for approximately 80% of the exam takers.

[39] I use the 25-64 age range because 25 is reasonably a stopping age for the highest educational level while 64 is still a well-representative age among the aging population in 2009. Therefore, those aged 25 and older would have in principle their lifetime schooling outcomes while excluding those aged over 64 would be a good strategy to avoid selection bias because the well-educated tend to live longer (over 64 years old) and thus have a higher likelihood to be included in the Census.

[40] In Vietnam, children start primary school (grade 1) at age 6 and complete high school (grade 12) at age 17 in Vietnam. In 2009, the ages for post-compulsory education are 15-17.

[41] These exams are held in a nationally comparable way in which their institutional arrangement and contents such as problems and solutions are identical across schools and provinces. The results from these exams are used for ranking students' high school graduation class (excellent, good, average, nearly passed, and failed) and also for university admissions.

TABLE 2.1: SUMMARY STATISTICS

	All		Treatment		Control	
	Observations	Mean	Observations	Mean	Observations	Mean
	Panel A. Vietnam Population and Housing Census (2009, 15% sample)					
Adult sample (25-64 years old)						
Schooling years (years)	341,930	9.349	235,650	10.285	106,280	7.274
Primary school completion (dummy)	341,930	0.823	235,650	0.882	106,280	0.693
Lower secondary school completion (dummy)	341,930	0.683	235,650	0.774	106,280	0.480
Upper secondary school completion (dummy)	341,930	0.378	235,650	0.463	106,280	0.189
College degree (dummy)	341,930	0.174	235,650	0.222	106,280	0.068
Child sample (15-17 years old)						
Post-compulsory school enrolment (dummy)	42,028	0.707	26,192	0.740	15,836	0.652
	Panel B. Vietnam National High School Examination Data (2016)					
Math scores (0-10 scale)	93,767	4.781	65,598	4.975	28,169	4.331
Literature scores (0-10 scale)	93,730	5.052	65,574	5.125	28,156	4.881
English scores (0-10 scale)	84,996	3.739	62,741	3.924	22,255	3.218
Physics scores (0-10 scale)	59,818	5.894	41,086	5.986	18,732	5.694
Chemistry scores (0-10 scale)	45,787	5.312	29,102	5.419	16,685	5.126
Biology scores (0-10 scale)	13,451	5.225	7,820	5.533	5,631	4.798

As the Exam Score data only has information about students' residential locations at the province level but not at the commune level, I restrict the sample to students living in the provinces around the 1698 boundary, acting as treatment regions (Ho Chi Minh City and Dong Nai) as well as control regions (Binh Duong, Tay Ninh, and Long An). The score for each subject is measured by a 10-point scale which ranges from zero (the lowest score) to 10 (the highest score). The sample sizes vary by subject, and compulsory subjects have larger samples relative to selective subjects. Panel B of Table 2.1 presents the mean scores and the number of students for these subjects, including 4.8 for mathematics (93,767 students), 5.1 for literature (93,730 students), 3.7 for English (84,996 students), 5.9 for physics (59,818 students), 5.3 for chemistry (45,787 students), and 5.2 for biology (13,451 students). To make my interpretation of the results more straightforward, I standardise the continuous variables of the logs of the scores into a mean of 0 and a standard deviation of 1.

2.3.2 Mechanism data

I additionally use several datasets to explore potential mechanisms behind the causal effects of interest, including cultural values and beliefs towards schooling and human capital investments. I firstly rely on the Asian Barometer Survey (ABS) to construct my measures of cultural values towards schooling. The ABS is an international survey carried out in 18 countries and territories in East and Southeast Asia, including Vietnam. The ABS elicits respondents' opinions about political attitudes and behaviour, social capital, traditionalism and culture, international affairs, and globalization. To construct the sample, I particularly use three ABS waves of 2003, 2004 and 2006 for Vietnam and restrict the data to those living in four provinces around the 1698 boundary, including Ho Chi Minh City and Ba Ria-Vung Tau for treatment regions, and Tien Giang and Can Tho for control regions. I rely on two main proxy measures for cultural values towards schooling. I particularly construct an indicator for *a preference for having better educational attainment as already achieved* by exploiting the following question: *Please tell*

me how satisfied or dissatisfied you are with your educational attainment in your life: (1) Very satisfied; (2) Somewhat satisfied; (3) Neither satisfied nor dissatisfied; (4) Somewhat dissatisfied; (5) Very dissatisfied. The indicator has a value of one if the answer is (4) or (5), and zero otherwise. For the second measure, I construct an indicator for *having beliefs about the importance of access to higher education beyond compulsory schooling* using the following question: *Of the following lifestyle aspects or life circumstances, please select five that are important to you: (1) Having enough to eat; …; (7) Having access to higher (beyond compulsory education) education; (8) Owning lots of nice things*… The indicator takes a value of one if the choice set includes (7) and zero if the choice set does not include (7).

Second, I use the 2010, 2012, 2014 and 2016 waves of the Vietnam Household Living Standards Survey (VHLSS). The VHLSS is a biannual household survey including about 40,000 individuals from 9,000 households drawn from the Census population. I extract information on children's education to construct several specific measures of parental spending on school-related activities over the last 12 months: school tuition, books and learning materials, learning tools and instruments, private tutoring, and total overall spending on education. These monetary expenditure variables are measured in 1,000 Vietnam Dong (VND) in 2010 prices, with the exchange rate equaling roughly 20,000 VND per 1 U.S. Dollar in 2010.

2.4 Empirical strategy

2.4.1 Estimation methods

I start with a simple descriptive confirmation of whether educational outcomes change with the length of time exposed to Dai Viet. I estimate the following ordinary least squares (OLS) equation using a full sample of individuals living across all Vietnamese regions involved in the Kinh ethnicity's territorial expansion:

$$Y_{ir} = \alpha_0 + \alpha_1 Duration_{ir} + \alpha_2 Duration_{ir}^2 + \alpha_3 \boldsymbol{X'}_i + \epsilon_{ir} \quad (2.1).$$

Y_{ir} is an educational outcome for individual i living in region r. $Duration_{ir}$ is the duration of exposure to Confucian culture measured by one hundred years between the year the region was added to Dai Viet and 1858 when the French arrived in Vietnam. $\boldsymbol{X'}_i$ is the set of control variables, including birth cohort fixed effects and a dummy for gender (male). ϵ_{ir} is an error term. Standard errors are clustered at the commune level. I allow for a quadratic in $Duration_{ir}$ in order to allow for decreasing effects of annexation duration. I expect smaller effects at higher levels of duration because at high levels of duration (say, 600 years in the treatment regions versus 500 years in the control regions), the control region as well had ample time to absorb the culture in order that a 100-year difference could make less of a difference. The marginal effect of annexation duration is $ME_{Duration} = \alpha_1 + 2\alpha_2 Duration_{ir}$ and indicates how the educational outcome changes with an additional 100 years of exposure to Confucian culture. The coefficient α_1 can be interpreted as the effect of the first 100 years of annexation.

In producing the estimates of causal treatment effects, however, the OLS estimates using Equation (2.1) are, arguably, possibly biased due to potential confounders. The economics literature has shown that many factors other than culture can drive schooling outcomes and thus possibly play the role of being potential confounders. These factors include climate and weather (Park et al., 2020; Randell and Gray, 2019), natural disasters (Takasaki, 2017), historical formation (Gallego 2010), political regimes (Fuchs-Schündeln and Masella, 2016), conflicts (Shemyakina, 2011; Chamarbagwala and Morán, 2011), and opportunity costs of schooling (Carrillo, 2020; Shah and Steinberg, 2017). In the context of Vietnam, these confounding factors are possible, as there are obvious regional differences in several characteristics across the country. First, climate differences are well documented across Vietnamese regions. For instance, while increases in annual temperatures are higher in southern than in northern regions (Nguyen et al., 2014; Phan et al., 2009), provinces in the middle region are more likely to suffer

from annual natural disasters such as typhoons and storms than those in northern and southern regions (Noy and Vu, 2010). Second, regarding the history of state formation, different regions have experienced the rules of different sets of institutions. While northern provinces purely belonged to the rule of a Chinese-style statecraft (also known as the Sinic state of Northeast Asia), provinces in the middle and southern regions were primarily governed by a Hindu-Buddhist statecraft (also known as the Indic state of Southeast Asia) during pre-modern times (Wolters and Wolters, 1999). Third, during the Vietnam war (1955-1975), northern Vietnam was uniquely a Soviet Union-style socialist state, whereas southern provinces enjoyed a United States-style market system. The distribution of bombings dropped by American air forces was additionally uneven across Vietnamese provinces (Miguel and Roland, 2011). Last but importantly, educational policies in Vietnam have potential regional heterogeneity in their impacts, leading to various changes in schooling attainment (Cornelissen and Dang, 2020). These possible differences across Vietnamese regions spanning from natural to social and historical characteristics make causal inference from the OLS estimates unreliable.

To disentangle the causal impact of Confucian cultural heritage on modern-day educational success, I follow Dell et al. (2018) to draw my main empirical analysis on a SRDD. I particularly estimate the following equation:

$$Y_{ict} = \beta_0 + \beta_1 Confucian_{ic} + f(Geo_c) + \sum_{j=1}^{n} \beta_2 Seg_{cj}$$

$$+ \beta_3 Dist_c + \beta_4 \boldsymbol{X'}_i + \theta_t + \varepsilon_{ict} \qquad (2.2).$$

Y_{ic} is the educational outcome for individual i living in commune c. $Confucian_{ic}$ is an indicator for the individual living in a treatment commune, implying a 135-year longer historical exposure to Confucian cultural heritage compared one living a control commune. $f(Geo_c)$ is a linear polynomial function of latitude and longitude of the corresponding commune (which I extend to a quadratic polynomial in a robustness check). The length of the

1698 boundary is divided into 20 segments ($n = 20$). In Equation (2.2), Seg_{cj} is segment j of the 1698 boundary to which commune c is adjacent. The term $\sum_{j=1}^{n} Seg_{cj}$ indicates boundary segment fixed effects. $Dist_c$ is the distance from the commune to Saigon, the central area of Ho Chi Minh City. $\boldsymbol{X'}_i$ is the set of control variables including birth cohort fixed effects and a dummy for gender.

θ_t indicates survey year fixed effects used to control for potential time trends across survey years in specifications using the ABS and VHLSS data consisting of several survey waves, and it is removed in specifications using the Census and Exam Scores data with only one year. ε_{ict} is an error term. My parameter of interest is the coefficient β_1, which provides the causal effect of Confucian cultural heritage on the educational outcome. Standard errors are clustered at the commune level, which is the level of spatial characteristics.

It is important to note that I interpret the coefficient of β_1 as the effects of Confucian cultural heritage on the schooling outcome although this estimate only provides a reduced-form effect of exposure to Dai Viet rather than a direct effect of Confucian culture. This is because while Confucianism, that has strong connections with valuing education, was deeply rooted in treatment regions, institutions and policies in both treatment and control regions were changed and unified under the French and the subsequent political regimes as described in Section 2.2.5. For that reason, the persistent difference in schooling must have been driven by Confucian culture that is passed on from parents to children. Moreover, I show that cultural values and beliefs today are affected by the treatment in Section 2.6.1, which indirectly supports the idea that the cultural transmission of Confucianism is the mechanism of the persistent effect.

2.4.2 Examining potential confounders

To ensure that the effects of interest could be interpreted as causal treatment effects, it is essential for the SRDD strategy to satisfy the key identifying assumption that all relevant factors apart from the treatment and the educational outcomes must change smoothly at the 1698

boundary. To evaluate the plausibility of this assumption, I provide a series of balance tests using the commune-level data from the 2010, 2012, 2014, and 2016 waves of the VHLSS and estimate the baseline SRDD specification using Equation (2.2), in which the explanatory variables include a dummy for the treatment status, a linear function of latitude and longitude, dummies for boundary segments, the distance from the commune to *Sai Gon*, and boundary segment fixed effects. The results are present in Table 2.2, focusing on geo-climatic characteristics, local organisation and infrastructure (panel A), local economic structure and labour market costs (panel B), central and local government policy (panel D), and demographic characteristics and local school organization (panel E). I find that all these pre-determined characteristics smoothly work through the boundary.

Columns 1-2 of panel A show that there are no statistically significant differences in geo-climatic characteristics, including with indicators for mountainous terrain (column 1) and the number of natural disasters that had occurred in the commune over the previous 12 months (column 2). Additionally, columns 3-6 of panel A present statistically insignificant effects on local organization and infrastructure, in particular an indicator for the high quality of commune roads (column 3), an indicator for having a post office (column 4), an indicator for having a local radio station (column 5), and an indicator for having a community house (column 6).

Columns 1-3 of panel B document the similar results for local economic structure for both sides of the boundary. The effects on indicators for main economic activities such as agriculture (column 1), and aquaculture (column 2) are all statistically insignificant. In the same manner, the estimates in columns 3-6 of panel B demonstrate that labour prices for economic activities are balanced between the treatment and control regions. I use an average price of agricultural production (column 3) and component prices for specific main tasks, including land preparation (column 4), caring (column 5), and harvesting (column 6). While the opportunity costs of schooling may affect educational decisions in less developed countries (Carrillo, 2020; Shah

and Steinberg, 2017), my results suggest that labour prices, which are effective proxies for the opportunity costs of schooling, are fairly equal across local labour markets, as this is the case in both the treatment and control regions of my study.

Another concern could be that the implementation of development policies such as public infrastructure investments possibly differ across treatment and control regions (Do et al., 2017) and could drive schooling outcomes. As seen in panel C of Table 2.2, I examine the treatment effects on the implementation of both central and local government policies. I use an indicator for the receipt of a development project operated by the central government over the last three years as a proxy for the central government policies in column 1 (panel C) and find no differences at the boundary. In columns 2-6, panel C, I examine the effects on various measures of the local government policies which were carried out by the province and district authorities over the previous 12 months, including the percentage of households receiving financial support (column 2), the percentage of households receiving support from aid programmes due to natural disasters and production loss (column 3), the percentage of households receiving vocational training (column 4), the percentage of households receiving business tax exemptions (column 5), and an indicator for having an irrigation system (column 6). I find no statistically significant effects on these outcomes, suggesting that disparities in educational outcomes between the treatment and control regions are not potentially driven by the execution of development policies at both the central and local government levels across regions.

TABLE 2.2: BALANCE TESTS

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Geo-climatic characteristics, local organisation, and infrastructure					
	Mountainous terrain (dummy)	Natural disaster (time)	Good commune road (dummy)	Post office (dummy)	Radio station (dummy)	Community house (dummy)
Confucian	0.037	0.006	-0.006	-0.009	-0.082	0.020
	(0.030)	(0.227)	(0.053)	(0.094)	(0.058)	(0.079)
Observations	271	271	271	271	271	271
	Panel B. Local economic structure and labour market costs					
	Agriculture as main activity (dummy)	Aquaculture as main activity (dummy)	Agricultural labour price (VND1,000, log, prices in 2010)	Land preparation price (VND1,000, log, prices in 2010)	Caring price (VND1,000, log, prices in 2010)	Harvesting price (VND1,000, log, prices in 2010)
Confucian	0.008	-0.018	0.017	0.013	-0.007	-0.004
	(0.079)	(0.018)	(0.038)	(0.035)	(0.043)	(0.048)
Observations	271	271	271	271	271	271
	Panel C. Central and local government policy					
	Central gov: Development project (dummy)	Local gov: finance (% hh received)	Local gov: aid programme (% hh received)	Local gov: vocational training (% hh received)	Local gov: business tax exemption (% hh received)	Local gov: irrigation system (dummy)
Confucian	-0.020	-0.013	-0.001	0.004	-0.004	-0.012
	(0.076)	(0.020)	(0.003)	(0.007)	(0.004)	(0.098)
Observations	271	263	255	252	252	270
	Panel D. Demographic characteristics and local school organisation					
	Kinh as major ethnicity (dummy)	Giving birth at hospital (dummy)	Nursery school (dummy)	Kindergarten school (dummy)	Primary school (dummy)	Secondary school (dummy)
Confucian	-0.039	0.0003	0.042	-0.068	0.027	0.015
	(0.042)	(0.039)	(0.028)	(0.071)	(0.023)	(0.095)
Observations	271	271	271	271	271	271

Notes: Samples restrict to communes within 20 kilometers of the boundary distance. Robust standard errors clustered at the commune level are in parentheses. Controls include a linear function of latitude and longitude, a dummy for river segments, distance from commune to Sai Gon, and boundary segment fixed effects.

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

Data source: Vietnam Household Living Standards Surveys (2010, 2012, 2014 and 2016)

Finally, I further find no differences around the 1698 boundary for the effects on key demographic characteristics and local school organization, as seen in panel D. I find that the distribution of the Kinh ethnicity, who are the ethnic majority in present-day Vietnam, is balanced across regions (column 1). An indicator for giving births at the hospital as opposed to a traditional home birth (column 2), which possibly captures traditional versus modern norms, changes smoothly at the boundary as well. In terms of local school organization, I do not find differences in the measures of the supply side of schooling, including an indicator for having a nursery school (column 3), an indicator for having a kindergarten school (column 4), an indicator for having a primary school (column 5), and an indicator for having a lower or upper secondary school (column 6).

2.5 Empirical results

2.5.1 Stylised facts

I start my discussion of the empirical results by presenting the OLS estimates of the association between the duration of exposure to Dai Viet rule and present-day schooling outcomes using Equation (2.1). I use two samples: one countrywide sample (the country sample being 3,638,776 individuals)[42] and one sample restricted to those living within 20 kilometres of the 1698 boundary (the SRDD sample being 341,930 individuals).

The estimates in Table 2.3 show that the duration of exposure to Dai Viet rule is statistically significantly related to increases in present-day schooling outcomes using both the country and SRDD samples. The coefficients are all highly statistically significant at the 1% level. In the overall country sample, the coefficient on the linear term of $Duration$ (α_1 in Equation (2.1)) is the marginal effect of duration evaluated at zero duration. It can be

[42] I exclude those living in the provinces: Gia Lai, Kon Tum, Dak Lak, Dak Nong, and Lam Dong, which were out-of-the conquest process engaged by the Dai Viet kingdom.

approximately interpreted as the effect of 100 years of Dai Viet rule compared to zero years of Dai Viet rule.

TABLE 2.3: ANNEXATION DURATION AND EDUCATIONAL OUTCOMES

	(1)	(2)	(3)	(4)	(5)	(6)
	Schooling years	Primary school	Lower secondary school	Upper secondary school	College degree	Children's post-compulsory school enrolment
	Panel A. Country sample					
Duration	0.915***	0.084***	0.102***	0.062***	0.037***	0.074***
	(0.039)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)
Duration squared	-0.060***	-0.005***	-0.005***	-0.005***	-0.003***	-0.005***
	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	3,638,776	3,638,776	3,638,776	3,638,776	3,638,776	616,475
	Panel B. SRDD sample					
Duration	2.190***	0.137***	0.213***	0.200***	0.112***	0.066***
	(0.114)	(0.009)	(0.013)	(0.010)	(0.007)	(0.010)
Observations	341,930	341,930	341,930	341,930	341,930	42,028

Notes: Observations are at the individual level. Sample includes individuals aged 25-64. Country samples include individuals in all provinces across the country (excluding four out-of-the conquest provinces: Gia Lai, Kon Tum, Dak Lak, Dak Nong and Lam Dong). RDD samples includes individuals in communes within 20 kilometers of the boundary distance (the distance from the commune to the 1698 boundary). Robust standard errors clustered at the commune level are in parentheses. Duration is measured by one hundred years between the year the land was added into Dai Viet and the French arrival timing in 1858. Specifications include control variables (a dummy for male) and cohort-fixed effects.

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

Data source: Vietnam Population and Housing Census (2009, 15% sample)

As shown in panel A, for adults aged 25-64, this leads to an increase of 0.9 schooling years (column 1), 8.4 percentage points for primary school completion (column 2), 10.2 percentage points for lower secondary school completion (column 3), 6.2 percentage points for upper secondary school completion (column 4), and 3.7 percentage points for achieving a college degree (column 5). A zero-to-100-year increase in exposure to Dai Viet rule additionally raises post-compulsory school enrolment for children aged 15-17 by 7.4 percentage points (column 5). For all outcomes presented in panel A, the coefficient on the squared term of $Duration$ is negative, implying that the effect of duration diminishes at higher values of duration, as expected (see the discussion of Equation (2.1) above). For example, for years of

schooling, the marginal effect of an additional 100 years of annexation declines from 0.9 when evaluated at zero year to 0.3 when evaluated at 500 years of duration.

For the SRDD sample (panel B), it is not possible to identify a non-linear specification of annexation duration because the duration only assumes two values (160 years versus 25 years). Panel B therefore only reports a linear effect. The results show considerably higher associations between the duration of exposure to Dai Viet rule and schooling outcomes in the SRDD sample as compared to the overall sample. An additional 100-year duration of Dai Viet exposure is related to an increase in the number of schooling years by about two years (column 1), primary school completion by nearly 14 percentage points (column 2), lower secondary school completion by 21 percentage points (column 3), upper secondary school completion by 20 percentage points (column 4), and college degree completion by 11 percentage points (column 5).[43]

2.5.2 Effects on adults' educational attainment and degree achievement

Next, I present my empirical results for the treatment effects on adults' lifetime educational outcomes in Table 2.4, including schooling years (panel A), primary school completion (panel B), lower secondary school completion (panel C), upper secondary school completion (panel D), and a college degree (panel E). For each outcome, I use several different specifications in addition to the baseline SRDD specification to check how robust the estimates are.

For comparison purposes, column 1 presents the simple OLS estimates in which I exclude from the baseline SRDD specification in Equation (2.2) all spatial terms (a linear polynomial function of latitude and longitude of the corresponding commune, the boundary segment fixed effects, and the distance from the commune to *Saigon*). In principle, these regressions are

[43] Several reasons might explain the higher effects in the SRDD sample. There might be regional effect heterogeneity, and the regions covered by the SRDD sample might simply have higher effects compared to regions at comparable margins of duration in the country sample. Alternatively, the parametric nonlinear specification in panel A as a quadratic might be restrictive and may lead to an under-estimate of the duration effect at low margins of duration.

similar to those presented in Table 2.3, but for comparability with the SRDD approach, the effects are then scaled differently. While, as shown in Table 2.3, the coefficients are scaled for a 100-year increase in historical exposure to Confucianism, the effects presented in Table 2.4 are scaled for a 135-year increase (corresponding to the difference observed at the 1698 boundary). As expected, the effects shown in column 1 of Table 2.4 are greater than those shown in Table 2.3 by a factor of 1.35, confirming the substantially positive and highly statistically significant associations between duration of exposure to Dai Viet rule and schooling outcomes.

Column 2 of Table 2.4 presents the baseline SRDD estimates which are used as my main results. The treatment effects considerably lessen to between one-fifth and one-quarter of the OLS effects, suggesting that there are upward biases in the OLS estimates when excluding all spatial terms. Panel A shows that Confucian cultural heritage increases schooling years by an average of 0.69 years (statistically significant at the 1% level). The estimates in panels B, C and D show that Confucian cultural heritage increases the probability of completing basic school levels by 3.8 percentage points (statistically significant at the 5% level) for primary school, 7.8 percentage points (statistically significant at the 1% level) for lower secondary school, and 6.1 percentage points (statistically significant at the 1% level) for upper secondary school. Importantly, the cultural effect further reaches tertiary education. Panel E indicates that a person living in a region with Confucian cultural heritage is, on average, more likely to obtain a college degree by about 2.7 percentage points (statistically significant at the 10% level).

As seen in the remaining columns, I perform several robustness checks for the baseline SRDD model. First, the literature on applied RDD methods documents a debate regarding the choice between a linear polynomial function and high-order polynomials of the cut-off variable (Gelman and Imbens, 2019; Imbens and Wager, 2019). To check whether my baseline results change when using a higher-order polynomial function of the geographic running variable, I

use a quadratic polynomial function instead of a linear polynomial function of latitude and longitude, as shown in column 3 of Table 2.4. This specification produces highly similar estimates compared to the baseline SRDD approach in terms of both their effect sizes and the statistical significance levels.

TABLE 2.4: EFFECTS ON ADULTS' SCHOOLING OUTCOMES

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	Baseline SRDD	Quadratic polynomial in geographic locations	Excluding urban HCM City	Excluding urban	Excluding river segments
	Panel A. Schooling years					
Confucian	2.956***	0.687***	0.771***	0.498**	0.544***	0.930***
	(0.154)	(0.188)	(0.193)	(0.210)	(0.180)	(0.195)
	Panel B. Primary school completion					
Confucian	0.185***	0.038**	0.037**	0.026*	0.022	0.026*
	(0.012)	(0.016)	(0.016)	(0.015)	(0.019)	(0.015)
	Panel C. Lower secondary school completion					
Confucian	0.288***	0.078***	0.079***	0.058**	0.058**	0.068**
	(0.018)	(0.024)	(0.025)	(0.025)	(0.025)	(0.030)
	Panel D. Upper secondary school completion					
Confucian	0.270***	0.061***	0.073***	0.047**	0.057***	0.106***
	(0.013)	(0.018)	(0.018)	(0.019)	(0.014)	(0.015)
	Panel E. College degree					
Confucian	0.151***	0.027*	0.037***	0.019*	0.026***	0.071***
	(0.009)	(0.014)	(0.014)	(0.011)	(0.006)	(0.011)
Observations	341,930	341,930	341,930	167,381	129,936	184,434
Clusters	574	574	574	311	255	319

Notes: Samples restrict to individuals in communes within 20 kilometers of the boundary distance (adults aged 25-64). Robust standard errors clustered at the commune level are in parentheses. OLS specification in column 1 includes controls (a dummy for male) and birth cohort-fixed effects. Baseline specification in columns 2-6 includes controls (a dummy for male), a linear function of spatial location, distance to Saigon, boundary segment-fixed effects and birth cohort-fixed effects. Linear function of spatial location is a linear function of latitude and longitude of the commune. Boundary segment varies with a 20-kilometer unit. Distance to Saigon (kilometers) is measured by the shortest travelling distance from the center of commune to the center of Ho Chi Minh City (Ho Chi Minh City People's Committee Hall).

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

Data source: Vietnam Population and Housing Census (2009, 15% sample)

Second, regional economic development has been shown to link to educational attainment. My treatment regions include observations from Ho Chi Minh City's urban areas, which are the most developed areas in Vietnam. A possible concern is therefore that this

inclusion could drive the baseline treatment effects. I, therefore, estimate another version of the SRDD sample that excludes individuals living in urban Ho Chi Minh City from the treatment regions. All the estimates remain statistically significant (column 4, Table 2.4), and treatment effects reduce by 20-30% compared to the baseline SRDD effects. These findings confirm that the inclusion of urban Ho Chi Minh City does not largely drive my baseline treatment estimates.

Third, there is the possible issue that urbanicity either acts as a confounder (although this is unlikely due to the smoothness of placebo outcomes, as demonstrated in Table 2.2) or that effects are purely driven by urban areas. For that reason, in column 5 of Table 2.4, I present estimates using another sample that excludes all individuals living in urban areas from the SRDD sample. The results show that the treatment effects remain highly robust for nearly all outcomes. Among the statistically significant effects, the effect sizes range from 4-26% of the baseline effects. An exception is the effect on primary school completion, shown in panel B, which is statistically insignificant at the 10% level.

Fourth, the 1698 boundary comprises both river and non-river segments. River segments possibly play a role as a natural physical barrier inhibiting social interactions across the boundary, leading to the stronger preservation of distinct cultures on both sides. Non-river segments, in contrast, possibly facilitate social interaction leading to a dilution of historical cultural differences, subsequently possibly leading to smaller treatment effects when focusing on non-river segments of the border. To check whether this is the case, I estimate a sub-sample that excludes all individuals living on both sides of the boundary's river segments. The results shown in column 6, Table 2.4 do not provide clear evidence of any dilution of the treatment effects. While the estimates for the effect on primary school completion (panel B) and lower secondary school completion (panel C) are smaller than the baseline effects, the estimates for the effect on schooling years (panel A), upper secondary school (panel D), and a college degree (panel E) are larger than the baseline estimates.

Furthermore, I explore heterogeneity in the baseline SRDD estimates by various age groups (25-34, 35-44, 45-54, and 55-64). If effects were absent for the oldest age groups, for example, this would cast doubt on the interpretation of the effects as stemming from the intergenerational transmission of historical culture. The results are in Appendix B, Table B.2. I find statistically significant effects for all age groups in nearly all schooling outcomes. There is a pattern by which increases in lower degrees (primary and lower secondary schooling) are driven by older age cohorts, and increases in higher degrees (in particular, for college) are driven by younger age cohorts. This is consistent with a general increase in educational attainment over time. When examining the overall measure of years of schooling, the youngest (25-34) and oldest (55-64) groups have the largest effects. Thus, there is no sign that either the youngest or the oldest group is entirely driving the results.

2.5.3 Effects on children's school enrolment and academic performance

Table 2.5 presents the results for the effects of Confucian cultural heritage on the post-compulsory school enrolment of children aged 15-17 years old. While school enrolment is likely a commonly used proxy for quantity of education, I specifically focus on children aged 15-17 because schooling is compulsory for children aged 14 and younger in Vietnam (Cornelissen and Dang, 2020). I estimate a set of specifications similar to those presented in Table 2.4, including OLS (column 1), baseline SRDD (column 2) and other robustness specifications (columns 3-6). The OLS estimate shown in column 1, Table 2.5 indicates that Confucian cultural heritage increases school enrolment among school-aged children by 8.9 percentage points (statistically significant at the 1% level).

The baseline SRDD estimate shows an increasing effect of Confucian cultural heritage on school enrolment by 5.8 percentage points (statistically significant at the 5% level). The baseline SRDD estimate is smaller than the OLS estimate by approximately 35%, implying a potential upward bias in the OLS estimate. This baseline estimate is additionally strongly robust

compared to the estimates using other robustness specifications, as shown in columns 3-6, Table 2.5. For example, the specification using a quadratic polynomial function of geographic locations in column 3 produces an effect of 7.9 percentage points (statistically significant at the 1% level). When excluding the observations from urban Ho Chi Minh City and all urban areas from the baseline sample, the treatment effects are 5.1 percentage points (statistically significant at the 5% level) and 5.4 percentage points (statistically significant at the 5% level), respectively, as shown in columns 4 and 5. Finally, in column 6 of Table 2.5, when excluding the observations of persons living around river segments from the baseline sample, I obtain an effect of 8.3 percentage points (statistically significant at the 1% level).

TABLE 2.5: EFFECTS ON CHILDREN'S POST-COMPULSORY SCHOOL ENROLMENT

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	SRDD Baseline	Quadratic polynomial in geographic locations	Excluding urban HCM City	Excluding urban	Excluding river segments
Confucian	0.089***	0.058**	0.079***	0.051**	0.054**	0.083***
	(0.014)	(0.025)	(0.025)	(0.025)	(0.026)	(0.027)
Observations	42,028	42,028	42,028	24,426	19,519	24,131
Clusters	574	574	574	311	255	319

Notes: Baseline samples restrict to individuals in communes within 20 kilometers of the boundary distance (children aged 15-17). Robust standard errors clustered at the commune level are in parentheses. Baseline specification includes controls (a dummy for male), a linear function of spatial location, distance to Saigon, boundary segment-fixed effects and cohort-fixed effects. Linear function of spatial location is a linear function of latitude and longitude of the commune. Boundary segment varies with a 20-kilometer unit. Distance to Saigon (kilometers) is measured by the shortest travelling distance from the center of commune to the center of Ho Chi Minh City (Ho Chi Minh City People's Committee Hall).

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

Data source: Vietnam Population and Housing Census (2009, 15% sample)

Next, I investigate the cultural effects on academic performance by focusing on standardised test scores from the 2016 Exam Scores data. The sample sizes vary by specific subject, and Mathematics, Literature, and English have higher numbers of students, while smaller numbers of students study selective subjects. I regress each of the test score outcomes on Confucian cultural heritage and a set of controls (dummies for gender and birth months). In

the model, all spatial terms in Equation (2.2) are not included because information about the location of students at the commune level is not available in the dataset. The model is thus similar to the OLS model presented in the previous tables, and I expect the effects to be biased upwards. I could therefore interpret my results as upper-bound estimates. The estimates are present in Table 2.6.

TABLE 2.6: CONFUCIAN CULTURAL HERITAGE AND TEST SCORES

	(1)	(2)	(3)
	Panel A. Compulsory subjects		
	Mathematics	Literature	English
Confucian	0.366***	0.244***	0.447***
	(0.008)	(0.007)	(0.007)
Observations	93,767	93,730	84,996
	Panel B. Selective subjects		
	Physics	Chemistry	Biology
Confucian	0.213***	0.213***	0.441***
	(0.009)	(0.010)	(0.017)
Observations	59,818	45,787	13,451

Notes: Sample includes individuals of the 1998 cohort. Robust standard errors clustered at the individual level are in parentheses. Scores are standardised into a mean of 0 and a standard deviation of 1. Control variables include dummies for gender (male) and birth month.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Data source: Vietnam National High School Examination Data (2016)

The results demonstrate that students from Confucian cultural heritage regions perform much better than those in control regions for all subjects. Panel A presents the estimates for compulsory subjects, which show that Confucian cultural heritage increases the scores for Mathematics by 37% of a standard deviation (column 1), Literature by 24% of a standard deviation (column 2), and English by 44% of a standard deviation (column 3). Similarly, panel B documents substantial and positive effects of Confucian cultural heritage on performance in selective subjects, with 21%, 22%, and 46% of a standard deviation for Physics (column 1), Chemistry (column 2), and Biology (column 3), respectively. All these estimates are highly statistically significant at the 1% level.

2.6 Potential mechanisms

2.6.1 Cultural values and beliefs towards education

To study the main mechanism for the effect of Confucian cultural heritage on educational success, I investigate two proxy measures for cultural values and beliefs towards schooling constructed from the ABS data. These include an indicator for *a preference for having better educational attainment as already achieved*, and an indicator for *beliefs about the importance of access to higher education beyond compulsory schooling*. For each measure, I present estimates on two samples: one entire sample of all the observations of persons living in all available provinces and another sample restricted to the observations of persons who only reside in the two largest cities: Ho Chi Minh City (treatment regions) and Can Tho (control regions).

TABLE 2.7: CONFUCIAN CULTURAL HERITAGE AND CULTURAL VALUES AND BELIEFS

	(1)	(2)	(3)	(4)
	Preference for having better education as already achieved		Belief about the importance of access to higher education beyond compulsory schooling	
Confucian	0.053***	0.056***	0.030**	0.032*
	(0.015)	(0.016)	(0.014)	(0.016)
Observations	1,296	1,047	1,296	1,047

Notes: Robust standard errors clustered at the individual level are in parentheses. Columns 1 and 3 use the whole sample. Columns 2 and 4 use the sub-sample including Ho Chi Minh City (treatment) and Can Tho (control). Survey year fixed effects are included. Control variables include a dummy for gender (male), and age, age squared.

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

Data source: Asian Barometer Survey (2003, 2004 and 2006).

The estimates in Table 2.7 show that individuals living in Confucian culture regions have highe postive values and beliefs towards schooling than those living control regions. Confucian cultural heritage particularly raises the probability of a preference for having better educational attainment as already achieved by 5.6 percentage points (statistically significant at the 1% level)

for both samples (columns 1 and 2). Confucian cultural heritage raises beliefs about the importance of access to higher education beyond compulsory schooling by 2.7 percentage points (statistically significant at the 10% level) when estimating the entire sample (column 3) and by 3 percentage points (statistically significant at the 10% level) when estimating the restricted sample (column 4).

2.6.2 Household investments in children's human capital

Another mechanism contributing to the causal link between Confucian cultural heritage and educational success is household investments in children's human capital. In Table 2.8, I present my exploration of Confucian cultural heritage effects on a range of monetary expenditures on children's school and learning activities using data from the VHLSS. While school enrolment is a measure of school quantity, these investments are likely good proxy measures for school quality and are therefore helpful for predicting my main results for educational success and, particularly, academic performance. I estimate a pooled sample of 3,444 children aged 6-17 using the baseline SRDD specification in Equation (2.2).

Column 1 of Table 2.8 shows that Confucian cultural heritage increases spending on children's school tuition by 7.4% of a standard deviation, statistically significant at the 10% level. Semi-public and private schools which would typically provide better school quality result in higher tuition fees than traditional public schools in Vietnam (Glewwe and Patrinos, 1999). The increase in tuition fees could therefore reflect higher school quality. Confucian cultural heritage also increases other expenditures. In particular, the estimates in columns 2, 3 and 4, respectively, show positive and statistically significant effects on books and learning materials (11.1% of a standard deviation, statistically significant at the 1% level), learning tools and instruments (9.5% of a standard deviation, statistically significant at the 5% level), and private tutoring (10% of a standard deviation, statistically significant at the 5% level). Finally, column 5 shows the effect on total educational expenditures covering all expenditures related

to children's school and learning activities. The treatment increases this total spending by 11.7% of a standard deviation (statistically significant at the 1% level).

TABLE 2.8: EFFECTS ON INVESTMENTS IN CHILDREN'S SCHOOL AND LEARNING ACTIVITIES

	(1)	(2)	(3)	(4)	(5)
	School tuition	Books and learning materials	Learning tools and instruments	Private tutoring	Total educational spending
Confucian	0.074*	0.111***	0.095**	0.100**	0.117***
	(0.043)	(0.040)	(0.039)	(0.047)	(0.039)
Mean of the dependent variable	430.971	74.413	72.333	417.757	1431.605
Observations	3,444	3,444	3,444	3,444	3,444

Notes: Samples restrict to children aged 6-17 living in communes within 20 kilometers of the boundary distance. Robust standard errors clustered at the individual level are in parentheses. Controls include a dummy for gender (male), age, age squared, distance to Saigon, a linear function of longitude and latitude, boundary segment-fixed effects, birth cohort-fixed effects, and survey year-fixed effects. Expenditure variables are standardised into a mean of 0 and a standard deviation of 1.

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

Data source: Vietnam Household Living Standards Surveys (2010, 2012, 2014 and 2016)

2.7 Intergenerational educational mobility

In this section, I present my investigation of whether Confucian cultural heritage affects intergenerational schooling mobility. I rely on the Census data and restrict the sample to those aged 25-64 who have available information on their schooling and that of their parents. To examine the Confucian cultural heritage effects on the intergenerational persistence of education, I estimate the following equation:

$$S_{ic}^{o} = \gamma_0 + \gamma_1 S_{ic}^{p} + \gamma_2 Confucian_{ic} + \gamma_3 S_{ic}^{p} \times Confucian_{ic} + f(Geo_c) + \sum_{j=1}^{n} \gamma_4 Seg_{jc}$$

$$+ \gamma_5 Dist_c + \gamma_6 \boldsymbol{X'}_i + \zeta_{ic} \quad (2.3).$$

S_{ic}^{o} is the educational outcome for offspring i living in commune c. S_{ic}^{p} is the educational outcome for the parent of the corresponding offspring. $\boldsymbol{X'}_i$ is a set of controls for child birth cohort fixed effects. ζ_{ic} is the error term. Other terms are similarly defined as in Equation (2.2).

The coefficient γ_1 indicates the baseline intergenerational elasticity (IGE) of schooling. The coefficient γ_3, which is my parameter of interest, measures how Confucian cultural heritage affects IGE. I also cluster standard errors at the commune level, which is again the level of geographic chracteristics.

Table 2.9 presents the coefficients for intergenerational schooling persistence for different child-parent pairs. The coefficients on parental schooling document a baseline IGE of around 0.5 years of schooling. The interaction effects indicate that the schooling of individuals residing in Confucian cultural heritage regions are less dependent on their parents' schooling than the schooling of those living in control regions. Interestingly, the moderating effects of Confucian cultural heritage are stronger for child-mother than for child-father pairs. Confucian cultural heritage reduces the dependence of offspring's schooling on fathers' schooling by 0.04 (weakly statistically significant at the 10% level) for sons, as seen in column 1, and by nearly 0.05 (statistically significant at the 5% level) for daughters, as shown in column 3. The reduction is about 0.06 (statistically significant at the 5% level) for son-mother pairs, as shown in column 2, and 0.09 (statistically significant at the 1% level) for daughter-mother pairs, as presented in column 4. My results suggest that culture towards schooling is helpful in promoting intergenerational mobility through lessening the dependence of offspring's schooling on parents' schooling.

My findings in this section complements an increasing literature in economics devoted to explain considerable heterogeneity in intergenerational social and economic mobility across locations (Chetty et al., 2014), time (Chetty et al., 2017a), and socio-economic status (Chetty et al., 2020; Fletcher and Han, 2019). Previous studies have shown the roles of the neighbourhood environment during childhood (Chetty and Hendren, 2018a, 2018b), type of college education (Chetty et al., 2017b), income shocks (Bütikofer et al., 2018), compulsory schooling laws (Cornelissen and Dang, 2020; Demirel and Okten, 2020), disease control

campaign (Bütikofer and Salvanes, 2020), and the timing of parental income during childhood (Carneiro et al., 2021). My findings indicate that a culture towards schooling helps promote the educational mobility across generations.

TABLE 2.9: EFFECTS ON INTERGENERATIONAL PERSISTENCE OF SCHOOLING

Dep. variable: Offspring's years of schooling	(1)	(2)	(3)	(4)
	Son-father	Son-mother	Daughter-father	Daughter-mother
Parental schooling	0.516***	0.536***	0.496***	0.544***
	(0.014)	(0.016)	(0.017)	(0.016)
Parental schooling x Confucian	-0.040**	-0.059***	-0.049**	-0.091***
	(0.017)	(0.018)	(0.020)	(0.018)
Observations	19,619	29,793	13,827	21,649
Clusters	637	636	630	635

Notes: SRDD estimation is used. Sample is restricted to children age 25-64 of the Kinh ethnicity living in communes within 20 kilometers of the boundary distance. Robust standard errors clustered by the commune are in parentheses. Control variables include child birth cohort fixed effects.

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

Data source: Population and Housing Census of Vietnam (2009, 15% sample)

2.8 Conclusion

Education sciences, education psychology, and sociology have long recognized culture as a potentially important determinant of educational outcomes. Yet, whether culture causally affects educational decisions and academic performance is less clear because such educational effects of culture are difficult to isolate from confounding factors. In identifying the causal effect of culture on education, economists primarily focus on *visible* daily cultural practices in modern societies (Ashraf et al., 2020; La Ferrara and Milazzo, 2017). However, what people think or believe in their minds about the importance of schooling is a crucial cultural component that may affect educational decisions (Figlio et al., 2019). This has been rarely investigated, as it is typically difficult to disentangle empirically (Becker et al., 2020). Furthermore, understanding which determinants fundamentally drive such beliefs and preferences is important but remains unclear.

To shed light on these questions, I exploit a unique historical territorial expansion of historical Vietnam to study the effects of Confucian cultural heritage on educational attainment and academic performance in present-day societies. Based on a spatial regression discontinuity approach, I find that adults living in regions of Confucian cultural heritage has significantly higher average schooling years and qualification achievement than those residing in regions without Confucian cultural heritage. School-aged children who have inherited Confucian culture have higher school enrolment and also perform much better at school than their counterparts living in the former Khmer culture. These findings held in different samples and are strongly robust to various empirical specifications. In exploring potential interpretations of these results, I find evidence to suggest that my main effects are mediated via positive cultural values and beliefs towards education as well as increased investments in children's school and learning activities.

Inequality in schooling is the most vital cause of inequality in socioeconomic outcomes. Therefore, the implementation of educational policies and programmes to promote educational attainment and thus reduce inequality in schooling continues to be the central focus of initiatives fighting against poverty worldwide, particularly for poor countries in the years to come. Understanding the importance of traditional culture in general and cultural values and beliefs towards schooling in particular for educational success can therefore offer policymakers significant implications in designing their educational policies, and tailoring policies to specific cultural contexts is essential for obtaining the highest effectiveness rather than using one-size-fits-all programmes (Ashraf et al., 2020; Rao and Walton, 2004; World Bank, 2015).

Lastly but as importantly, although my paper specifically focuses on Vietnam, there are reasons to believe that its results could be generalized to the broader region of Northeast Asian countries, which are parts of the Confucian cultural sphere. Confucianism and the exam-based meritocratic institutions that it engendered were the core elements of historical Chinese

societies, which were then imported to pre-modern Korea and Japan in addition to Vietnam via Chinese colonial legacies. In the early modern era, Confucian culture has continued to expand its influence on other territories such as Taiwan, Macao, Hong Kong, and Singapore via the flows of Chinese immigrants (see Appendix B3 for a detail of the spread of Confucian culture). Although no longer formally used in today's Northeast Asia countries and having been replaced by other ideologies – for example, communist ideology – in China and Vietnam, the results of my study suggest that Confucianism remains influential on social lives via the values it has firmly implanted into societies.

Chapter 3

Universal Credit: Welfare Reform and Mental Health

This chapter is jointly co-authored with Mike Brewer and Emma Tominey

Abstract

A primary role of the welfare state is to provide a safety net against adverse shocks such as becoming unemployed. We estimate the effect of a major welfare reform in the UK on mental health for unemployed claimants. In 2013 Universal Credit replaced six existing benefits, creating a simplified system of applications and payments, whilst simultaneously applying somewhat draconian policy rules including a commitment to intensive job search, a change in benefit income and a five-week wait to receive the first benefit payment. Exploiting a staggered roll-out across areas and time, we find the welfare reform was less able to mitigate negative mental health effects from entering unemployment by 26% of a standard deviation. We decompose this effect into the proportion coming from the individual policy rules, finding that a cut in income and a reduction in the number of benefits claimed worsened mental health problems from entering unemployment.

JEL codes: I22, I24

Keywords: Welfare reform; Mental health; Mediation; Decomposition; Universal Credit; United Kingdom

3.1 Introduction

Governments spend a lot of money on welfare payments to individuals and families in need of social assistance. Accounting for around 20% of all public expenditure in the OECD, UK and US,[44] it is not surprising that efficient delivery of the welfare state is a common goal of governments across the world.

The objectives of a well functioning welfare state is to raise welfare of recipients, providing a safety net which mitigates for any negative consequences of losing a job or the loss of income. Whilst the efficient delivery requires trading off objectives of poverty reduction against delivering a welfare programme which raises the incentives to work, failure to strike the correct balance can result in unintended consequences such as induced mental health issues, illness or criminal activities of claimants (Blank, 1997, 2002).

In this paper we evaluate a major overhaul of the welfare state in the UK - Universal Credit (UC) - on the mental health of participants.[45] [46] The UK Welfare Reform Act 2012 which introduced UC has been recognised as the most radical social security reform for over 60 years, replacing the existing "legacy" system (Dwyer and Wright, 2014). The reform is estimated to cost £15 billion to implement and the early roll-out had a positive albeit very modest effects on employment of claimants.[47] A full evaluation of the reform requires to identify the mental health costs or benefits.

[44] In the UK, this represents around 11% of national income (Office for Budget Responsibility, 2017).

[45] Wickham et al. (2020) estimates a negative mental health association between being unemployed, which is larger after the UC roll-out than before. Our estimate is different, as individuals in the roll-out area became eligible if they changed their circumstances. For this reason, we estimate a panel data model observing individuals across time, identifying the effect of becoming unemployed whilst claiming UC versus legacy benefits on a claimant's mental health.

[46] Papers documenting the relationship between unemployment and mental health include Björklund (1985); Hamilton et al. (1997); and Tefft (2011).

[47] Department for Work and Pensions (2014) found that 69% of UC claimants found a job between making their claim six months later compared to 65% of legacy claimants.

The design of UC may result in both positive and negative consequences of the reform. A first objective of UC was to reduce the administrative burden of the current welfare state by combining application processes and payments of up to six existing benefits combining income support, housing and child benefits into one.[48] The second aim was to strongly incentivise claimants into self-sufficiency, through policy rules including changes in benefit income (Brewer et al., 2012) and compulsory intensive job search of up to 30 hours per week for unemployed or low income claimants. Whilst the simplified application process may raise mental health of claimants, the movement to draconian restrictions is likely to have the opposite effect.[49]

Using the UK Household Longitudinal Study (UKHLS) we answer two research questions. First, does the UC welfare reform exacerbate or mitigate any negative mental health effects of entering unemployment? A factor for mental health is constructed using 12 self-reported answers to the General Health Questionnaire (GHQ-12), including questions relating to feeling constantly under strain, unhappy or depressed.[50] [51]

Second, to inform future policy in the UK and internationally we causally decompose the total mental health effect to identify the sub-policies which protect and those which worsen the mental health of claimants. Specifically we employ causal decomposition analysis to identify the separate role of three mediators - household income, the number of benefit claimed, and intensity of job search - in mediating the mental health effects of UC. Figure 3.1 highlights the pathways through which treatment - defined as entering unemployment under UC versus legacy

[48] The legacy system is similar to the welfare systems in many countries, offering a set of benefits depending on different needs. The six legacy benefits combined into UC include Income Support, Income Based Jobseeker's Allowance, Income-Related Employment Support Allowance, Housing Benefit, Child Tax Credit and Working Tax Credit.

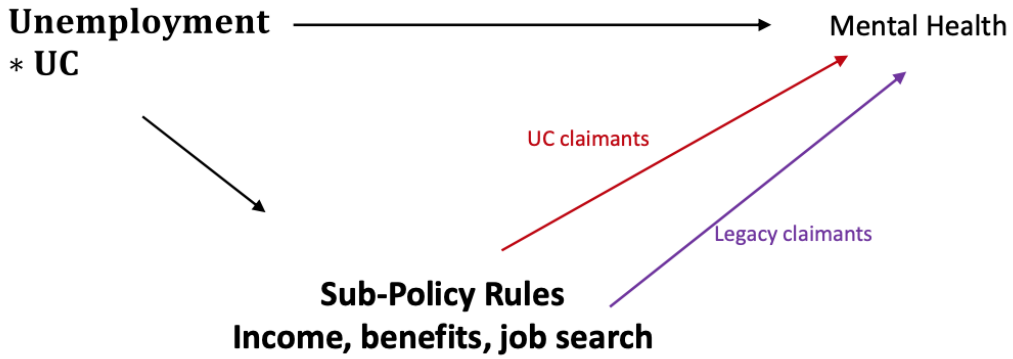
[49] See Section 3.2 for full details on the policy rules.

[50] Validation studies by Jackson (2007) have found the GHQ generates measures of psychological distress which has a large association with mental disorders.

[51] The GHQ has been used by economists as a measure of mental health, for example Baird et al. (2013), as well as public health research, see Weich et al. (2003), Weich et al. (2001).

- may affect the mental health of claimants. There may be a direct effect - indicated from the pathway from treatment to the outcome - estimating whether compared to the former system, UC mitigates or exacerbates mental health effects of entering unemployment (holding constant the mediators).

FIGURE 3.1: MEDIATION PATHWAY FOR TREATMENT EFFECT OF BECOMING UNEMPLOYED AND CLAIMING UC ON MENTAL HEALTH



Notes: This figure illustrates the mediation pathway for the treatment effect of becoming unemployed whilst claiming UC on mental health. The three mediators - income, number of benefits and job search intensity - were sub-policy rules of UC. There may be treatment heterogeneity in the effect of the mediators on mental health due to additional policy rules in implementing UC. For example, a change in income may differentially affect mental health of UC claimants because the entire benefit payment under UC was received by the claimant; whereas under legacy housing benefits and council tax were paid straight to landlords and the council; UC was paid monthly whereas legacy payments were either weekly or bimonthly. UC claimants signed a work commitment to job search for up to 30 hours per week or face benefit sanctions, hence the effect of job search on mental health is likely to be heterogeneous across treatment to UC.

The indirect effects measure the proportion of the treatment effect attributed to each of the three potential mediators, indicated in the figure by an arrow from treatment to the mediator and from the two arrows from mediators to mental health. The two arrows allow for possible treatment heterogeneity in the effect of a mediator on mental health under UC versus legacy, stemming from different implementation of the two welfare systems.[52] Specifically, a change in income may differentially affect UC versus legacy claimant's mental health because the payment moved from weekly or bimonthly to monthly leading to at least 5 weeks between

[52] See VanderWeele and Vansteelandt (2009).

approval and payment and paying benefits for housing and council tax to the claimant rather than the tenant or council. Heterogeneous pathways from the number of benefits claimed to mental health stem from to IT difficulties under UC which increased the risk of a rejected application. Under legacy having one rejected application is less problematic if the claimant also receives a different benefit payment. A change in job search intensity may differentially affect the mental health of UC claimants who were compelled to complete a set number of hours of job search per week in order to avoid benefit sanctions. Under legacy the job search criteria was not specified directly.

To identify the treatment effect of UC on the mental health of participants, we exploit a staggered roll-out across areas of the UK between 2013-2018 which started in the North of the UK and slowly moved across the whole country. So as not to overwhelm the roll-out, not all benefit claimants within a roll-out area were eligible for UC, but rather those changing their employment or housing status whilst satisfying eligibility rules explained in Section 3.2.3. Given this, our identification strategy estimates a panel data model of the effect on mental health of entering unemployment under the the UC versus legacy system. Whilst the effects of an individual entering unemployment across time or claiming a benefit are potentially endogenous, the focus is on the difference in the effect of an individual entering unemployment under the two systems. This parameter is causally identified if the roll-out is exogenous and if the common trends assumption holds and, we show that our strategy is robust to tests of these two assumptions.

To implement causal decomposition analysis, we require that variation in the meditators is uncorrelated with the outcome or treatment status (Celli et al., 2019). Again, this is satisfied if the identification assumptions of exogenous roll-out and common trends across treatment and control regions is satisfied (Deuchert et al., 2019). In addition, there can be no confounders post-treatment which affect the relationship between treatment and mediators, and is correlated

with the outcomes (VanderWeele and Vansteelandt, 2009). This assumption is satisfied because the potential mediators or policy rules of UC are contemporaneous to treatment. The intuition for the mediation analysis identification strategy is to compare two similar individuals who enter unemployment under different welfare systems. If they were both eligible to, say, 4 legacy benefits, then the individual living in the UC roll-out area claims fewer benefits, has a different level of benefit income and commits to a higher intensity of job search hours than an individual living in a legacy area. We identify what proportion of the total treatment effect comes from these three mediation channels.

Our benchmark results suggest that the UC system exacerbates mental health problems among the unemployed individuals. In total, the mental health of newly unemployed claimants under UC versus legacy is 26% of a standard deviation worse with claiming UC. Whilst UC led to small positive employment effects, there were large negative consequences for mental health. 15% of the treatment effect can be explained by the reduction in income and number of benefits claimed. Job search intensity did not contribute to the treatment effect and we show an additional treatment effect was to lower the probability of being unemployed in the future suggesting that any negative mental health effects from intense job search may have cancelled out for UC claimants if they found a job. These findings are very informative for future government policy in the UK and elsewhere, aiming to improve the efficiency of a welfare system whilst protecting the mental health of claimants.

Our paper contributes to several strands of the economics literature. First, it speaks to the central question of the consequences of welfare reforms (Blank, 2002). Previous studies on this research topic has initially focused on employment which is typically the direct target of welfare reforms through rectifying in-work credits (Brewer and Hoynes, 2019). Accordingly, welfare reforms are helpful in raising labour supply for the affected working age population including lone parents' labour supply (Brewer et al., 2006; Francesconi and Van der Klaauw, 2007; Gregg

et al., 2009) and immigrant labour participation (Borjas, 2003). The literature has been extended to consider mental health outcomes, such as improving subjective well-being for single mothers (Herbst, 2013) as well as other unintended consequences including disparities in political outcomes (Fetzer, 2019) and increasing criminal activities (d'Este and Harvey, 2020; Giulietti and McConnell, 2020; Tuttle, 2019; Watson et al., 2019).

We contribute to this research strand by focusing on mental health as a main outcome which is understudied from the literature. Wickham et al. (2020), also studies the mental health effect of UC, estimating a different parameter to ours. Whilst Wickham et al. (2020) compares a group of unemployed individuals who claimed UC to employed individuals who did not, before and after the UC roll-out, our paper focuses specifically on the individuals within a roll-out area who were eligible for UC because of a change in unemployment status. We evaluate the relative merit of UC in mitigating for mental health effects of entering unemployment. Second our paper decomposes the main treatment effect into the indirect effects working via several key mediators which are driven by changes in UC rules compared to the legacy rules, providing a novel contribution to understanding mediating channels for the effects of a welfare reform.

Next, our paper relates a growing literature in economics that use mediation analysis to decompose the main effect of a treatment into indirect effects working via different mechanisms. Celli et al. (2019) provides a summary of the different methods used for causal identification of mediators separately to the treatment effect including using difference-in-difference methods (for example, Deuchert et al. (2019), instrumental variables (for example, Nicoletti et al. (2020) and Attanasio et al. (2020), using a randomised control trial (Heckman and Pinto, 2015 among others) and synthetic control methods (Celli et al., 2019). In our paper, we exploit exogenous variation in potential mediators which are strongly driven by policy changes under the welfare reform of UC.

3.2 Welfare systems in the UK

The UK Welfare Reform Act of 2012 legislated for UC, a major reform aimed at simplifying the welfare system by replacing six means-tested benefits and in-work tax credits into one benefit. This reduced the administrative burden to applicants and welfare offices. UC replaced the former, or 'legacy' benefits: housing benefit, income-based jobseeker's allowance (JSA), income-related employment and support allowance (ESA), income support (including support for mortgage interest), child tax credit and working tax credit.[53] UC only required one application and made just one welfare payment.

3.2.1 Legacy

The welfare system prior to the UC reform is known as legacy. The system is common in most OECD countries, whereby a set of benefits exist for different purposes. Individuals claim separately for each benefit they are eligible for. Here we detail the six benefits under the legacy system which were combined under UC.

Income-based JSA offers financial support whilst looking for work. Eligible individuals would have worked as an employee and paid national insurance in the last 2 to 3 years be aged 18 to pension age, not in full-time education and available for work but currently out of work. Payments made every 2 weeks.

Income-based Employment Support Allowance (ESA) is paid for individuals with a disability or health condition which affects how much they can work. For employed, self-employed, unemployed to give money for living costs if out of work and support getting back to work if and when able.

[53] Other benefits were not influenced by the reform including disability living allowance, contribution-based JSA, contribution-based ESA, carer's allowance and child benefit.

Income support is for those with low or no income with savings less than £16,000, aged 16 up to the pension age, not in full-time work and satisfying one of these conditions: lone parent, lone foster parent, carer, on parental leave, unable to work and receiving benefits for sickness or disability, in full-time education (not university) age 16-20 and a parent or not living with a parent, a refugee learning English, in custody or due to attend court or a tribunal. It is usually paid to claimants every 2 weeks.

Housing benefit offers help paying rent for unemployed, low income or claiming benefits. This benefit is not eligible under if paying a mortgage rather than rent. Importantly, payments are made straight to the landlords.

Working tax credits requires working a certain number of hours per week which varies across demographic, from at least 16 hours for single with at least one child, over 60s or disabled and at least 30 hours for age 25-59.

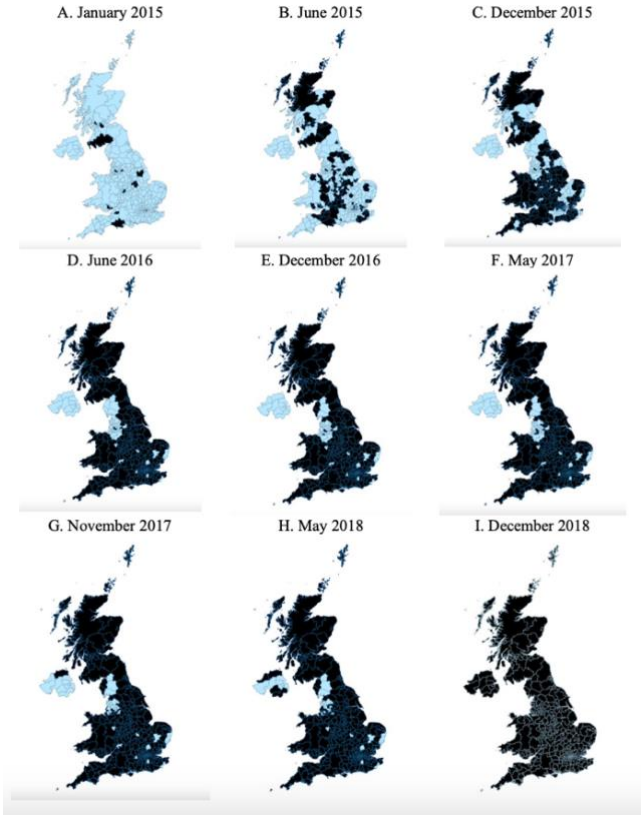
Child tax credits is an extension of working tax credits for those with children, where since 2017 payments are made only for the first two children.

3.2.2 UC roll-out

The implementation of UC roll-out is managed by the Department of Work and Pensions (DWP). The welfare reform required substantial changes in the technology of processing welfare payments and as such UC was rolled out across different local authorities slowly across time, starting from the pilot 'pathfinder' areas in April 2013, followed by the staggered roll-out from 2015 and completing in December 2018 when all areas in the UK had introduced UC.

Figure 2 demonstrates the national expansion of the UC roll-out coverage between January 2015 and December 2018. The figure shows that by January 2015 the Northern pathfinder areas had incorporated UC into their welfare systems. There followed a quick expansion across 2015 and by 2018 all local authorities in the UK had rolled out UC.

FIGURE 3.2: UC ROLL-OUT



Note: This figure illustrates the geographic expansion of the UC roll-out coverage between January 2015 and December 2018. Each panel shows the geographic coverage of UC roll-out at a specific time. The roll-out dates are at the local authority district level.

Data source: UK's Department for Work and Pensions (DWP)

3.2.3 UC eligibility

Individuals living in a rolled-out local authority would become eligible for UC only if their housing or employment circumstances changed and they satisfied eligibility criteria.[54] From the initial roll-out, individuals have to satisfy the following 'gateway' conditions. Individuals were eligible to claim UC if they resided in a roll-out area, had a change to their employment circumstances, were single with no partner or children and were aged 18-60, with no or low income (under £270 (or £330) per month if under (or older than) 25 years old), not being self-

[54] This strict condition allowed DWP to prevent a rush of applicants transferring from the legacy system to UC within a local authority.

employed, not being in education or homeless, had savings no higher than £16,000 and if they accepted a 'claimant commitment' to work-related requirements.[55]

These conditions were changed in the following years to expand the coverage of UC whereby couples without children became eligible from 2014 and households with children from May 2016. In our analysis, we exploit the regional roll-out variation for our identification, comparing two individuals with the same characteristics (in particular conditioning on marital status, number of children) entering unemployment under two different policy regimes. Consequently for identification, we exploit the geographical variation in roll-out rather than the policy variation related to individuals' traits.

As of July 2019, the UK government planned a "managed migration" where all benefit claimants would be moved to UC. A pilot was initiated in Harrogate, Yorkshire but indefinitely postponed from March 2020 once the Covid-19 pandemic led to national lockdown and a large increase in UC claims.

3.2.4 UC rules as potential mediators

Whilst the overall objective of UC was to align six benefits into one, in practice UC was implemented along with several other individual policy changes, which will feature in our analysis of the decomposition of the effect of UC on claimant outcomes.

First, UC aimed at strengthening incentives to work and a movement out of the benefit system. The overall expectations was that the benefits paid out would increase through UC as more individuals claim for their full benefit entitlement with one benefit application compared to several applications under the legacy system. Yet, there were distributional changes in benefit income received by different groups of individuals, designed to strengthen incentives to work where these were previously weakest, including low income households (Brewer and Hoynes,

[55] See Section 3.2.4 for the detailed information.

2019). For example, employed couples received the greatest increase in benefits and single parents received the greatest loss. In practice therefore, for some UC claimants, household income would fall under UC compared to legacy system whilst for others income would rise but given a set of covariates, the change in income is exogenously driven by the policy and not by individual unobserved heterogeneity. Furthermore, there was an increase in deductions from the total UC amount for earned income, unearned income and capital attached to the claimants. These deductions potentially lead to a significant reduction in the final income the claimants received from UC compared to that from legacy benefits.

Second, UC stipulated an intense job search criteria for either claimants out of work, receiving a low income or working just a few hours. To claim UC, individuals including non parents or single parents of a child aged three or over (or five or over for before April 2017) were expected to meet the full work-related requirements which consist of actively spending 30 hours per week on job search. Upon being offered a job, claimants were obliged to accept if they were unemployed claimants, or the job increased their work hours and earnings for those already working. These activities were supported and monitored by an assigned work counsellor.[56] Failure to adequately meet this work-related commitment without acceptable reasons resulted in benefit sanctions (non-payment) - although note that the specific policy of sanctions applied across both the legacy and UC systems (Williams, 2021). The severity of the sanctions varied across the work requirement missed. The lowest level of sanction would prohibit benefits until a missed work-related meeting with the work counsellor had taken place;

[56] Several UC claimants with specific conditions can be exempted from the full work-related requirements if they have one of the following conditions: having no sufficient ability for work or work-related activities, being satisfied for taking pension credit, being pregnant and within 11 weeks for the due of giving birth, being responsible for mainly caring a severely disabled individual, being responsible for caring a under-one child, being students who are aged under 21 without parental support and have a student loan or grant which will be deducted from the benefit when claiming UC, being students who are in a couple and have a student loan or grant which will be deducted from the benefit when claiming UC, or a victim of domestic violence (would be given a 13-week duration of work-related requirement exemption).

whilst a highest level stopped benefits for 3 months, for example if a job offer was not taken up.

The policy rules of income, the number of benefits claimed and job search intensity will be three mediators through which the treatment effect (entering unemployment whilst claiming UC versus legacy) may affect mental health of claimants. We now detail the additional policy rules which lead us to expect heterogeneous effects of the mediators on claimants' mental health under the UC and legacy systems.

Income received by UC claimants may differentially affect mental health compared to legacy claimants for four reasons. First, UC shifted from a weekly or bimonthly to a monthly welfare payment for recipients, resulting in at least a five-week wait between the benefit application and receipt of the first payment. Second, from the initial pilot, DWP learnt that the delay in benefit payments led claimants to struggle to pay their bills and so from April 2014, claimants could apply for a loan (known as a UC advance) to cover their bills or living expenditures until their first payment was received. The advance is paid off across the subsequent 12 months, taken directly from the welfare payment. Third, he monetary sum of UC is calculated at the household level, rather than the former legacy system calculating at individual level and the one household level payment can be paid into a single or joint account. It was suggested in dual-household claims that this may increase the financial independence of women if the benefit was paid into her account. Finally, the housing benefits and council tax payments became included in the one benefit payment to UC claimants who had the responsibility to make payments themselves, whereas under the legacy system were paid directly to the landlord and the district's council. A consequence of these rules of UC was an increase in financial debt leading to adverse consequences. According to Windle and Martin (2019), "76% of claimants on Universal Credit are behind on their rent payments, with just 24%

not in some form of rent arrears." An unintended consequence of the UC reform therefore was an increased debt which may induce mental health problems of claimants.

Finally, whilst combining six benefit applications into one could ease the administrative burden of the welfare state for recipients, there are potential downsides also which lead us to expect the effect of the number of benefit claims to vary across treatment status. There were often IT issues which delayed a new claimant's application. Any error on the UC application meant that the individual received zero benefits, whereas under the legacy system an error in one benefit claim would affect only that specific payment. Therefore whether the reduction of benefits improved or worsened mental health of claimants remains an empirical question.

It is possible that whilst the reduced administrative burden of claiming benefits under UC may have positive mental health effects for claimants, the implementation of these multiple stringent policy rules could have a reverse effect. In our analysis, we will exploit these policy rules, identifying the role of household income, the number of benefits claimed, and the intensity of job search as potential mediators for the effect of entering unemployment and claiming UC on claimants' mental health.

3.3 Data

3.3.1 Data source

We use data from the UK Household Longitudinal Study (UKHLS), which is commonly refereed as Understanding Society. The UKHLS is a large and nationally representative panel survey which replaced the former British Household Panel Survey (BHPS). Our study uses a panel sample of UKHLS spanning from wave 1 (implemented in 2009-2011) up to wave 9 (implemented in 2017-2019). Each UKHLS wave contains information including socio-economic and demographic issues, health, employment and social benefits of about 40,000

households across the United Kingdom. Because the age condition for claiming UC is strictly between 18 and 60, our main sample is constructed based on an unbalanced panel sample of working-age individuals aged 18-60.

In principle, unemployed individuals are among the most likely groups to claim social benefits during their unemployment spells. However, some unemployed individuals would be in reality not eligible to take any benefit if they had an amount of savings or household income large enough to claim any benefit. To make sure our results are not influenced by this group of unemployed observations, we exclude the observations who are unemployed but not claiming any benefits, UC or legacy among others (2.1% of the whole sample) from our benchmark sample. They are included in the analysis of Appendix C2.

Table 3.1 presents summary statistics of key variables in our main sample. Our sample consists of 194,428 individual-year observations aged 18-60 in which there are 48,945 individuals and on average one idividual appears in 6 UKHLS waves.

3.3.2 Benefit claim

The UKHLS participants report whether they are currently in receipt of a set of different benefit payments, allowing us to construct our measures of UC and legacy benefits. Our main policy variable is an indicator for the individual claiming the UC benefit in a particular wave of data. In particular, the two following questions, one from waves 1-3 (question 1) and another from waves 4-9 (question 2), are used to construct two dummy variables for claiming UC and legacy.

Question 1: *Which, if any, of these types of payments are you currently receiving: (1) Unemployment-related benefits, or National insurance credits; (2) Income Support; (3) Sickness, Disability or Incapacity benefits (including Employment Support Allowance); (4) Any sort of pension including a private pension or the state pension; (5) Child Benefit; (6) Tax Credits, such as the Working Tax Credit or Child Tax Credit; (7) Any other family related*

benefit or payment; (8) Housing or Council Tax Benefit, other than the single person council tax discount.

Question 2: *Are you currently receiving any of these payments: (1) Income Support; (2) Job Seeker's Allowance; (3) Child Benefit; (4) Universal Credit; (96) None of these.*

An indicator for claiming UC takes all values of 0 for waves 1-3 and a value of 1 if the answer for question 2 is *(4) Universal Credit* and 0, otherwise for waves 4-9.

An indicator for claiming a legacy benefit takes a value of 1 if the answer to question 1 takes at least one of the following choices (1), (2), (3), (5), (6) or (8) and 0 otherwise for waves 1-3; and takes a value of 1 if the answer to question 2 takes at least one of the following choices: (1), (2) or (3) and 0 otherwise for waves 4-9.

From Table 3.1, the number of the observations claiming UC is 888 - while that figure for claiming a legacy benefit is 42,669. The difference represents that UC roll-out occurred from wave 4 out of 9 in the data, and only individuals who changed their employment or housing status were eligible.

3.3.3 Mental health

Information from the UKHLS health section is used to construct the measure of mental health (Jackson, 2007). We particularly rely on the answers for a question set of the 12-item General Health Questionnaire (GHQ-12) to construct a score of poor mental health. The GHQ-12 provides short self-reported measures of mental ability in a non-clinical setting with several scores given to specify the severity of symptoms of the most popular components of anxiety, mental illnesses and depression which has been used in economics research (for example Baird et al., 2013). Validation studies have shown that the GHQ generates measures of psychological distress which has a large association with mental disorders (Jackson, 2007).

TABLE 3.1: SUMMARY STATISTICS

	All		Claim UC		Claim Legacy	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Poor mental health (score, standardised)	0.000	1.000	0.102	0.367	0.084	0.329
Unemployed (dummy)	0.065	0.246	0.241	0.428	0.179	0.383
Income (£, monthly, real value in 2010 prices)	3825.241	2601.509	2207.527	1518.661	2285.733	1434.894
Number of benefits claimed (number)	0.664	0.970	1.510	0.548	2.113	0.939
Job search intensity (number of job search)	0.113	0.634	0.586	1.360	0.380	1.146
Age (years)	39.952	11.982	39.212	11.418	39.409	10.520
Prior mental disorder (dummy)	0.024	0.153	0.019	0.137	0.059	0.235
Higher degree (dummy)	0.120	0.325	0.041	0.197	0.049	0.217
First degree (dummy)	0.167	0.373	0.094	0.291	0.093	0.290
Higher diploma (dummy)	0.078	0.268	0.089	0.285	0.074	0.261
A level (dummy)	0.101	0.302	0.100	0.301	0.072	0.258
GCSE/O level (dummy)	0.225	0.418	0.303	0.460	0.288	0.453
Having a child aged under 15 (dummy)	0.367	0.482	0.398	0.490	0.654	0.476
Married (dummy)	0.513	0.500	0.336	0.473	0.447	0.497
Observations	194,428		888		42,669	

In the UKHLS data, the GHQ-12 asks 12 questions corresponding to including: *concentration; loss of sleep; playing a useful role; being capable of making decisions; constantly under strain; problem overcoming difficulties; enjoy day-to-day activities; ability to face problems; unhappy or depressed; losing confidence; believe worthless; and general happiness*. For each component, the respondents are asked with a four-point Likert-scale response (from 1 to 4) in which a higher number gives a *poorer* status of that mental component.[57]

For example, the question which is used to measure the mental ability of the concentration component is: *The next questions are about how you have been feeling over the last few weeks. Have you recently been able to concentrate on whatever you're doing? (1) Better than usual, (2) Same as usual, (3) Less than usual, (4) Much less than usual*. Meanwhile, the question used to elicit the information about *loss of sleep* is: *Have you recently lost much sleep over worry? (1) Not at all; (2) No more than usual; (3) Rather more than usual; (4) Much more than usual*. All mental health measures and their responses are specifically present in Appendix, Table C.1.

Previous studies commonly use a dummy for poor mental health or a discrete score of mental ability from aggregating these GHQ-12 measures as a measure of mental health. However, such a mental health construction is probably prone to measurement error stemming from the use of Likert-scale questions (Brown et al., 2018). Such measurement error likely makes statistical analysis biased and inconsistent because of the potential problem of misclassification of the dependent variable (Hausman et al., 1998).

To overcome this problem, we use factor analysis to construct a *continuous* score for poor mental health (see Cunha and Heckman, 2008). Using factor analysis allows us to control for measurement error by estimating a latent variable for mental health and thus sufficiently

[57] A Liker-scale question is a statement that elicits the respondent about their evaluation by giving a quantitative value for a level of agreement or disagreement on a dimension (Hu et al., 2007).

controlling for measurement error. A higher score value indicates a poor mental health ability. The equation used for estimating the latent factor is present in Appendix C, Equation (C.1). To make our interpretation of the results more straightforward, we standardise this poor mental health score into a mean of 0 and a standard deviation of 1. In Appendix C, Table C.2, we present the results of our factor analysis with factor loadings of 12 mental health measures. The reference loading is based on *concentration* with a fixed score of 1. Based on this reference, we estimate the factor loadings for other mental health components. Among estimated coefficients, *unhappy and depression* has the highest loading with a score of 2.18 whilst *capable of making decisions* has the lowest factor loading of 0.83.

Table 3.1 reports that the measure of standardised poor mental health score has a mean of 0 and standard deviation 1 in the full sample, whilst UC and legacy claimants have a worse mental health score of 0.1 and 0.08, respectively.

3.3.4 Unemployment

To construct a measure of unemployment, we rely on the following question asking the UKHLS respondents about their current economic activity from the module of Demographics of UKHLS:

Question: *Which of these best describes your current employment situation? (1) Self employed; (2) In paid employment (full or part-time); (3) Unemployed; (4) Retired; (5) On maternity leave; (6) Looking after family or home; (7) Full-time student; (8) Long-term sick or disabled; (9) On a government training scheme; (10) Unpaid worker in family business: (11) Working in an apprenticeship; (97) Doing something else*.

An indicator for unemployment takes a value of 1 if the answer for the above question is *(3) Unemployed,* and 0 otherwise. From Table 3.1, 6.5% of the total sample - whilst 24% and 18% of UC and legacy claimants - are unemployed.

3.3.5 Mediators

The potential mediators through which eligibility to UC exacerbated or mitigated the mental health effects of unemployment are given by the different policy rules explained in Section 2.4. The mediators consist of household income, the number of benefits claimed and the intensity of job search.

Household income. Compared to the former system, UC changed the claimants' household income through several changes in benefit rules such as increased deductions. We measure household income directly from the data, calculating monthly income of a household from all income sources, summed across all household members. Household income is measured in GPB in 2010 prices and is standardised into a mean of 0 and a standard deviation of 1.

Number of benefits claimed. UC simplified the benefit application process by aggregating applications for up to six legacy benefits into one UC claim. Importantly, the number of benefits claimed as entering unemployment is a policy tool, exogenous to the claimant's mental health. We exploit the information from the UKHLS data to construct a variable for the number of benefit claimed by summing up all benefits the respondents take at the survey time. The number of benefits claimed includes those not in the UC system, including disability allowance and carers allowance.

Job search intensity. UC stipulates that unemployed or low income individuals must commit to finding a job through active actions, spending up to 30 hours per week in job search activities in order to claim the benefit. We proxy for job search intensity with a measure of the number of job search methods used by an individual for seeking a job. In particular, we exploit several questions from the UKLHS data asking the respondents about their use of each of the six following strategies for searching a job over the last four weeks including: *(1) applying directly to an employer; (2) studying or replying to advertisements; (3) searching for*

jobs/information about jobs on the internet; (4) contacting a private employment agency or job; (5) asking friends or contacts; and *(6) asking steps to start their own business*. The number of job search methods is simply the sum of these six strategies.

Table 3.1 shows the differences in these mediators between the groups of claiming UC versus legacy benefits from our main sample. As expected, there are clear differences in these mediators between UC and legacy claim. Monthly household income is on average less for a UC claimant than a legacy claimant by GBP 78. An individual claiming UC also has the number of benefits fewer than a legacy beneficiary by approximately 0.6 benefits. A UC claimant has on average about 1.5 benefits while a legacy claimant has about 2.1 benefits.[58] A UC claimant on average uses a higher number of job search methods with 0.59 methods than a legacy claimant with 0.38 methods. These differences suggest that changes in UC policies compared to the former legacy system likely cause changes in the mediating outcomes which are potentially linked to the mental health of the claimants.

3.3.6 Control variables

Control variables for individual characteristics include age, age squared, a dummy for having a previous mental disorder, a dummy for having a child aged 15 or younger, a dummy for being married and dummies for the highest educational levels.

We use a question asking whether the individual had a depression problem in the past from the UKLHS data to construct a dummy for having a previous mental disorder.

Educational levels are classified into several categories which are used for constructing dummies for the highest educational levels including higher degree (a higher degree is any degree beyond a bachelor's degree), first degree (a first degree is an undergraduate degree),

[58] The average number of benefits claimed among the UC group is larger than 1 because in addition to claiming UC at the same time some people still claim other benefits such as Bereavement Allowance, Carer's Allowance, Incapacity Benefit, Industrial Injuries Disablement Benefit among others. Receiving other benefits may also reduce the amount of income one receives from UC due to a higher deduction.

higher diploma (the higher diploma is a level 2 qualification on the Regulated Qualifications Framework), A-level (Advanced-level set of qualifications which are typically taken at age 18) and GCSE/O-level (the GCSE level is the General Certification of Secondary Education which is a higher level set of qualifications which are typically taken at age 16 and the O-level is the Ordinary level is a subject-based qualification conferred as a component of the General Certificate of Education).

The average age of the observations in our sample is nearly 40 years old. The share of the observations having a prior mental disorder is 2.4% (similar for UC claimants at 2% but higher for legacy claimants at 5.9%). In terms of the educational levels, approximately 12% hold a higher degree, 16.7% have a first degree, 7.8% have a higher diploma, 10.1% complete an A-level, and 22.5% complete a GCSE/O level. Nearly 36.7% of the sample have a child and around 51.3% are married.

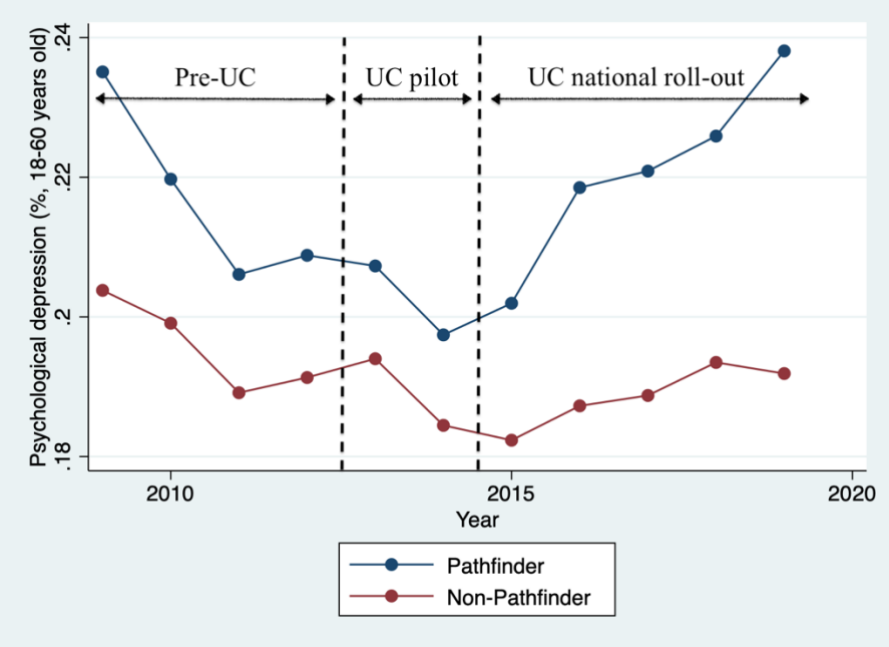
3.4 Methodology

3.4.1 Exogeneity of UC roll-out

As discussed in Section 3.2.2, UC was rolled out on a district-by-district basis from 2013 (wave 4 of UKHLS) and by the end of 2018 (wave 9) covered all the local authority districts in the UK.

Our methodology exploits changes in the mental health status of newly unemployed individuals compared across UC versus legacy areas. In essence, we conduct a triple difference (or D-in-D-in-D analysis) - comparing individuals across time, changing their unemployment status, under different welfare systems. As such it is important to test the common trends assumption, specifically asking if the areas rolled out as pathfinder regions in 2013 were chosen because of different trends in mental health.

FIGURE 3.3: COMMON TRENDS IN MENTAL HEALTH



Note: This figure tests the common trends assumption by comparing the trends of mental health between Pathfinder districts (rolled out in April 2013) and non-Pathfinder districts, between 2009 to 2019. Mental health is measured by the rate of people aged 18-60 with psychological depression.

Data source: UKHLS (2009-2019)

The early Pathfinder districts include Ashton-under-Lyne, Wigan, Warrington, Oldham, Hammersmith, Rugby, Inverness, Harrogate, Bath and Shotton. In Figure 3.3 we the share of those aged 18-60 years old with psychological depression across the years 2009 to 2014, differentiating between the Pathfinder districts which received the early UC treatment and the non-Pathfinder districts which were rolled out from 2015 onwards. The trends leading up to the initial UC roll-out are parallel across the two types of districts, justifying the common trends assumption.

Our identification strategy exploits not just the initial pathfinder roll-out, but the full expansion of UC. To show that the timing of roll-out is not related to local characteristics, Table C.3 regresses district level characteristics against the month and year of the local autority roll-out. Local characteristics from the 2011 UK censuses include population size, the share of white

population, the percentage of working-age population, the percentage of population aged 16 and over with being married, the share of economically active population aged 16-74, the share of population aged 16-74 with a full-time job, the share of households with unshared dwelling, and the share of population with very good reported health. These measures are aggregated at the local authority district level. Table C.3 shows that the date of UC roll-out is not correlated to these local characteristics. In column 9, when we regress the UC roll-out date on all of these characteristics in one specification, we find that all coefficients for these characteristics are statistically insignificant and *p*-value for joint significance of covariates is also statistically insignificant (*p*-value=0.645). These findings support our hypothesis that the timing of UC roll-out is exogenous to local socio-demographic characteristics which may be linked to the mental health of local people.

3.4.2 Estimation

Does UC exacerbate or mitigate mental health issues from entering unemployment? We estimate this treatment effect, exploiting the exogenous roll-out across regions and time using a panel data estimation model.

For the poor mental health outcome Y_{idt} of individual i, living in local authority district d and observed in year t, we run the regression:

$$\begin{aligned} Y_{idt} = \quad & \alpha_0 + \alpha_1 U_{idt} + \alpha_2 D_{idt} + \alpha_3 U_{idt} \times D_{idt} + \alpha_4 \boldsymbol{X}'_{idt} \\ & + \phi_i + \phi_d + \phi_t + \epsilon_{idt} \end{aligned} \tag{3.1}$$

U_{idt} is a dummy variable indicating whether the individual is unemployed and D_{idt} is a dummy variable which takes the value 1 if the individual claims UC and 0 otherwise.

Welfare programmes should in principle reduce mental health effects of becoming unemployed by providing income support and job search assistance. To understand whether UC mitigates or exacerbates the mental health effect of being unemployed, we include an

interaction term between being unemployed and receiving UC denoted $U_{idt} \times D_{idt}$. The coefficient α_3 - our parameter of interest - is the differential effect of an individual entering unemployment under the UC compared to legacy benefit system on the claimant's mental health.

In the estimation model, we include fixed effects for the individual, local authority district and year, denoted by ϕ_i, ϕ_d and ϕ_t, respectively. Controlling for the individual and year fixed effects in the model allows the coefficient on U_{idt} to exploit the variation in unemployment status within an individual and across year - estimating the effect of moving into unemployment status in a particular year. The local authority district fixed effects are included to absorb any unobserved differences across regions which may be linked to the timing of the UC roll-out.

$\boldsymbol{X}'_{idt}$ denotes the set of covariates in our model, including a dummy for claiming legacy benefit, age, age squared, a dummy for prior mental disorder, dummies for educational levels (higher degree, first degree, higher diploma, A-level and GCSE/0-level), a dummy for having a child aged 15 or younger, and a dummy for being married. ϵ_{idt} is an error term assumed to have conditional mean zero.

Given the local authority is the level at which treatment variation is defined, we therefore cluster our standard errors at the local authority district level in our estimation model to account for potential correlations across time within the same district.

The coefficient of unemployment (α_1) estimates the change in mental health from an individual entering a state of unemployment, but is not likely to be causal given the possibility of entering unemployment due to reasons related to their mental health. Therefore, in our analysis we will interpret α_1 descriptively. Instead, the purpose of our analysis is to estimate whether the UC welfare reform can affect the mental health effect of unemployment. The intuition behind the identification strategy is to compare two individuals entering unemployment, but under different welfare systems. Even if the cause of unemployment is

endogenous, the exposure to UC versus legacy is not, due to the staggered roll-out of UC across time and local authority districts as discussed in Section 3.4.1. Hence we can interpret the change in mental health as a causal treatment effect.

3.4.3 Mediation analysis

Whilst estimation of the total treatment effect is important, future policy reform in the UK and in other countries will rely on identifying the "effect of the cause" (Gelman and Imbens, 2013). Which aspects of a welfare reform help attenuate mental health effects of becoming unemployed and which exacerbate? Our framework will decompose the main treatment effect estimated using Equation (3.1) into the direct effect and the indirect effects through the different mediators - household income, the number of benefits claimed, and the intensity of job search.

Causal mediation analysis carries inherent difficulties in separate identification from the treatment effect. Assuming that treatment is randomised, causal mediation analysis requires (i) exogenous variation in the mediators uncorrelated with the outcome; (ii) variation in the mediators uncorrelated with treatment status; and (iii) no confounders affecting the relationship between the treatment and the mediators which drive the mental health outcome (Celli et al., 2019). In our case, the mediators are specific policy instruments whose variation across the two welfare systems of UC and legacy is uncorrelated with claimant's mental health and eligibility to the treatment. Intuitively, our analysis compares two individuals who enter unemployment under different welfare systems due to the staggered UC roll-out, who consequently have different values of the mediators. Therefore, variation in the mediators used for identification is uncorrelated with either mental health or with the treatment (assumptions (i) and (ii)).

Assumption (iii) is thought particularly difficult to satisfy and requires that no post-treatment confounders exist. VanderWeele and Vansteelandt (2009) state that the assumption is less likely to be upheld as the time period between treatment and measurement of the

mediators increases. In our case, the variation in mediators is contemporaneous to treatment exposure.

An exemplar of the identification strategy is to compare two individuals who enter unemployment and would be eligible for the same set of benefits, say job seekers allowance and housing benefit. The individual living in a UC roll-out area will make one benefit claim less, receive a different level of benefit payments and commit to an increased number of hours of job search compared to the individual eligible for legacy benefits. Only two policy rules, namely household income and the number of benefits, are observed directly and can be interpreted as causal mediators. The remaining mediator of the intensity of job search is a proxy for the policy rule of a commitment to spend up to 30 hours per week searching for a job. As this variable measures the policy rule with error, its value may be correlated with mental health; and we therefore cautiously give a descriptive interpretation to this potential mediator.

Our decomposition analysis include several steps. First, we obtain the mediated effect of an UC versus legacy take-up on poor mental health of unemployed by adding each mediator and its interactive terms with D_{idt} into Equation (3.1). Adding the interactive terms with D_{idt} allows heterogeneous indirect effect across treatment status to UC and legacy take-ups, as suggested by VanderWeele and Vansteelandt (2009) and Deuchert et al. (2019). As explained in Figure 3.1 and Section 3.2, while household income which is a potential mediator can drive mental health itself, the indirect effect of UC treatment on mental health through this channel may vary across the treatment status, due to the benefit payments for council tax and housing benefit being paid to the claimant rather than the council or landlord. The effect of the number of benefits claimed on mental health may vary across treatment status because under UC the right to claim additional benefits (such as disability benefit) reduces the risk of a rejected application; whilst the effect of job search intensity on mental health may vary under UC where the claimants' signed a work commitment which if broken, led to benefit sanctions.

In particular, we estimate the following equation:

$$Y_{idt} = \beta_0 + \beta_1 U_{idt} \times D_{idt} + \lambda^k \boldsymbol{M}_{idt} + \theta^k \boldsymbol{M}_{idt} D_{idt} + \beta_2 \boldsymbol{Z}'_{idt} + \zeta_{idt} \quad (3.2).$$

M^k_{idt} presents mediator k for individual i living in local authority district d in year t. There are K mediators. $\boldsymbol{Z}'_{idt} = (U_{idt}, D_{idt}, X_{idt})$ and $\zeta_{idt} = \phi_i + \phi_d + \phi_t + \varepsilon_{idt}$ where ε_{idt} is the error term and other terms are similarly defined as in Equation (3.1). In our mediation analysis, we particularly use two sets of mediators: one set includes only two mediators which are exogenously driven by changes in UC rules; and another set includes all three potential mediators. The set of control variables $\boldsymbol{X}'_{idt}$ is the same as Equation (3.1).

Second, we estimate the treatment effect on each mediator M^k_{idt} using the following equation:

$$M^k_{idt} = \gamma^k_0 + \gamma^k_1 U_{idt} \times D_{idt} + \gamma^k_2 \boldsymbol{Z}'_{idt} + \nu^k_{idt} \quad (3.3).$$

$\nu^k_{idt} = \omega^k_{idt} + \omega^k_{idt} + \omega^k_{idt} + e^k_{idt}$ summarises the fixed effects at the individual, local authority, and year level and the error term respectively.

To decompose of the treatment effect (the average treatment effect), consider a change in treatment status from 0 to 1 (which coincides with a change in eligibility for UC if unemployed from 0 to 1). The aim is to decompose the total effect of universal credit on mental health of newly unemployed given by the coefficient α_3 in Equation (3.1) into the direct and indirect effects, calculated by combining equations (3.2)-(3.3).

The direct effect is the effect of treatment holding constant the mediators at the untreated level (m^k_0) and is given by the following equation:

$$DE = E\left[Y\left(d_1, m^k_0\right) - Y\left(d_0, m^k_0\right) \middle| C\right] = \beta_1 + \theta^k(\gamma^k_0 + \gamma^k_1 + \gamma^k_2) \quad (3.4).$$

The indirect effect through mediator k is allowed to be heterogeneous across the treatment status and is the effect through a change in mediator k from the untreated to the treated levels

(from m_0^k to m_1^k), holding constant treatment at the untreated level. It is calculated by combining equations (3.2)-(3.3) and using the following formula:

$$IE = \quad E\left[Y\left(d_0, m_1^k\right) - Y\left(d_0, m_0^k\right)\middle| C\right] = \lambda^k \gamma_1^k + \theta^k \gamma_1^k \qquad (3.5).$$

The first term, $\lambda^k \gamma_1^k$, represents the indirect effect through mediator k itself. The second term, $\theta^k \gamma_1^k$, represents the differential indirect effect for UC claimants. The sum of the indirect effects from all K mediators is the total indirect effect through K mediators.

3.5 Results

3.5.1 Main treatment effect

Did the UC welfare reform protect unemployed individuals from experiencing mental health problems? As discussed in Section 3.2, there are two details which inform our research design. The roll-out of UC was staggered across regions and time periods and within a roll-out region, individuals became eligible only if their employment or housing changed. Using a panel data model including fixed effects at the individual, year and local authority district level, we focus on individuals entering unemployment and identify the differential effect on mental health for those claiming UC relative to legacy benefits.

The coefficients estimated using Equation (3.1) for the main treatment effect are reported in Table 3.2. As an individual enters unemployment, their propensity to experience mental health problems rises by nearly 18% of a standard deviation. The positive coefficient on the interaction between unemployed and UC suggests that the UC system exacerbates poor mental health for those becoming unemployed compared to the legacy system. In particular, entering unemployment and claiming UC compared to legacy raises the poor mental health score by

nearly 26% of a standard deviation (statistically significant at the 5% level). This finding provides evidence on the negative unintended consequence of the welfare reform.[59]

TABLE 3.2: EFFECTS OF BECOMING UNEMPLOYMENT AND CLAIMING UC ON POOR MENTAL HEALTH, INCOME, NUMBER OF BENEFITS CLAIMED AND JOB SEARCH INTENSITY

	(1)	(2)	(3)	(4)
	Poor mental health	Income	Number of benefits claimed	Job search intensity
Unemployed	0.178***	-0.211***	0.114***	1.555***
	(0.020)	(0.017)	(0.016)	(0.046)
UC	0.057	-0.033	0.951***	0.060**
	(0.050)	(0.034)	(0.035)	(0.029)
Unemployed*UC	0.262**	-0.172**	-0.183***	0.314**
	(0.125)	(0.068)	(0.061)	(0.134)
Controls	Yes	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Local authority district fixed effects	Yes	Yes	Yes	Yes
Observations	194,428	194,428	194,428	194,428

Notes. Sample is restricted to observations aged 18-60. Standard errors are clustered at the local authority district level. Controls include age, age squared, a dummy for prior mental disorder, and dummies for educational levels (higher degree, first degree, higher diploma, A-level, and GCSE/0-level), and dummies for having a child and being married.

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

Data source: UKLHS (2009-2019)

The augmented version of column 1 of Table 3.2 is present in Appendix C, Table C.5 in which all coefficients for key control variables are in reported. We can see that the poor mental health outcome has a non-linear relationship with age. Poor mental health has a strong positive link with prior mental disorder. Previous mental health problems increase the poor mental health score by about 44% of a standard deviation. However, it is surprising that educational

[59] It is possible to separately estimate the moderating effect of the legacy welfare system on mental health of unemployed claimants if we include in our sample unemployed individuals making no benefits claim. In Appendix C, Table C.4 details that an unemployed individual but not claiming any benefit has increased mental health problem by 22% of a standard deviation, which is raised by 21% of a standard deviation for being unemployed interacted with UC but reduced by nearly 5% of a standard deviation for being unemployed interacted with claiming a legacy benefit. In total, the differential treatment effect of entering unemployment and claiming UC versus legacy is nearly 26% of a standard deviation. This effect is highly similar to that using the benchmark sample and estimation model.

levels have no statistically significant relationship with the poor mental health outcome. This result is in line with previous evidence on no effect of education on mental health (Avendanoa et al., 2020). Both having a child and being married help mitigate mental health problems by approximately 2% and 5% of a standard deviation.

We also find a robust effect of entering unemployment and claiming UC on individuals' poor mental health when we restrict our sample to UKHLS waves 4-9. The estimates in Appendix C, Table C.6 show that the treatment effect of 28% of a standard deviation (statistically significant at the 5% level), which is highly similar to the benchmark treatment effect as shown in Table 3.2.

3.5.2 Mediation analysis

In this section, we decompose the treatment effect of becoming unemployed and claiming UC on mental health into the direct effect and the indirect effects via key mechanisms induced by reforms under the UK welfare reform. We present the results for two sets of mediators. The first one only includes the exogenous mediators which measure directly UC welfare rules (household income and the number of benefits claimed). The second set consists additionally of job search intensity which is a proxy for UC policy rules on work-related requirements. Because the job search intensity is likely an endogenous mediator, we treat the results for the second set of mediators as a descriptive decomposition.

3.5.2.1 Effects on mediators

Under the assumptions that treatment is randomized across regions and time and the common trends assumption, we can identify the causal effect of exposure to becoming unemployed and claiming UC on these three mediators and their interactions with claiming UC. The estimates in columns 2-4 of Table 3.2 estimates the model of Equation (3.3), replacing the dependent variable with the three mediators, income (column 2), the number of benefits claimed (column 3), and job search intensity (column 4).

Columns 2 and 3 of Table 3.2 show strongly statistically significant impacts on exogenous mediators: income and the number of benefits claimed respectively. As expected, claiming UC reduces household income for those entering unemployment by 17.2% of a standard deviation (statistically significant at the 5% level). Claiming UC also reduces the number of benefits claimed for a newly unemployed individual by 0.18 benefits (strongly statistically significant at the 1% level).

Column 4 in Table 3.2 shows that UC take-up is more likely to increase job search intensity. The number of job search methods used by an unemployed claimant under the UC system is higher than that for the counterpart person under the legacy system by 0.31 methods (statistically significant at the 5% level).

3.5.2.2 Treatment effects conditional on mediators

Do the mediators reduce the total effect of becoming unemployed and claiming UC on claimant's mental health? The estimates produced using estimates from equations (3.2)-(3.3) are combined to estimate the direct effect of treatment on mental health, holding constant the mediators at the untreated level in Equation (3.4) and the indirect effect through the mediators from Equation (3.5).

Table 3.3 reports the results from Equation (3.2), estimating the treatment effect conditional on the mediators. Column 1 shows the results for the first set of exogenous mediators including income and the number of benefits claimed. The coefficient on the interaction between unemployment and UC is no longer statistically significant and importantly its effect size also reduces by about one third of the benchmark treatment effect revealed in Table 3.2. The treatment effect now is only 17% of standard deviation.

Column 2 of Table 3.3 show the results when using the full set of the mediators. The coefficient of interest is now 24% of a standard deviation, making a reduction of about 7%

compared to the benchmark treatment effect. The coefficient is also not statistically different to zero.

TABLE 3.3: EFFECTS OF BECOMING UNEMPLOYMENT AND CLAIMING UC ON POOR MENTAL HEALTH CONDITIONAL ON MEDIATORS

	(1)	(2)
Unemployed	0.173***	0.102***
	(0.019)	(0.020)
UC	0.275*	0.276*
	(0.158)	(0.161)
Unemployed*UC	0.171	0.243
	(0.139)	(0.168)
Household income	-0.025***	-0.023***
	(0.004)	(0.004)
Household income*UC	-0.044	-0.043
	(0.059)	(0.059)
Number of benefits claimed	-0.005	-0.007
	(0.007)	(0.007)
Number of benefits claimed*UC	-0.144*	-0.144*
	(0.086)	(0.087)
Job search intensity		0.048***
		(0.006)
Job search intensity*UC		-0.042
		(0.051)
Controls	Yes	Yes
Individual fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Local authority district fixed effects	Yes	Yes
Observations	194,428	194,428

Notes. Sample is restricted to observations aged 18-60. Standard errors are clustered at the local authority district level. Controls include age, age squared, a dummy for prior mental disorder, and dummies for educational levels (higher degree, first degree, higher diploma, A-level, and GCSE/0-level), and dummies for having a child and being married.

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

Data source: UKLHS (2009-2019)

In terms of the sign of the coefficients of mediators on mental health problems, an increase in income helps reduce mental health problems as shown in both columns 1 and 2 and the differential for UC claimants is more negative, indicating a larger benefit to mental health from a change in income. An increase in the number of benefits claimed also lowers mental health problems, by a larger absolute value for UC claimants. This suggests that despite the reduction in the administrative burden from UC, the risk of a application with error dominated

the effect on claimant mental health. In contrast, whilst for non UC claimants an increase in job search intensity increases mental health problems, the differential effect for UC claimants is a reduction in mental health problems to a coefficient close to zero.

The different magnitude and even sign of the effect for the treated and untreated group is intuitive given the implementation of UC.

3.5.2.3 Mediation decomposition

Table 3.4 decomposes the total treatment effect into the direct effect and the indirect effects working through the mediators. Recall that the total treatment effect is measured by the coefficient α_3 in Equation (3.1), and its coefficient are present in column 1 of Table 3.2. The direct effect is measured by Equation (3.4) and the indirect effects through Equation (3.5) using estimates from Tables 3.2 and 3.3. We then sum up all of the indirect effects via various mediators to show the total indirect effect via all mediators.

In column 1, the indirect effects of treatment through the policy rules of income and the number of benefits account for nearly 15% of the total treatment effect (3.9% of a standard deviation). Among the indirect effects, the effect working through income contributes 4.5% (1.1% of a standard deviation) whilst the effect working via the number of benefit claimed contributes 10.4% (2.7% of a standard deviation) to the total treatment effect. These indirect effects working via the mediators is added by the direct effect which amounts to 85% of the total treatment effect (nearly 22.3% of a standard deviation) to constitute the total treatment effect of 26.2% of a standard deviation.

Column 2 of Table 3.4 shows the decomposition results when using the full set of mediators. The results show that the contributions of the indirect effects via income and the number of benefits claimed to the total treatment effect remain highly similar to those in column 1. They occupy 4.33% and 10.55% of the total treatment effect, corresponding to 1.1% and 2.8% of a standard deviation of the poor mental health score, respectively.

On the other hand, job search intensity has no moderating effect on poor mental health for unemployed individuals who claim UC. One possible reason why is that despite the commitment to intense job search under UC with potential consequences of sanctions for non-compliance, the job search activities may have helped individuals to find a job. Indeed, in Table C.7 we estimate the effect of becoming unemployed and claiming UC using the specification from Equation (3.1) but replacing the dependent variable with an indicator for being employed (column 1) or unemployed (column 2) in wave $t + 1$. The analysis shows a positive (albeit not statistically significant) effect on employment and a fall of unemployment by 11.9 percentage points from an unemployed individual claiming UC versus legacy.

TABLE 3.4: DECOMPOSING EFFECT OF BECOMING UNEMPLOYMENT AND CLAIMING UC ON POOR MENTAL HEALTH

	(1)	(2)
Effect through household income	0.011	0.011
	[4.53%]	[4.33%]
Effect through number of benefits claimed	0.028	0.028
	[10.41%]	[10.55%]
Effect through job search intensity		0.002
		[0.72%]
Effect through all mediators	0.039	0.041
	[14.9%]	[15.6%]
Direct effect	0.223	0.221
	[85.1%]	[84.4%]
Total effect	0.262	0.262
	[100%]	[100%]

In summary, we find that the indirect effects via the proposed mediator of household income has a relatively modest impact on the treatment effect. This is not surprising given that the first eligible group of individuals - singles with no children - experienced the smallest change in income from the roll-out of UC versus legacy. However, the implementation of UC which combined many benefit claims into one actually worsened mental health of claimants relative to legacy claimants. The intense job search criteria did not affect the treatment effect which could be explained by increased success in the labour market.

3.6 Conclusion

Reforming the social welfare system may generate many benefits such as increasing labour market participation, poverty reduction and reducing administrative costs as well as fraud and errors in running the existing system. Yet, there are considerable costs associated with such reforms. Conventional knowledge typically focuses on the fiscal basis for calculating the cost. To understand the full costs of a welfare reform, it is essential to take into account its unintended consequences.

In this study, we show that the welfare reform of UC in the UK exacerbates mental health problems of the benefit claimants, contributing 26% of a standard deviation to the poor mental health score. This suggests that the cost of a welfare reform is larger than previously assumed when the mental health effects are included.

We decompose our main treatment effect of becoming unemployed and claiming a UC benefit on mental health into the direct effect as well as into the indirect effects working via several mediators which are driven by changes in new rules of the welfare system. The indirect effects contribute to 15% of the total treatment effect. Among these indirect effects, whilst the effects working via a reduction in household income and a reduction in the quantity of benefits claimed have positive contributions to poor mental health, the effect working via an increase in the job search intensity did not alter the treatment effect.

Conclusion

This thesis consists of three chapters in applied microeconomics. While Chapter 1 and Chapter 2 studied the causes and consequences of schooling in the developing country context, Chapter 3 explored the mental health consequences of a welfare reform in a developed country. To make my thesis fulfilled with these chapters, I used a diverse combination of research methods and data. In particular, I applied several key research methods for causal evaluation in applied microeconomics including differences-in-differences and spatial regression discontinuity design. In addition to estimating the treatment effect of a welfare reform on mental health, Chapter 3 applied a causal mediation analysis to decompose the treatment effect into the direct effect and the indirect effects working via different mechanisms. Several types of data structure including cross-sectional and panel data which is from both censuses and household surveys are used in this thesis.

Chapter 1 studied the role of a compulsory schooling law in promoting school enrolment at the primary school level and the impacts it generates. Using compulsory schooling laws has been recognised as an effective tool in improving the educational enrolment level in both developed and developing countries. By focusing on the 1991 compulsory schooling law in Vietnam, which mandated all children aged 14 and younger to complete primary school, Chapter 1 shows that the law caused a considerable improvement in primary school enrolment as well as general education for those who were directly exposed to the law from the regions with a traditionally low level of primary school enrolment. This finding shows the importance of a primary compulsory schooling law in improving educational attainment in the developing world which can be applied in other poor countries with low rates of primary school enrolment such as sub-African countries. Furthermore, Chapter 1 contributes to the literature documenting the consequences of schooling. The economics literature has traditionally focused on personal benefits of schooling such as income, health and social behaviours for those who directly

involve in schooling. However, recent evidence reveals that the returns to schooling may be larger than what economists traditionally found if the spillover effects of education across generations are taken into account. Despite the importance of the intergenerational spillover returns to schooling, this topic has been understudied. Chapter 1 contributes to this research gap by providing evidence on the multigenerational impacts of exposure to the educational expansion induced by the 1991 schooling law in Vietnam.

The results in Chapter 1 indicate that the educational expansion not only generates benefits for those who were directly exposed to the expansion but also has positive effects on the human capital investments (school enrolment and educational and health investments) of the next generation (the children of the directly affected generation) as well as the health in old age of the previous generation (the parents of the directly affected generation). By showing these impacts of an educational policy on three generations, Chapter 1 demonstrates considerably large benefits of a policy promoting educational attainment in a developing country, even for the basic level of primary school. These findings in this chapter could therefore provide a crucial rationale for poor countries which still have low rates of primary school completion to implement similar educational policies and laws.

The study of the determinants of schooling has been long interested among economists as well as researchers from other social science disciplines. Disparities in schooling among different geographic regions or groups of people may come from many factors. As shown in Chapter 1, a compulsory school law is likely a contributor to schooling. Despite the importance of culture for educational achievement which has been well-discussed in educational studies, psychology, and sociology, causal evidence on the culture-education nexus has been extremely scant. Understanding whether culture causes educational outcomes is of importance for explaining why some groups of people whose a pro-schooling culture have better educational achievement than those without such a culture. Chapter 2 of my thesis revealed the positive role

of Confucian cultural heritage in explaining educational success in Vietnam. To implement a causal evaluation, this chapter exploited the territorial expansion of historical Vietnam which created geographic variation in Confucian cultural heritage in modern-day Vietnam. The results show that individuals living in the regions with a stronger Confucian cultural heritage have better educational outcomes measured by schooling years and degree achievement than those living in the regions with a weaker heritage. Children living in the treatment regions also perform better than those living in the control regions at the national examinations. The positive effects of a stronger Confucian cultural heritage on schooling outcomes are explained via positive cultural values towards schooling.

Finally, Chapter 3 shows the negative effect of a welfare reform on mental health for entering unemployment. The welfare system is typically designed to protect vulnerable people from adverse shocks such as being unemployed. However, Chapter 3 disclosed that the recent welfare reform known as Universal Credit in the UK considerably exaggerated mental health problems among unemployed individuals. This finding indicates that the costs of a reform in the social benefits system may be larger than the costs commonly assumed when taking into account unintended consequences of the reform such as the mental costs. Exploiting changes in potential mediators which are driven by exogenous changes in sub-policy rules within the reform compared to the previous system, Chapter 3 decomposes the main effect into the direct effect and the indirect effects working via these potential mechanisms. The results show that a cut in income and a reduction in the number of benefits claimed worsened mental health problems from entering unemployment. This should serve as a note of caution to policy makers who implement welfare reform, to pay attention how not just the income changes, but also changes in the application process and payment system can affect the mental well-being of claimants.

Appendix A: Appendix to Chapter 1

TABLE A.1: SUMMARY STATISTICS

	(1)	(2)	(3)
	Data source	Observations	Mean
Panel A. The directly affected generation			
Primary school completion (dummy)	Census	1,656,579	0.80
Cohorts 1974-1976 (pre-reform)	Census	407,593	0.78
Cohorts 1977-1980 (phase-in)	Census	582,486	0.77
Cohorts 1981-1984 (post-reform)	Census	666,500	0.84
Secondary school completion (dummy)	Census	1,656,579	0.66
Years of schooling (number)	Census	1,656,579	7.12
Literacy (dummy)	Census	1,656,579	0.98
Economically active (dummy)	Census	1,656,579	0.90
Non-agricultural sector (dummy)	VHLSS	17,471	0.74
Earnings (monthly, VND 1,000, 2010 prices)	VHLSS	17,471	2201.7
Lived in same municipality past 5 years (dummy)	Census	1,656,579	0.88
Married (dummy)	Census	1,656,579	0.79
Spouse's years of schooling (years)	Census	1,656,579	6.60
Women's having at least one child (dummy)	Census	832,706	0.81
Women's being experienced child mortality (dummy)	Census	832,706	0.21
Women's number of children conditional on having at least one child (number)	Census	672,555	1.78
Male (dummy)	Census	1,656,579	0.50
Age (years)	Census	1,656,579	29.7
Kinh ethnicity (dummy)	Census	1,656,579	0.80
Tay ethnicity (dummy)	Census	1,656,579	0.04
Thai ethnicity (dummy)	Census	1,656,579	0.03
Other ethnicities (dummy)	Census	1,656,579	0.13
Buddhist religion (dummy)	Census	1,656,579	0.06
Other religions (dummy)	Census	1,656,579	0.09
No religion (dummy)	Census	1,656,579	0.85
Panel B. The children of the directly affected generation			
School enrolment (dummy)	VHLSS	9,237	0.94
School related expenditures: Tuition (annual, VND 1,000, 2010 prices)	VHLSS	9,237	135.4
School related expenditures: Books and learning materials (annual, VND 1,000, 2010 prices)	VHLSS	9,237	121.7
School related expenditures: Learning tools and instruments (annual, VND 1,000, 2010 prices)	VHLSS	9,237	128.6
School related expenditures: Private tutoring (VND 1,000, 2010 prices)	VHLSS	9,237	341.8

School related expenditures: Total school related spending (VND 1,000, 2010 prices)	VHLSS	9,237	1203.9
Home expenditures: Children's books and magazines (monthly, VND 1,000, 2010 prices)	VHLSS	9,237	3.40
Home expenditures: Children's toys (annual, VND 1,000, 2010 prices)	VHLSS	9,237	33.9
Working for the household (dummy)	VHLSS	9,237	0.11
Working for earnings (dummy)	VHLSS	9,237	0.02
Hours of work for earnings (hours)	VHLSS	9,237	0.20
Per capita household spending on food consumption (annual, VND 1,000, 2010 prices)	VHLSS	9,237	6403.4
Household spending on tobacco and cigarettes (monthly, VND 1,000, 2010 prices)	VHLSS	9,237	49.9
Health insurance coverage (annual, dummy)	VHLSS	9,237	0.87
Number of preventive health visits (annual, times)	VHLSS	9,237	0.76
Preventive health care expenditure - Public (annual, VND 1,000, 2010 prices)	VHLSS	9,237	34.4
Preventive health care expenditure - Private (annual, VND 1,000, 2010 prices)	VHLSS	9,237	47.7
Hospitalization (annual, dummy)	VHLSS	9,237	0.04
Male (dummy)	VHLSS	9,237	0.52
Age (years)	VHLSS	9,237	10.6
Kinh ethnicity (dummy)	VHLSS	9,237	0.71
Tay ethnicity (dummy)	VHLSS	9,237	0.04
Thai ethnicity (dummy)	VHLSS	9,237	0.04
Other ethnicities (dummy)	VHLSS	9,237	0.20
Panel C. The parents of the directly affected generation			
Days of sickness (Annual, days)	VNAS	1,818	16.78
Good self-reported health status (dummy)	VNAS	1,818	0.33
Relative good health status (compared to others) (dummy)	VNAS	1,818	0.43
Depression (dummy)	VNAS	1,818	0.00
Sleep problems (dummy)	VNAS	1,818	0.75
Satisfied with life (dummy)	VNAS	1,818	0.31
Poverty (dummy)	VNAS	1,818	0.18
Income meeting personal needs (dummy)	VNAS	1,818	0.34
Income support from children for daily living (dummy)	VNAS	1,818	0.66
Savings (dummy)	VNAS	1,818	0.10
Number of home improvements (number)	VNAS	1,818	1.86
Satisfied with financial status (dummy)	VNAS	1,818	0.13
Private health insurance (dummy)	VNAS	1,818	0.01
Smoking (dummy)	VNAS	1,818	0.25
Drinking at least 2-3 times a week (over last 6 months, dummy)	VNAS	1,818	0.15
Drinking at least 4-6 times a week (over last 6 months, dummy)	VNAS	1,818	0.13
Drinking at least once a day (over last 6 months, dummy)	VNAS	1,818	0.12
Social activities (dummy)	VNAS	1,818	0.55
Having grandchild (dummy)	VNAS	1,818	0.99
Number of children-in-law (number)	VNAS	1,818	4.19
60-64 years old (Dummy)	VNAS	1,818	0.38
65-69 years old (Dummy)	VNAS	1,818	0.19

70-74 years old (Dummy)	VNAS	1,818	0.22
75-79 years old (Dummy)	VNAS	1,818	0.10
80 and over years old (Dummy)	VNAS	1,818	0.12
Major ethnicity (Dummy)	VNAS	1,818	0.88
Male (Dummy)	VNAS	1,818	0.47
Primary education (Dummy)	VNAS	1,818	0.55

Notes: Census: Population and Housing Census of Vietnam (2009, 15% sample). VHLSS: Vietnam Household Living Standards Survey (2010, 2012 and 2014). VNAS: Vietnam Aging Survey (2011)

TABLE A.2: PLACEBO TESTS

	(1)	(2)
	Males	Females
	Panel A. Effects of reform exposure on parents' skilled occupation	
Treat*Post	-0.003	-0.003
	(0.004)	(0.006)
Observations	637,140	260,738
	Panel B. Effects of 'hypothetical' reform exposure on primary school completion	
Treat*Post	0.008	0.005
	(0.008)	(0.006)
Observations	726,409	748,326

Notes: All specifications include fixed effects for cohort-by-province and region, and control variables. Panel A: Control variables include dummies for ethnicities (Kinh, Tay, Thai and others), dummies for religious affiliations (Buddhism, others and no religious affiliations) and a dummy for parental gender (male). Grandparents' highly skilled occupation is a dummy, missing values are set to the mean. Panel B: Control variables include dummies for ethnicities (Kinh, Tay, Thai and others) and dummies for religious affiliations (Buddhism, others and no religious affiliations). Samples include the individuals born 1965-1975. The timing of the 'hypothetical' reform is 1982 and the oldest affected by this reform is the 1968 birth cohort. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014).

TABLE A.3: REFORM EFFECTS ON THE DIRECTLY AFFECTED GENERATION (ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A. Education and economic outcomes						
	Primary school completion	Secondary school completion	Years of schooling	Literacy	Economically active	Non-agricultural sector	Log earnings
Treat*Post*Female	0.083***	0.090***	0.665***	0.011***	-0.006**	0.048*	0.117
	(0.003)	(0.005)	(0.037)	(0.001)	(0.003)	(0.034)	(0.150)
Treat*Post*Male	0.091***	0.100***	0.735***	0.011***	0.032***	0.049*	0.175
	(0.004)	(0.006)	(0.041)	(0.001)	(0.003)	(0.032)	(0.160)
Data source:	*Census*	*Census*	*Census*	*Census*	*Census*	*VHLSS*	*VHLSS*
Observations	1,656,579	1,656,579	1,656,579	1,656,579	1,656,579	17,471	17,471
	Panel B. Family outcomes						
	Lived in same municipality past 5 years	Married	Spouse's years of schooling	At least one child	Experienced child mortality	No. of children|>0	
Treat*Post*Female	0.057***	0.002	0.610***	0.022***	-0.026***	-0.011	
	(0.004)	(0.005)	(0.026)	(0.005)	(0.005)	(0.012)	
Treat*Post*Male	0.015***	0.086***	0.895***	n.a.	n.a.	n.a.	
	(0.004)	(0.006)	(0.028)				
Data source:	*Census*	*Census*	*Census*	*Census*	*Census*	*Census*	
Observations	1,656,579	1,656,579	1,656,579	832,706	832,706	832,706	
	Panel C. Intergenerational persistence						
Dep. Variable:	*Years of schooling of directly affected generation*						
Sample:	Son-father	Son-mother	Daughter-father	Daughter-mother			
Parental schooling	0.385***	0.359***	0.392***	0.389***			
	(0.009)	(0.010)	(0.015)	(0.015)			
Treat*Post*Parental schooling	-0.030**	-0.070***	-0.009	-0.067***			
	(0.014)	(0.015)	(0.023)	(0.024)			
Data source:	*Census*	*Census*	*Census*	*Census*			
Observations	187,957	236,127	71,804	91,600			

Notes: This table replicates the findings of Table 3 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 3. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Population and Housing Census of Vietnam (2009, 15% sample) and Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.4: REFORM EFFECTS ON THE CHILDREN'S GENERATION: CHILD LABOUR OUTCOMES (AGED 6-14)

	(1)	(2)	(3)
	Working for the household	Working for earnings	Working hours for earnings
At least one treated parent*Post	-0.010	-0.017**	-0.136*
	(0.031)	(0.009)	(0.100)
Observations	7,906	7,906	7,906

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. The sample includes children aged 6-14 of parents born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.5. REFORM EFFECTS ON AGE OF THE CHILDREN'S GENERATION

At least one treated parent*Post	0.053
	(0.306)
Observations	9,237

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. The sample includes children aged 6-17 of parents born in 1974-1984. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.6. REFORM EFFECTS ON THE CHILDREN'S GENERATION: HETEROGENEITY BY CHILD GENDER (ALL CHILD OUTCOMES)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A							
	School enrolment	Tuition	Tuition, conditional on enrolment	Books and learning materials	Learning tools and instruments	Private tutoring	Total school related spending	Working for the household
Unconditional pre-reform gender difference (son-daughter)	-0.022***	-0.027	-0.010	-0.087***	-0.066***	-0.046**	-0.076***	0.018**
	(0.006)	(0.023)	(0.024)	(0.022)	(0.023)	(0.023)	(0.023)	(0.007)
At least one treated parent*Post*Daughter	0.069**	0.168*	0.078	0.156*	0.158	-0.011	0.126	0.019
	(0.031)	(0.104)	(0.104)	(0.102)	(0.139)	(0.103)	(0.115)	(0.044)
At least one treated parent*Post*Son	0.096***	0.298***	0.208**	0.234**	0.272**	-0.017	0.302***	-0.048*
	(0.028)	(0.112)	(0.109)	(0.105)	(0.132)	(0.126)	(0.114)	(0.033)
Effect difference (son-daughter)	0.027	0.130	0.130	0.078	0.114	-0.007	0.176*	-0.067*
	(0.027)	(0.108)	(0.105)	(0.093)	(0.116)	(0.108)	(0.094)	(0.037)
Observations	9,237	9,237	8,694	9,237	9,237	9,237	9,237	9,237
	Panel B							
	Working for earnings	Hours of work for earnings	Health insurance coverage	Number of preventive health checks	Preventive health care expenditure - Public	Preventive health care expenditure - Private	Hospitalization	
Unconditional pre-reform gender difference (son-daughter)	0.010***	0.121***	-0.029***	0.046	0.024	0.033	0.007	
	(0.003)	(0.036)	0.008	(0.042)	(0.023)	(0.023)	(0.004)	
At least one treated parent*Post*Daughter	-0.007	-0.114	0.023	0.237	-0.095	0.095	-0.013	
	(0.014)	(0.155)	(0.041)	(0.256)	(0.140)	(0.121)	(0.034)	
At least one treated parent*Post*Son	-0.024**	-0.365***	0.053	0.148	-0.223*	0.204*	-0.045*	
	(0.014)	(0.147)	(0.048)	(0.237)	(0.159)	(0.127)	(0.035)	
Effect difference (son-daughter)	-0.017	-0.251	0.030	-0.089	-0.128	0.109	-0.032	
	(0.014)	(0.159)	(0.036)	(0.221)	(0.146)	(0.121)	(0.033)	
Observations	9,237	9,237	9,237	9,237	9,237	9,237	9,237	

Notes: All specifications include fixed effects for survey year, paternal cohort-by-province, maternal cohort-by-province, and region. Control variables: child's gender, ethnicitiy (Kinh, Tay, Thai and others), age and age squared. Expenditure variables are based on log expenditure (in 2010 prices), standardised into a mean of 0 and a standard deviation of 1. The sample includes children aged 6-17 of parents born in 1974-1984. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.7: REFORM EFFECTS ON THE CHILDREN'S GENERATION: INVESTMENTS INTO SCHOOLING AND LEARNING (ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		School related expenditures						***Home expenditures***	
	School enrolment	Tuition	Tuition, conditional on enrolment	Books and learning materials	Learning tools and instruments	Private tutoring	Total school related spending	Children's books and magazines	Children's toys
At least one treated parent*Post	0.088***	0.160**	0.064	0.130*	0.210**	-0.071	0.183**	0.056	0.160*
	(0.026)	(0.093)	(0.094)	(0.097)	(0.127)	(0.103)	(0.103)	(0.111)	(0.125)
Observations	9,237	9,237	8,694	9,237	9,237	9,237	9,237	9,237	9,237

Notes: This table replicates the findings of Table 4 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 4. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.8: REFORM EFFECTS ON THE CHILDREN'S GENERATION: CHILD LABOUR OUTCOMES (ROBUSTNESS)

	(1)	(2)	(3)
	Working for the household	Working for earnings	Hours of work for earnings
At least one treated parent*Post	-0.026	-0.015	-0.230**
	(0.035)	(0.013)	(0.134)
Observations	9,237	9,237	9,237

Notes: This table replicates the findings of Table 5 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 5. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.9: REFORM EFFECTS ON THE CHILDREN'S GENERATION: INVESTMENTS INTO HEALTH (ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Per capita household spending on food consumption	Household spending on tobacco and cigarettes	Health insurance coverage	Number of preventive health visits	Preventive health care expenditure - Public	Preventive health care expenditure - Private	Hospital-ization
At least one treated parent*Post	0.157**	-0.086	0.035	0.133	-0.185*	0.127	-0.029
	(0.093)	(0.135)	(0.042)	(0.231)	(0.135)	(0.112)	(0.033)
Observations	9,237	9,237	9,237	9,237	9,237	9,237	9,237

Notes: This table replicates the findings of Table 6 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 6. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.10: REFORM EFFECTS ON THE CHILDREN'S GENERATION: HETEROGENEITY BY CHILD GENDER (ALL CHILD OUTCOMES, ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A							
	School enrolment	Tuition	Tuition, conditional on enrolment	Books and learning materials	Learning tools and instruments	Private tutoring	Total school related spending	Working for the household
Unconditional pre-reform gender difference (son-daughter)	-0.022***	-0.027	-0.010	-0.087***	-0.066***	-0.046**	-0.076***	0.018**
	(0.006)	(0.023)	(0.024)	(0.022)	(0.023)	(0.023)	(0.023)	(0.007)
At least one treated parent*Post*Daughter	0.070***	0.095	0.003	0.103	0.155	-0.063	0.095	0.012
	(0.030)	(0.104)	(0.105)	(0.107)	(0.142)	(0.108)	(0.114)	(0.044)
At least one treated parent*Post*Son	0.097***	0.207**	0.115	0.158*	0.270**	-0.078	0.263***	-0.057*
	(0.028)	(0.112)	(0.110)	(0.107)	(0.134)	(0.127)	(0.112)	(0.035)
Effect difference (son-daughter)	0.027	0.112	0.112	0.055	0.115	-0.015	0.168*	-0.068*
	(0.027)	(0.108)	(0.105)	(0.093)	(0.115)	(0.107)	(0.095)	(0.037)
Observations	9,237	9,237	8,694	9,237	9,237	9,237	9,237	9,237
	Panel B							
	Working for earnings	Hours of work for earnings	Health insurance coverage	Number of preventive health checks	Preventive health care expenditure - Public	Preventive health care expenditure - Private	Hospitalization	
Unconditional pre-reform gender difference (son-daughter)	0.010***	0.121***	-0.029***	0.046	0.024	0.033	0.007	
	(0.003)	(0.036)	0.008	(0.042)	(0.023)	(0.023)	(0.004)	
At least one treated parent*Post*Daughter	-0.004	-0.070	0.021	0.172	-0.146	0.082	-0.024	
	(0.014)	(0.155)	(0.042)	(0.268)	(0.148)	(0.125)	(0.036)	
At least one treated parent*Post*Son	-0.020*	-0.307**	0.050	0.066	-0.271*	0.184*	-0.032	
	(0.015)	(0.155)	(0.049)	(0.250)	(0.166)	(0.137)	(0.038)	
Effect difference (son-daughter)	-0.017	-0.238	0.029	-0.106	-0.125	0.102	-0.008	
	(0.014)	(0.160)	(0.035)	(0.217)	(0.146)	(0.122)	(0.033)	
Observations	9,237	9,237	9,237	9,237	9,237	9,237	9,237	

Notes: This table replicates the findings of Appendix A, Table A.6 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table A.6. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Household Living Standards Survey (2010, 2012 and 2014)

TABLE A.11: REFORM EFFECTS ON THE PARENT'S GENERATION: HEALTH OUTCOMES (ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)
	Days of sickness	Good self-reported health status	Relative good health status (compared to others)	Depression	Sleep problems	Satisfied with life
	Panel A. Baseline					
At least one treated child*Post	-9.367*	0.091***	0.123***	-0.001	-0.022	0.041
	(5.752)	(0.036)	(0.049)	(0.003)	(0.043)	(0.048)
	Panel B. Heterogeneity by parental gender					
At least one treated child*Post*Mother	-7.190**	0.078**	0.078**	-0.001	0.023	0.039
	(3.490)	(0.034)	(0.034)	(0.003)	(0.040)	(0.042)
At least one treated child*Post*Father	-2.940	0.086**	0.144***	0.002	-0.130***	0.063
	(5.849)	(0.051)	(0.054)	(0.005)	(0.050)	(0.053)
Effect difference (father-mother)	4.250	0.008	0.065	0.003	-0.153**	0.024
	(6.348)	(0.067)	(0.064)	(0.007)	(0.067)	(0.067)
Unconditional pre-reform gender difference	4.552	0.101***	0.097***	0.003	-0.087***	-0.061**
(father-mother)	(2.880)	(0.025)	(0.027)	(0.004)	(0.023)	(0.025)
Observations	1,818	1,818	1,818	1,818	1,818	1,818

Notes: This table replicates the findings of Table 8 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 8. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Aging Survey (2011)

TABLE A.12: REFORM EFFECTS ON THE PARENTSS GENERATION: POTENTIAL FINANCIAL MECHANISMS (ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Poverty	Income meets personal needs	Regular income support from children	Savings	Number of home improvements	Satisfied with financial status	Private health insurance
	Panel A. Baseline						
At least one treated child*Post	0.003	0.056	0.015	0.094***	0.208**	0.061**	0.017*
	(0.040)	(0.051)	(0.040)	(0.027)	(0.089)	(0.030)	(0.013)
	Panel B. Heterogeneity by parental gender						
At least one treated child*Post*Mother	0.013	0.022	0.016	0.039*	0.133**	0.031	0.010
	(0.031)	(0.043)	(0.037)	(0.022)	(0.071)	(0.027)	(0.012)
At least one treated child*Post*Father	0.031	0.056	-0.032	0.077**	0.128*	0.065**	0.021**
	(0.040)	(0.051)	(0.059)	(0.032)	(0.097)	(0.035)	(0.012)
Effect difference (father-mother)	0.018	0.034	-0.048	0.038	-0.005	0.034	0.011
	(0.050)	(0.063)	(0.073)	(0.036)	(0.115)	(0.041)	(0.015)
Unconditional pre-reform gender difference	-0.042**	0.039	-0.073***	-0.014	0.081	0.049***	-0.002
(father-mother)	(0.020)	(0.026)	(0.026)	(0.016)	(0.069)	(0.018)	(0.006)
Observations	1,818	1,818	1,818	1,818	1,818	1,818	1,818

Notes: This table replicates the findings of Table 9 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 9. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Aging Survey (2011)

TABLE A.13: REFORM EFFECTS ON THE PARENT'S GENERATION: POTENTIAL BEHAVIOURAL HEALTH MECHANISMS (ROBUSTNESS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Alcohol consumption, at least…						
	Smoking	2-3 times per week	4-6 times per week	once per day	Social activities	At least one grand-child	Number of children-in-law	Household size
	Panel A. Baseline							
At least one treated child*Post	-0.021	-0.057**	-0.052**	-0.035*	-0.012	0.006	0.289***	0.162
	(0.035)	(0.027)	(0.027)	(0.026)	(0.049)	(0.013)	(0.100)	(0.210)
	Panel B. Heterogeneity by parental gender							
At least one treated child*Post*Mother	-0.020	-0.001	0.007	0.017	-0.028	0.001	0.303***	-0.003
	(0.026)	(0.019)	(0.017)	(0.017)	(0.038)	(0.014)	(0.091)	(0.148)
At least one treated child*Post*Father	-0.052	-0.100***	-0.125***	-0.112***	0.082*	0.006	0.157**	0.190
	(0.043)	(0.042)	(0.044)	(0.041)	(0.055)	(0.010)	(0.095)	(0.198)
Effect difference (father-mother)	-0.031	-0.099*	-0.132**	-0.129***	0.110**	0.005	-0.146	0.193
	(0.049)	(0.053)	(0.052)	(0.048)	(0.061)	(0.017)	(0.127)	(0.250)
Unconditional pre-reform gender difference (father-mother)	0.327***	0.279***	0.234***	0.216***	-0.065**	-0.002	0.132	0.070
	(0.021)	(0.018)	(0.017)	(0.017)	(0.027)	(0.006)	(0.112)	(0.116)
Observations	1,818	1,818	1,818	1,818	1,818	1,818	1,818	1,818

Notes: This table replicates the findings of Table 10 in the main text, when adding a linear cohort trend interacted with an urban/rual indicator. The remaining control variables are the same as those in Table 10. Significance levels are based on one-sided hypothesis tests. Robust standard errors clustered at the district level are in parentheses.

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

Data source: Vietnam Aging Survey (2011)

Appendix B: Appendix to Chapter 2

TABLE B.1: TOP 10-PEFORMING COUNTRIES IN PISA TEST SCORES

Rank	2015			2012			2009		
	Math	**Science**	**Reading**	**Math**	**Science**	**Reading**	**Math**	**Science**	**Reading**
1	Singapore	Singapore	Singapore	China	China	China	China	China	China
2	Hong Kong	Japan	Canada	Singapore	Hong Kong	Hong Kong	Singapore	Finland	Korea
3	Macao	Estonia	Hong Kong	Hong Kong	Singapore	Singapore	Hong Kong	Hong Kong	Finland
4	Taiwan	Taiwan	Finland	Taiwan	Japan	Japan	Korea	Singapore	Hong Kong
5	Japan	Finland	Ireland	Korea	Finland	Korea	Taiwan	Japan	Singapore
6	China	Macao	Estonia	Macao	Estonia	Finland	Finland	Korea	Canada
7	Korea	Canada	Korea	Japan	Korea	Taiwan	Liechtenstein	New Zealand	New Zealand
8	Switzerland	Viet Nam	Japan	Liechtenstein	Viet Nam	Canada	Switzerland	Canada	Japan
9	Estonia	Hong Kong	Norway	Switzerland	Poland	Ireland	Japan	Estonia	Australia
10	Canada	China	Macao	Netherlands	Liechtenstein	Poland	Canada	Australia	Netherlands
Rank	**2006**			**2003**			**2000**		
	Math	**Science**	**Reading**	**Math**	**Science**	**Reading**	**Math**	**Science**	**Reading**
1	Taiwan	Finland	Korea	Hong Kong	Finland	Finland	Japan	Korea	Finland
2	Finland	Hong Kong	Finland	Finland	Japan	Korea	Korea	Japan	Canada
3	Hong Kong	Canada	Hong Kong	Korea	Hong Kong	Canada	New Zealand	Finland	New Zealand
4	Korea	Taiwan	Canada	Netherlands	Korea	Australia	Finland	UK	Australia
5	Netherlands	Estonia	New Zealand	Liechtenstein	Liechtenstein	Liechtenstein	Australia	Canada	Ireland
6	Switzerland	Japan	Ireland	Japan	Australia	New Zealand	Canada	New Zealand	Korea
7	Canada	New Zealand	Australia	Canada	Macao	Ireland	Switzerland	Australia	UK
8	Macao	Australia	Liechtenstein	Belgium	Netherlands	Sweden	UK	Austria	Japan
9	Liechtenstein	Netherlands	Poland	Macao	Czech Rep.	Netherlands	Belgium	Ireland	Sweden
10	Japan	Liechtenstein	Sweden	Switzerland	New Zealand	Hong Kong	France	Sweden	Austria

TABLE B.2: HETEROGENEITY: EFFECTS ON ADULTS' SCHOOLING OUTCOMES BY AGE GROUPS

	(1)	(2)	(3)	(4)
	25-34	35-44	45-54	55-64
	Panel A. Schooling years			
Confucian	0.807***	0.589***	0.619***	0.805***
	(0.184)	(0.194)	(0.227)	(0.230)
	Panel B. Primary school completion			
Confucian	0.030**	0.036**	0.051**	0.079***
	(0.014)	(0.016)	(0.020)	(0.022)
	Panel C. Lower secondary school completion			
Confucian	0.072***	0.078***	0.101***	0.112***
	(0.024)	(0.025)	(0.026)	(0.026)
	Panel D. Upper secondary school completion			
Confucian	0.084***	0.052***	0.035*	0.055***
	(0.021)	(0.018)	(0.020)	(0.019)
	Panel E. College degree			
Confucian	0.049**	0.012	-0.007	0.008
	(0.022)	(0.011)	(0.011)	(0.010)
Observations	127,714	97,691	77,799	38,726
Clusters	574	574	574	574

Notes: Samples restrict to individuals in communes within 20 kilometers of the boundary distance (adults aged 25-64). Robust standard errors clustered at the commune level are in parentheses. Baseline specification includes controls (a dummy for male), a linear function of spatial location, distance to Saigon, boundary segment-fixed effects and birth cohort-fixed effects. Linear function of spatial location is a linear function of latitude and longitude of the commune. Boundary segment varies with a 20-kilometer unit. Distance to Saigon (kilometers) is measured by the shortest travelling distance from the center of commune to the center of Ho Chi Minh City (Ho Chi Minh City People's Committee Hall).

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

Data source: Vietnam Population and Housing Census (2009, 15% sample)

Appendix B1: Confucianism on education

Confucianism provides key theoretical and practical principles for learning activities which were mainly documented in two Confucian texts including the *Annects* (Lunyu) and the *Xueji* ("Record of Learning") (Tan, 2017; Li, 2003). In terms of theoretical principles, Confucianism highlights the importance of education as a key means for transforming people and maintaining society with a stable social order (Tan, 2015a, 2015b). Therefore, rulers must dedicate their best efforts to educate their citizens (Di, 2016). Confucius stated that "[I]f a ruler desires to transform the people [and] perfect [their] customs, [the ruler] can only do so through education."[60] In addition, Confucianism strongly points up that to obtain the best learning outcomes students must study hard and invest their best efforts on learning process with strict discipline and deep aspiration (Tan, 2015a, 2015b) because "[L]earning without thought is labour lost; thought without learning is perilous."[61]

Regarding practical principles for learning, Confucianism established a standard objective of *dao* (meaning "the Way of Heaven") for the learning process (Chan, 2000), which was considered as a 'guiding course' inherited from ancient wisdom (Hansen, 1989) for reaching a "vision of human excellence" (Cua, 1989). *Dao* was first applied in learning in the ruling times of the Yao, Shun, and Yu dynasties in ancient China (Tan, 2017). Confucianism argues that "people who do not learn will not realize *dao*"[62] and thus they would be failed to obtain "human transformation and cultural perfection." To become an exemplary person, a male must achieve *dao* because "[A]lthough the ultimate *dao* is present, [one] does not know [its] goodness if

[60] The Confucian text *Xueji I.*

[61] The Confucian text *Analects 2.52.*

[62] The Confucian text *Xueji II.*

[one] does not learn it"[63] and "the exemplary person[64] learns for the sake of *dao*."[65] Confucius further called for long-life learning to achieve "the good *dao* till death."[66]

According to Confucianism, students could fully achieve *dao* by inculcating *ren* (meaning "humanity") through *li* (meaning "normative behaviors"). The concept of *ren* implies a lifelong endeavour any learner needs to comply to become an exemplary person (Wei-ming, 1979). Confucianism evaluates a person's morality based on his best efforts devoted in lifelong learning to pursue the highest success of 'self-perfection' (Li, 2003). Using the spirit of *ren* helps a learner acquire a "great learning" (Li, 2003). Furthermore, Confucianism constructs the concept of *li*[67] comprising a guide of normative behaviors which should be used as a means for approaching *ren* (Tan, 2017). One of the most essential principles of *li* is learning aspiration encouraging learners to invest their best efforts to transform learning results through positive attitudes (Hall and Ames, 1987). Learners' general objective is to recognize and to enlarge *dao* by clasping and expressing *li* during their learning course. Confucius underlined that thanks to such an educational approach, governors could positively change their citizens withing maintaining traditional values.[68] Confucian perspectives help inspire students to consolidate their knowledge through daily self-cultivation and social interaction (Wei-Ming, 1985).

[63] The Confucian text *Xueji III*.

[64] The 'exemplary person' is a role model person in society who has high competence of knowledge and moral standards. The 'exemplary person' is *junzi* in Chinese and *nguoi quan tu* in Vietnamese.

[65] The Confucian text *Analects* 19.7.

[66] The Confucian text *Analects* 19.7.

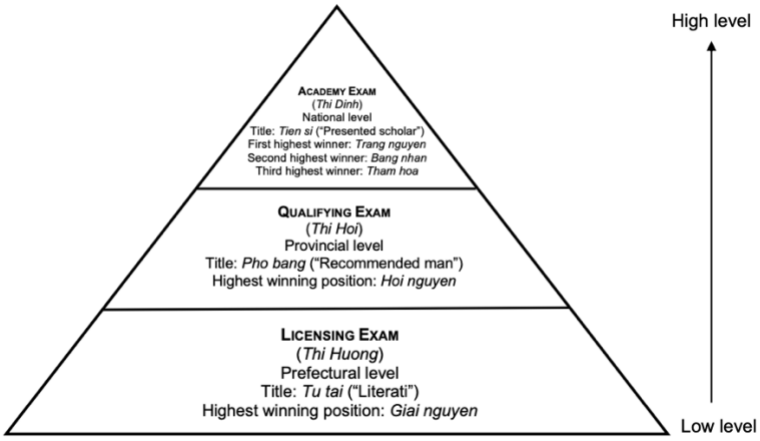
[67] The Confucian text *Analects* 12.1.

[68] The Confucian text *Xueji I*.

Appendix B2: Dai Viet's Confucian exam system

Starting in the early 1000s, Dai Viet's Confucian exam system was strongly developed during the ruling times of the Tran dynasty (1225-1400) with a two-level system, including the exams in local governments and the exams in the central government (Quoc-Su-Vien-Trieu-Le, 1993). Candidates who performed best in local exams were selected into exams at the central government level. Dai Viet also constructed a complete set of exam rules to help carry exams seriously and efficiently. The exam system was consecutively advanced during the consecutive dynasties. In particular, its curriculum was also improved over time by customizing the exam content for each of specific job positions although it was based on Confucianism.

FIGURE B1: DAI VIET'S COMPLETE EXAM STRUCTURE



Source: This figure is created by the author based on Taylor (2013), Quoc-Su-Quan-Trieu-Nguyen (1972), Ngo et al. (2001)

The exam system was gradually developed by expanding other exam levels. Its structure reached the complete version under the reign of the Nguyen dynasty, which was a three-exam system including the "Licensing Exam" at the prefectural level, the "Qualifying Exam" at the provincial level, and the "Academy Exam" at the central government level. Figure B.1 depicts the complete structure version of Dai Viet's exam system. Licensing Exams (*Thi Huong*) were held by local authorities to select qualified candidates for Qualifying Exams (*Thi Hoi*). The

qualified candidates with top scores in Qualifying Exams were given the titles of provincial heroes. Finally, top candidates from Qualifying Exams across the state were granted admissions to participate in Academy Exams (*Thi Dinh*), that were usually held in the royal's hall in Dai Viet's capital. The central government was responsible for organizing, invigilating as well as grading of both the Qualifying and Academy Exams.

Dai Viet's rulers placed their special priorities on these exams. They therefore organized these exams seriously to guarantee that results exactly reflected the true quality of candidates who would then became bureaucrats.[69] All cheating behaviors disclosed would be seriously punished by law. Exams were opened to all males regardless of their social and family background. Winners in the exams were typically appointed as imperial bureaucrats who gained huge benefits. A well-known example was Le Van Thinh, who was born to ordinary parents and was ever the first exam winner of Dai Viet in 1075. Le Van Thinh was recruited as the Imperial Preceptor (known as "Teacher of the Emperor") in the royal court of the Ly dynasty and he then was promoted to State Chancellor (*Thai su*), that was the highest position in the central government (Taylor, 2013). Vietnamese history also witnessed many males from farming and poor families who performed well at exams were appointed as feudal mandarins.

[69] In many Academy exams, Emperors participated in exam committees playing the roles as problem givers and examiners.

Appendix B3: The spread of Confucianism

Confucianism initially emerged in ancient China and gradually established itself as one of the profound schools of thought[70] under the ruling times of the Han dynasty around the 2nd century B.C. In 140 B.C., Emperor Han Wudi formally accepted a proposal of using Confucianism as the national doctrine (Wang, 2013). Since then until the early 20th century, Confucianism maintained its prominent status in society. Although Confucianism was formally removed its formal centrality as the national doctrine since the early 20th century when Chinese imperialism was gradually collapsed and replaced by new ruling forces such as communists (Goldman, 1975; Gregor and Chang, 1979), its influence on Chinese social life has still been existent (Bell, 2010; Li and Liang, 2015). To generalize the influence of Confucianism throughout Chinese history, American Sinologist William Theodore de Bary wrote:

> *If we were to characterize in one word the Chinese way of life for the last two thousand years, the word would be 'Confucian'. No other individual in Chinese history has so deeply influenced the life and thought of his people, as a transmitter, teacher and creative interpreter of the ancient culture and literature and as a moulder of the Chinese mind and character*. (de Bary et al., 1960, vol. 1, pp. 15).

Although originating from ancient China, Confucianism's influence has been widespread to neighbouring countries and territories in Northeast Asia including Korea, Japan, Vietnam, Taiwan, Hong Kong, and Singapore to make up the region of *East Asian cultural sphere* (known as the *Sinosphere*) (Choi, 2010; Huat, 2004; Wei-ming, 1996). In addition to rooting into pre-modern Vietnamese society as discussed in the main paper, Confucianism entered Korea in 108 B.C. during the ruling times of the Joseon dynasty (Shin and Sin, 2012) during the ruling times of the Joseon dynasty. Confucianism began to gain its influence in historical Korean society since the ending of the *Three Kingdoms Period* (57 B.C.-668) when the Silla dynasty (57 B.C.-

[70] In addition to Confucianism, Daoism and Buddhism were among other ideologies in ancient Northeast Asia.

935) with support from historical China's Tang dynasty won in the war against Baekje (known as *Paekche*) and Goguryeo (known as *Koguryo*) kingdoms to unify the whole state of pre-modern Korea. Going through Korea, Confucianism arrived in Japan in about the 3rd century and then became an important political ideology during the 7th and 8th century. Confucianism strongly influenced cultural traditions during the Japanese imperialism (Paramore, 2016).

Confucianism advocated meritocracy and promoted equality of opportunity in access to schooling (Nuyen, 2001). Historical states in Northeast Asian countries conducted Confucian-inspired meritocracy (Liu, 2007; Kim, 2019; Kim et al., 2017). Public service positions at all levels were appointed based on candidates' performance at imperial civic exams (Elman, 2000; Sundell, 2014; Xiao and Li, 2013). Chinese meritocracy was based on its imperial examination system known as *Keju*, which was among the first exam-based meritocratic institution ever in the world (Bai and Jia, 2016; Chen et al., 2020; Elman, 2000). Although *Keju* was officially initiated in 605 A.D. during the reign of the Sui dynasty, its immature versions were initially inaugurated during the Han dynasty (206-220 A.D.). *Keju* was then developed during the Tang dynasty, advanced during the Song dynasty and achieved its highest development throughout the Ming dynasty and the Qing dynasty (Elman, 2000; Wang, 2013). Its system reached a complete structure during the Qing dynasty (Bai and Jia, 2016). Exams were opened for all males regardless of their age and social class, providing opportunities for commoners to change their lives (Elman, 2013). Imperial governments managed the exams with their best attempts to secure the fairness of contest that would help select true talents (Elman, 2013; Fan, 2016; Wang, 2012). Therefore, *Keju* to some extent likely improved social mobility (Weber, 1951; Chang, 1962; Qian, 1982) because individuals who performed well at exams typically became bureaucrats or teachers and scholars (Chang, 1955). Implementing such exam-based meritocracy allowed historical Chinese states to stabilize their political control over a long period. Chinese feudal society was collapsed in 1911 followed by the ending of *Keju* in 1905 several years (Bai and Jia, 2016).

Chinese imperial exams strongly influenced civic exams in other pre-modern Northeast Asian states (Liu, 2007). Japan, Korea, and Vietnam adopted the original version of Chinese exams using the same formats, procedures and contents to construct their exam-based meritocratic institutions for civil service recruitment. Japan was the first Northeast Asian country importing imperial exams from the Tang dynasty in ancient China and creating its system between the 7th and 8th century. Japanese exams' contents mainly relied on Confucian-based texts *Hsui-tsai* ('Exceptional Talent'), *Ming-ching* ('Learned in Classics'), *Chin-shih* ('Presented scholar'), and *Ming-fa* ('Learned in Law') (Spaulding, Jr., 2015; Wang, 2012). Although the Japanese exam system only endured about two centuries, it established a foundation for initiating later meritocratic regimes during the ruling times of the Tokugawa administration (1603-1867) and the 'Meiji Restoration' (1868-1912) (Gordon, 2019). Its influence was even prolonged to 1945 by inspiring higher civil exams in Japanese capitalism which combined both Confucian knowledge and legal studies for exam contents (Esman, 1947; Spaulding, 1967). Modern-day Japan also implements its national civil service examinations for the recruitment of public servants due to the influence of pre-modern examinations (Sakamoto, 2001).

In historical Korea, King Wonseong of the Silla dynasty founded the National Academy (*gook-hak*), which was typically mentioned as the state university for educating junior intellectuals with Confucian literature. He also started Confucian exams known as *toksõ-samp'um-kwa* (the three-grade reading exam) in 788, which was similar to exams held by ancient China's Tang dynasty (Lee, 2000). 252 Confucian exams were organised in ancient Korea during the Silla time (Cho, 1996). After a short termination period following the collapse of the Silla dynasty, the national civil exam system was reinstated by King Gwangjong during the reign of the Goryeo dynasty in 958 known as *gwa-geo*, which also adopted the Chinese version (Kang, 1974). *Gwa-geo* was very useful for recruiting civil officials and making a smooth transition from a military bureaucracy to a civil government, providing political

stability during the Goryeo and Joseon dynasty (Deuchler, 1992; Kim, 2019). The historical Korean exam system was formally dismissed from imperial bureaucracy in 1894 via the *Gabo* reform.

In other territories and countries such as Hong Kong, Taiwan, and Singapore,[71] Confucianism arrived in and rooted in society through historical waves of Chinese immigrants. Moreover, ruling elites in these countries also placed their high respect for Confucian values. For example, the founder of Taiwan Chiang Kai-shek encouraged the use of Confucian traditions to construct a new era of Taiwan, especially during the era of China's Cultural Revolution, in which Chinese traditional values were destroyed by communists (Kim, 2014). Similarly, the Singaporean government officially emphasized Confucian values as the "Asian values" (Chang, 2003).

Today, Confucianism is not formally used as the national doctrine in these countries, however, its long-standing influence still exists through cultural values and conformity it created and transmitted across generations (Boardman and Kato, 2003; Lin and Ho, 2009). These imperial civil exams induce long-lasting effects on educational outcomes in present-day society through the persistence of Confucian cultural values towards education. Qualitative evidence shows that parents invest more in their children's education (Lam et al., 2002), and children insert higher efforts into their schooling and exams to achieve better academic results in Confucianism-originated countries (Marginson, 2011). The effect of historical civil exams is also on modern business activities (Kim et al., 2017) in which firms organise examinations for personnel recruitment (Cheung and King, 2004; Hempel and Chang, 2002).

In addition, the influence of Confucianism has been also documented in second-generation immigrants in Western countries. Previous studies from sociology have documented

[71] Singapore is a special case because although its geographic location is in Southeast Asia, its cultural background belongs to Northeast Asia as a large part of its population is Chinese (Huat, 2009).

academic success of children of immigrants from Northeast Asian countries compared to children born to parents from other countries (Byun and Park, 2012; Jerrim, 2015; Jerrim and Choi, 2014; Kim and Chun, 1994).

Appendix C: Appendix to Chapter 3

TABLE C.1: GENERAL HEALTH QUESTIONNAIRE-12

Mental health measures		Scale			
		1	2	3	4
GHQ 1	Concentration	Better than usual	Same as usual	Less than usual	Much less than usual
GHQ 2	Loss of sleep	Not at all	No more than usual	Rather more than usual	Much more than usual
GHQ 3	Playing a useful role	More so than usual	Same as usual	Less so than usual	Much less than usual
GHQ 4	Capable of making decisions	More so than usual	Same as usual	Less so than usual	Much less capable
GHQ 5	Constantly under strain	Not at all	No more than usual	Rather more than usual	Much more than usual
GHQ 6	Problem overcoming difficulties	Not at all	No more than usual	Rather more than usual	Much more than usual
GHQ 7	Enjoy day-to-day activities	More so than usual	Same as usual	Less so than usual	Much less than usual
GHQ 8	Ability to face problems	More so than usual	Same as usual	Less able than usual	Much less able
GHQ 9	Unhappy or depressed	Not at all	No more than usual	Rather more than usual	Much more than usual
GHQ 10	Losing confidence	Not at all	No more than usual	Rather more than usual	Much more than usual
GHQ 11	Believe worthless	Not at all	No more than usual	Rather more than usual	Much more than usual
GHQ 12	General happiness	More so than usual	About the same as usual	Less so than usual	Much less than usual

TABLE C.2: FACTOR LOADINGS OF MENTAL HEALTH MEASURES

Mental health measures		Factor loadings	Signal
		(1)	(2)
GHQ 1	Concentration	1.0000	0.1743
GHQ 2	Loss of sleep	1.6961	0.3707
GHQ 3	Playing a useful role	1.0143	0.2172
GHQ 4	Capable of making decisions	0.8311	0.1553
GHQ 5	Constantly under strain	1.7365	0.3308
GHQ 6	Problem overcoming difficulties	1.7979	0.2648
GHQ 7	Enjoy day-to-day activities	1.1563	0.1753
GHQ 8	Ability to face problems	0.9597	0.1526
GHQ 9	Unhappy or depressed	2.1819	0.2403
GHQ 10	Losing confidence	2.0926	0.2491
GHQ 11	Believe worthless	1.7325	0.2433
GHQ 12	General happiness	1.2732	0.1886

TABLE C.3: BALANCE TESTS: RELATIONSHIP BETWEEN TIMING OF UC ROLL-OUT AND LOCAL AUTHORITY DISTRICT CHARACTERISTICS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dep. Var: UC roll-out date (month and year)								
Population (log, 1000 persons)	-0.2673								-0.5912
	(1.0918)								(1.2703)
Share of white population (%)		0.0534							0.0475
		(0.0555)							(0.0911)
Share of working-age population aged 16-64 (%)			-0.0646						-0.4029
			(0.2202)						(0.5264)
Share of being married for those aged 16 and over (%)				-0.0841					-0.3110
				(0.1113)					(0.3014)
Share of economically active population aged 16-74 (%)					-0.3430				-0.3041
					(0.3148)				(0.5443)
Share of population aged 16-74 with a full-time job (%)						-0.1805			0.1008
						(0.2525)			(0.3744)
Share of households with unshared dwelling (%)							4.2876		9.1381
							(6.8480)		(11.4806)
Share of population with very good health (%)								-0.3676	-0.2624
								(0.3379)	(0.3855)
p-value for joint significance of covariates									0.6446
R-squared	0.0002	0.0024	0.0002	0.0015	0.0031	0.0013	0.0010	0.0031	0.0159
Observations	382	382	382	382	382	382	382	382	382

Notes: Observations are measured at the local authority district level. Standard errors are in parentheses.

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

Data source: UK Census (2011)

TABLE C.4: EFFECT OF BECOMING UNEMPLOYMENT AND CLAIMING UC VS LEGACY ON POOR MENTAL HEALTH

	(1)
Unemployed	0.2230***
	(0.0210)
UC	0.0545
	(0.0499)
Legacy	0.0514***
	(0.0095)
Unemployed*UC	0.2129*
	(0.1192)
Unemployed*Legacy	-0.0467
	(0.0289)
Controls	Yes
Individual fixed effects	Yes
Year fixed effects	Yes
Local authority district fixed effects	Yes
Observations	199,563
Unemployed*UC - Unemployed*Legacy	0.2596**
	(0.1205)

Notes. Sample is restricted to observations aged 18-60. This sample includes all unemployed individuals regardless of whether they are claiming any benefits. Standard errors are clustered at the local authority district level. Controls include age, age squared, a dummy for prior mental disorder, and dummies for educational levels (higher degree, first degree, higher diploma, A-level, and GCSE/0-level), and dummies for having a child and being married.

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

Data source: UKLHS (2009-2019)

TABLE C.5: EFFECT OF BECOMING UNEMPLOYMENT AND CLAIMING UC ON POOR MENTAL HEALTH (FULL VERSION OF COLUMN 1, TABLE 3.2)

	(1)
Unemployed	0.178***
	(0.020)
UC	0.057
	(0.050)
Legacy	0.048***
	(0.010)
Unemployed*UC	0.262**
	(0.125)
Age	0.031***
	(0.010)
Age squared	-0.000***
	(0.000)
Prior mental disorder	0.435***
	(0.028)
Higher degree	-0.036
	(0.041)
First degree	-0.045
	(0.032)
Higher diploma	0.021
	(0.041)
A level	-0.003
	(0.031)
GCSE/O level	-0.000
	(0.041)
Having a child	-0.019*
	(0.009)
Being married	-0.051***
	(0.015)
Constant	-1.181***
	(0.431)
Individual fixed effects	Yes
Year fixed effects	Yes
Local authority district fixed effects	Yes
Observations	194,428
Number of individuals	48,945
R-squared	0.016

Notes: Sample is restricted to observations aged 18-60. Standard errors are clustered at the local authority district level. Controls include age, age squared, a dummy for prior mental disorder, and dummies for educational levels (higher degree, first degree, higher diploma, A-level, and GCSE/0-level), and dummies for having a child and being married.

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

Data source: UKLHS (2009-2019)

TABLE C.6: EFFECT OF BECOMING UNEMPLOYMENT AND CLAIMING UC ON POOR MENTAL HEALTH: ROBUSTNESS (RESTRICTED SAMPLE OF WAVES 4-9)

	(1)
Unemployed	0.157***
	(0.030)
UC	0.037
	(0.049)
Legacy	0.050***
	(0.016)
Unemployed*UC	0.285**
	(0.126)
Controls	Yes
Individual fixed effects	Yes
Year fixed effects	Yes
Local authority district fixed effects	Yes
Observations	116,289

Notes. Sample is restricted to observations aged 18-60 of waves 4-9. Standard errors are clustered at the local authority district level. Controls include age, age squared, a dummy for prior mental disorder, and dummies for educational levels (higher degree, first degree, higher diploma, A-level, and GCSE/0-level), and dummies for having a child and being married.

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

Data source: UKLHS (2009-2019)

TABLE C.7: EFFECTS OF BECOMING UNEMPLOYMENT AND CLAIMING UC ON FUTURE EMPLOYMENT AND UNEMPLOYMENT

	(1)	(2)
	Employed	Unemployed
Unemployed	-0.008	-0.055***
	(0.008)	(0.010)
UC	0.011	-0.026*
	(0.023)	(0.014)
Legacy	-0.022***	0.010***
	(0.004)	(0.003)
Unemployed*UC	0.110	-0.119*
	(0.068)	(0.063)
Controls	Yes	Yes
Individual fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Local authority district fixed effects	Yes	Yes
Observations	150,093	150,093

Notes. Dependent variables are measured at the year t+1. Sample is restricted to observations aged 18-60. Standard errors are clustered at the local authority district level. Controls include age, age squared, a dummy for prior mental disorder, and dummies for educational levels (higher degree, first degree, higher diploma, A-level, and GCSE/0-level), and dummies for having a child and being married.

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

Data source: UKLHS (2009-2019)

Appendix C1: Factor analysis

In this section, we show how we perform our factor analysis for the mental health measurement, including 12 components of mental health (concentration; loss of sleep; playing a useful role; being capable of making decisions; constantly under strain; problem overcoming difficulties; enjoy day-to-day activities; ability to face problems; unhappy or depressed; losing confidence; believe worthless; and general happiness).

We particular estimate the following equation:

$$Y_{ic} = \quad \alpha_c + \beta_c \gamma_{ic} + e_{ic} \qquad (\mathrm{C}.1).$$

Y_{ic} is the c^{th} component of the mental health of individual i ($c = 1, \ldots, 12$). α_c is the intercept of and β_c is a factor loading specific for mental health component c. e_{ic} is the measure-specific measurement error which has mean zero and is assumed to be uncorrelated with γ_{ic} and also independently distributed across individuals and mental health components. Finally, γ_{ic} is the latent factor for mental health-specific component c which can be identified and extracted by setting the factor mean to 0 and β_1 to 1.

Appendix C2: Separate effects of entering unemployment and claiming UC versus legacy on mental health

A small proportion of the UKHLS data reported being unemployed but were not claiming UC or legacy benefits. This can occur if unemployed individuals were ineligible for benefits, for example if the had savings above the threshold, or their household income was too high (in the case of UC). Our main analysis excluded these individuals, who represent a small number of unemployed individuals. We now include them in the sample in order to analyse the separate roles of legacy versus UC in mitigating any negative mental health effect of becoming unemployed.

Equation (3.1) becomes:

$$Y_{idt} = \alpha'_0 + \alpha'_1 U_{idt} + \alpha'_2 D_{idt} + \alpha'_3 L_{idt} + \alpha'_4 U_{idt} \times D_{idt} + \alpha'_5 U_{idt} \times L_{idt} + \boldsymbol{\alpha}'_6 \boldsymbol{X}'_{idt} + \mu_i + \mu_d + \mu_t + u_{idt} \quad (\mathrm{C}.2).$$

Similarly to Equation (3.1), U_{idt} is a dummy variable indicating whether the individual is unemployed, D_{idt} is a dummy variable indicating whether the individual claims UC and L_{idt} is a dummy variable indicating whether the individual claims one of the legacy benefits. μ_i, μ_d and μ_t are fixed effects for the individual, local authority district and year, respectively. u_{idt} is an error term.

The coefficients α'_4 and α'_5 indicates how claiming for UC and legacy respectively mitigates or exacerbates the poor mental health effect of becoming unemployed. The parameter of interest is the difference between the legacy and UC interaction terms, the coefficient gap $\alpha'_4 - \alpha'_5$, which represents the differential effect of UC versus legacy on the mental health of unemployed claimants.

Table C.4 reports the regression results for Equation (C.2). An individual unemployed but not claiming UC or legacy has poorer mental health by 22% of a standard deviation. Entering unemployment and claiming for a legacy benefit will mitigate this effect by nearly 5% of a standard deviation (the interaction between unemployed and legacy) whilst entering unemployment and claiming UC exacerbates the effect by 21% of a standard deviation. In all the difference of claiming UC versus legacy in mitigating the mental health effects of unemployment is given in the final row, as 26% of a standard deviation of the poor mental health score.

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