Three Essays on Development and Labour Economics

by

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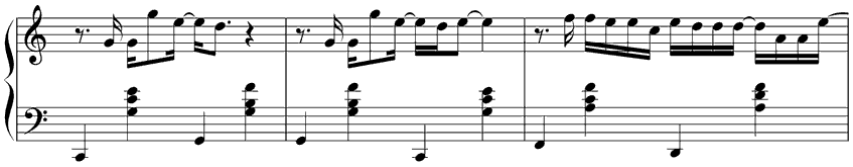

"The Serious Snow"

Abstract

This dissertation comprises three independent essays on empirical development and labour economics using data from both the UK and China. Chapter 1 provides the first economic investigation into the treatment effect of the Equality Act (EA) 2010 in Great Britain, which replaced the previous UK Disability Discrimination Act (DDA) 1995, and studies its consequences on disabled people's labour market status. I find optimistic evidence that the policy change improved the employment and wages of the disabled. In the last two chapters, I study the effects of migration on families and family members left behind, focusing on the case of China's Great Migration. In particular, Chapter 2 presents new evidence on the impact of daughters' and sons' migrations on the health and well-being of their elderly parents left behind in the rural villages. The migration of daughters increases parents' outcomes, whereas no similar beneficial effects were found for the migration of sons. Chapter 3 examines the impact of adult children's migration and remittances on the expenditure decisions of the rural households left behind, comparing households with temporary versus permanent migrants. I conclude that policymakers should view permanent migration as a potential pathway to boost local economic development.

Contents

List of Figures

List of Tables

Declaration of Authorship

I herewith declare that the thesis entitled *Three Essays on Development and Labour Economics* and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. Chapter 2 is a joint work with Professor Jackline Wahba who is my primary PhD supervisor. I have acknowledged all main sources of help and I have clearly given the sources I quoted or consulted from the work of others. I confirm that this thesis has not been presented in an identical or similar form to any other examination board and none of this work has been published before the submission.

Acknowledgements

Along my PhD journey, I have been in luck to meet and benefit tremendously from people who are more intelligent than I am. First and foremost, a huge debt of gratitude goes to my remarkable supervisors, Jackline Wahba and Christian Schluter. I do not think this dissertation would have been possible without their wise guidance. Jackie has not only been a supervisor, but a role model, and a mentor for research as well as a life. I hope one day I will become a great female economist like her.

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distance. To Zizhong Yan, my husband, thank you so much for everything.

Abbreviations

ATT	**A**verage **T**reatment Effects on the **T**reated
ADA	The **A**mericans with **D**isabilities **A**ct
ADL	**A**ctivities of **D**aily **L**iving
BHPS	**B**ritish **H**ousehold **P**anel **S**tudy
BMI	**B**ody **M**ass **I**ndex
CES-D-10	**10**-item CHARLS version of the **C**enter for **E**pidemiological **S**tudies **D**epression Scale
CHARLS	**C**hina **H**ealth **a**nd **R**etirement **L**ongitudinal **S**tudy
CAPI	**C**omputer-**A**ided **P**ersonal **I**nterview
DDA	The **D**isability **D**iscrimination **A**ct
DD	**D**ifference-in-**D**ifference
DDD	**D**ifference-in-**D**ifference-in-**D**ifference
DLA	**D**isability **L**iving **A**llowance
EA	The **E**quality **A**ct
ELSA	**E**nglish **L**ongitudinal **S**urvey of **A**geing
FRS	**F**amily **R**esources **S**urvey
HRS	**H**ealth and **R**etirement **S**urvey
IADLs	**I**nstrumental **A**ctivities of **D**aily **L**iving
IB	**I**ncapacity **B**enefit
IV	**I**nstrumental **V**ariable
KatzIADLs	**Katz** Index of **IADLs**
LawtonIADLs	**Lawton IADLs**
LFS	**L**abour **F**orce **S**urvey
LPM	**L**inear **P**robability **M**odel
NELM	**N**ew **E**conomics of **L**abour **M**igration
OLS	**O**rdinary **L**east **S**quares
QLFS	**Q**uarterly **L**abour **F**orce **S**urvey
RPI	**R**etail **P**rice **I**ndex
RHS	RUMiC **R**ural **H**ousehold **S**urvey
RUMiC	**R**ural-**U**rban **M**igration **i**n **C**hina

SHARE	**S**urvey of **H**ealth, **A**geing and **R**etirement in **E**urope
SIPP	**S**urvey of **I**ncome and **P**rogram **P**articipation
SRH	**S**elf-**R**eported **H**ealth **S**tatus
SWB	**S**ubjective **W**ell-**B**eing
2SLS	**Two S**tage **L**east **S**quares

Introduction

This thesis is a collection of three self-contained essays on empirical development economics and labour economics, documented in Chapter 1, 2 and 3. The aim of this Introduction is to provide the reader with an overview of each chapter's background and the key findings. Exploiting data from both the UK and China, the thesis addresses policy-relevant questions through econometric non-experimental methods with a particular focus on health, migration and labour market.

Chapter 1 and 2 both contribute to the economics of health, probing specifically into two groups of individuals who are widely deemed more "vulnerable" in health—disabled people and elderly parents. Firstly, *legislation changes* are important remedies to alleviate discrimination and inequality at work, as well as to promote a fairer society. It has been almost seven years since the enactment of the Equality Act 2010 in Great Britain. Despite this, almost no attempt has been made in economics to evaluate the policy's effectiveness. The purpose of the first chapter is thus to provide a first economic investigation into the labour market impact of the new Act, focusing on disabled people. Secondly, at a more micro level, *family changes* especially the separation of families that migration usually entails, could have a considerable impact on individual and household outcomes. Economic research concerning migration and its impact on sending areas, albeit growing, is still thin. Chapter 2 and 3 advance the existing literature on the impact of migration on the families and family members left behind, contributing directly to the economics of migration. Two important features that these two chapters share are, first, they are both within the context of rural-to-urban migration in China and, second, they both account for

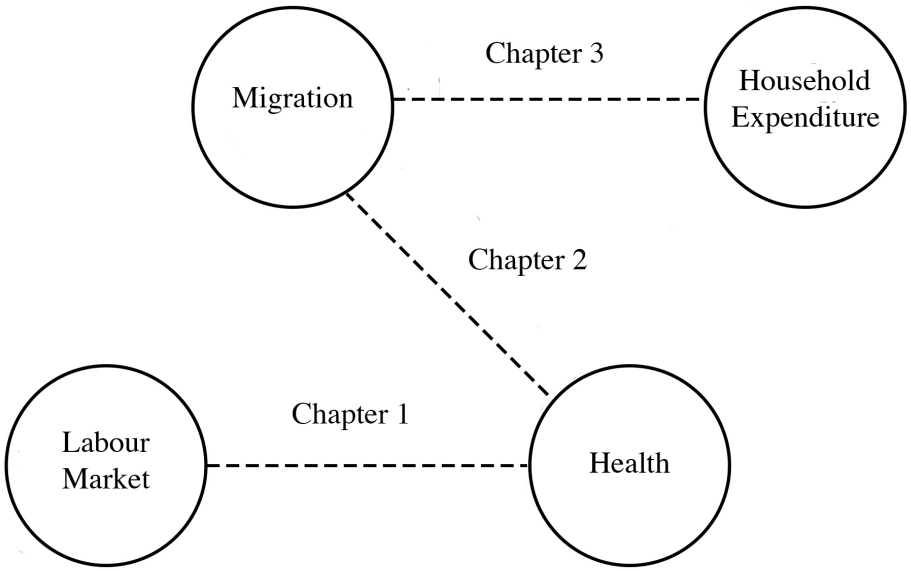

Figure 1: THESIS STRUCTURE
Chapter 1 is the combination of labour economics and economics of health.
Chapter 2 is the combination of economics of health and economics of migration.
Chapter 3 is well situated in the economics of migration research.

inherent heterogeneity of migration. Namely, Chapter 2 disentangles between the gender of migrant children whilst Chapter 3 distinguishes between the type of migration and remittances.

In particular, Chapter 1 of the thesis, *"Evaluating the UK Equality Act: Effects on the Labour Market Status of Disabled People"*, examines the policy effect of the Equality Act (EA) 2010, the first consolidating Act in Great Britain, which replaced and in some aspects extended existing anti-discrimination laws including the Disability Discrimination Act (DDA) 1995. Focusing on disability, one of the protected characteristics covered by the Act, I study whether and to what extent the new policy affected disabled people's labour market outcomes. My identification strategy exploits exogenous variations in time and health-related eligibility rules provided by this natural experiment and employs a difference-in-difference model. Using data from the UK Quarterly Labour Force Survey (QLFS), I find an improvement in both employment and wages for the disabled relative to

the non-disabled in the post-Act period. The estimated effects are robust to alternative explanations such as business cycle effects, development of other disability programmes, and possible compositional changes. Moreover, as the EA does not apply to Northern Ireland, I further introduce this additional variation in region and the difference-in-difference-in-difference estimates reinforce the benchmark results. The evidence expands upon current UK research that focuses exclusively on the DDA.

Chapter 2, joint with Jackline Wahba, is entitled *"Sons or Daughters? Gender, Child Migration and Health of Parents Left Behind"*. This essay provides new empirical evidence on the impact of adult children's rural-urban migration on the health and well-being of their elderly parents left behind in rural China, distinguishing between the gender of the migrant children. To deal with migration endogeneity, we exploit a novel variation in children's exogenous characteristics and apply instrumental variables methods. Employing data from the China Health and Retirement Longitudinal Study (CHARLS), we find that the migration of daughters increases parental health and well-being. In contrast, we find no evidence of such beneficial effects when sons migrate. We further explore the mechanism through which these gender-biased effects may arise. Our findings have important implications for would-be parents in China and for regions and countries that have high rates of female emigration.

Chapter 3 of the thesis, *"Child Migration, Remittances and Household Expenditures in China"*, investigates whether adult children's internal migration and remittances influence expenditure behaviour of households left behind in rural China, and how this relates to different types of migration. Exploiting unique *hukou* information in the China Health and Retirement Longitudinal Study (CHARLS) survey, I explicitly distinguish between temporary and permanent migration. To address the endogeneity of migration and remittance receipt, I implement an instrumental variable procedure. My results reveal different impacts on household expenditure patterns depending on whether children migrate temporarily or permanently to the city. Households with temporary migrant children and remittances spend more on one key consumption good—food—and less on other consumption goods and investment. In contrast, permanent migration and remittances have no

impact on household consumption but increase productive investment. Therefore, policy-makers should view permanent migration as a potential pathway to foster local economic development.

Chapter 1

Evaluating the UK Equality Act: Effects on the Labour Market Status of Disabled People

1.1 Introduction

Historically, people with disabilities are a large and economically disadvantaged group in the labour market. Disabled people are less likely to be employed and, when employed, receive lower wages than their non-disabled counterparts.[1] Over the last few decades, the primary pieces of legislation aimed at securing improvements in the labour market position of disabled workers are the Americans with Disabilities Act (ADA) 1990 in the US and the Disability Discrimination Act (DDA) 1995 in the UK. The introduction of the DDA was designed to protect the disabled against discrimination and to facilitate and enhance their access to employment by imposing obligations on employers to make reasonable adjustments to their premises and employment arrangements. In October 2010, the Equality Act (EA) 2010 consolidated existing anti-discrimination laws in Great Britain,

[1] The employment gap is often far wider than the gap in earnings (Longhi, Nicoletti, and Platt, 2012).

including the previous DDA, into one Act.[2] It was hoped that the extended rights under the EA would significantly improve the labour market experience of disabled people .

A key issue for policymakers is to determine the extent to which such legal reforms have achieved their objectives. The ADA has sparked a substantial academic debate about its consequences on the labour market outcomes of disabled people and a large body of publications has appeared following its enactment (see, for example, Acemoglu and Angrist, 2001; DeLeire, 2000b; Kruse and Schur, 2003). However, studies that explicitly assess the impact of the DDA have been surprisingly limited. Although some evidence is beginning to emerge (Bell and Heitmueller, 2009; Jones, 2006), the majority of the work in this regard explores only the efficacy of the DDA 1995, thus providing few implications for policy development. Therefore, a particular focus of this paper is to fill the gap in literature by evaluating the effect of the Equality Act 2010 on the labour market status of disabled individuals. To the best of my knowledge, there has been little attempt to evaluate this new Act for its impact on disabled people in the UK labour market, and my paper aims to be among the first formal economic pre- and post-evaluation of the Equality Act.

The theoretical justification for my model stems from the Acemoglu and Angrist (2001) argument that the general equilibrium effects of disability legislation on the labour market outcomes of the disabled are ambiguous. In the paper, the authors develop a standard competitive model with two types of agents (i.e., disabled and non-disabled workers) to derive theoretical predictions about the impacts of disability law. On the one hand, the mandates on non-discrimination in firing and reasonable adjustments for disabled employees make it more costly to hire a disabled worker and would decrease demand for disabled workers. On the other hand, the Act implicitly subsidises the hiring of the disabled because not hiring a disabled worker increases the potential threat of a costly lawsuit. Thus the net effect would depend on the relative importance of the various provisions. Empirically, most charges pertain to wrongful termination rather than discrimination in hiring,[3] which

[2]On top of the DDA, the Equality Act also replaced a range of other anti-discrimination laws, such as the Sex Discrimination Act and the Race Relations Act—but I will focus solely on disability, as this is the area that has changed the most.

[3]The extent to which accommodation requirements will affect employment depends on the accommodation costs which are difficult to estimate due to their intrinsic non-monetary features (e.g., allowing disabled

implies the net result of decreased employment and wages for the disabled. The negative effects may be somewhat offset by the increased productivity of disabled workers or by the increase in the supply of them as a result of a more favourable working environment brought about by the Act. Although the decline in employment (or increase in labour supply of disabled people) tends to reduce wages for disabled workers, the equal-pay provision may stifle such an effect.

My identification strategy exploits three sources of exogenous variation stemming from the 2010 policy change, namely, time, eligibility status and geographical coverage. The fact that the policy is disability-specific implies that non-disabled people form a natural comparison group. Utilising time and group variations, I firstly evaluate a difference-in-difference model where the before-after outcomes of the disabled and the non-disabled are compared. The resulting estimators, as in many other comparable studies, rely on the key assumption that the evolution of the outcome variable in the two groups being compared would have been the same in the absence of the treatment (*common trend assumption*). I consider three potential threats to this identifying assumption and perform robustness checks accordingly: 1) business cycle effects, 2) development of other disability-related programmes, and 3) compositional changes among the disabled and the non-disabled groups. Using data from the 2005-2013 UK Quarterly Labour Force Survey (QLFS), I find evidence of positive employment and earnings effect as a result of the new law. After controlling for the aforementioned confounding factors, the effects are still there. It is important to note that one fundamental problem with earlier studies on this issue is that because the law is implemented at national level and covers nearly all disabled people, it is difficult to obtain a comparison group of people who are also disabled but not subject to the same changes in legislation. As a result of this concern, an array of US literature uses state-level data and variation across states in disability discrimination laws prior to the ADA to generate the treatment and comparison group (Beegle and Stock, 2003; Jolls and Prescott, 2004; Hotchkiss, 2004). The UK, however, often lacks this sort of framework. Since the Equality

workers a more flexible schedule). Yet, it is very likely to be costly, especially for small or moderately sized establishments.

Act 2010 does not replace the DDA in Northern Ireland, I am able to capture groups of disabled individuals in the same period who are (the disabled in Great Britain) and are not (the disabled in Northern Ireland) affected by the Act. Making use of this additional variation in region allows me to build up a difference-in-difference-in-difference (DDD) model in which I am able to further control for changes in the relative outcomes of the disabled that are unrelated to the legislation change, significantly increasing precision of the estimates. Reassuringly, the estimated policy effects I obtain from the triple difference specification are similar to those obtained from the double difference model. Due to the Equality Act's intrinsic nature of being a harmonised law, this paper provides new evidence on the labour market impact of disability legislation, suggesting that law harmonisation can be more effective than law specialisation, at least in terms of improving disabled people's labour market experience.

The paper proceeds as follows. Section 1.2 provides a background for this research, with a detailed discussion of the Equality Act 2010 and a brief survey of existing literature. Section 1.3 presents the empirical framework, where I elaborate on the evaluation methodology, including identification of parameters of interest, estimation approach, as well as a number of potential threats to the key identifying assumption. Section 1.4 describes the data used in this paper, and the empirical results are illustrated in Section 1.5—1.7. The paper concludes in Section 1.8.

1.2 Background

1.2.1 The Equality Act 2010

What has changed?

The Equality Act 2010 came into force on 1st October 2010 with additional provisions (Public Sector Equality Duty) taking effect in April 2011. Being a consolidating Act, the EA brings together, for the first time in Great Britain, nine pieces of equality legislation based on various protected characteristics (i.e., age, disability, gender reassignment,

marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation) within a single Act. The Act does not extend to Northern Ireland, where the Disability Discrimination Act 1995 is still in force.

From a disability perspective, the EA has not only replaced the DDA and its subsequent amendments, but has also strengthened the law in several important dimensions to help protect and promote the interests of disabled people. Under Part II of the DDA that pertains to employment, it is unlawful to discriminate against the disabled in all aspects of employment and work, and employers may have to make "reasonable adjustments"[4] to the workplace and employment arrangements to remove potential barriers faced by disabled employees.[5] The new Equality Act, in addition to carrying forward disabled workers' existing rights and protection provided by the DDA, represents a significant step forward through the following improvements.

First, the definition of disability is relaxed. Specifically, the DDA defines disability as "a physical or mental impairment which has a substantial and long-term adverse effect on a person's ability to carry out normal day-to-day activities". To qualify for protection, a disabled person must *also* show that their impairment affects a particular capacity (that appears on an official list of eight capacities), such as eyesight, speech or hearing. The EA has made life easier for disabled people by removing the past list of capacities, and it is sufficient to show the incapability of performing daily activities like answering a telephone.[6] One might argue that evolving definitions of disability in the DDA and EA would confound the causal interpretation of estimates of the policy impact, which I will discuss at great length later.

[4] A "reasonable adjustment", also known as "reasonable accommodation", refers to any modification to the working environment without which it would be "impossible or unreasonably difficult" for the disabled person to use the service. The examples provided by the DDA include: altering working hours, acquiring or modifying equipment, modifying procedures for testing or assessment, providing a reader or interpreter, and other similar accommodations.

[5] Initially there was a small firm exemption for businesses with less than 20 employees. Then the threshold firm size was reduced to 15 in December 1998 and the exemption was fully abolished in October 2004.

[6] The EA also protects people who are perceived to be disabled (*perceived disability*), or who experience discrimination because they are linked with a disabled person (*associative discrimination*). Such individuals are impossible to identify in ready data because so far no robust survey has been conducted to estimate the actual incidence of perception or association. Nevertheless, it seems reasonable to assume that the size of this population should be very small.

A second change the EA made compared with the DDA relates to a new provision to restrict the questions that employers can ask job candidates about health and disability before offering them a job (except in certain circumstances). Notably, this aims to prevent disabled applicants from being unfairly screened out at an early stage of recruitment and selection, and hence is expected to increase their employment opportunities.

A third change is that the EA broadly extends the scope of protection for disabled people. Previously, the DDA banned *direct disability discrimination* only when it happened in relation to work.[7] Now, under the new Act, protection for the disabled applies beyond the employment field to other areas, e.g., facilities, goods and services. Furthermore, the EA introduces new provisions to protect disabled people also from *indirect disability discrimination*, *discrimination arising from disability*, and *harassment*.[8]

There is a fourth change in the EA concerning reasonable adjustments. Under the previous DDA, it was necessary to show that the service provider's premises, policies, practices and procedures make it "impossible or unreasonably difficult" to access the service. Now, adjustments should be made where a disabled person is placed at a "substantial disadvantage".

WHAT DOES THIS MEAN FOR EMPLOYERS?

By simplifying and harmonising existing laws, the EA intends to make it more consistent, clearer, and easier to operate and understand than previous equality legislation. As a matter of fact, employers' responsibilities remain largely the same, though they need to be aware of some differences. An immediate and practical impact on employers may be that they need to carefully review their old policies and practices. In addition, the Act provisions allow employers to take steps to promote diversity in their workforce. Actions may include widening recruitment strategies to reach under-represented groups, such as skills training

[7] *Direct disability discrimination* occurs when a person receives unfavourable treatment because of the disability itself.

[8] *Indirect disability discrimination* occurs when a rule, policy or procedure applies in the same way to everyone but particularly disadvantages disabled people. *Discrimination arising from disability* happens when unfavourable treatment towards the disabled person arises from something connected with their disability. *Harassment* refers to unwanted behaviour related to disability, from a third party that has the purpose or impact of violating a person's dignity or creating an unfavourable or offensive environment.

for disabled people. The Act also allows employers to take positive action in recruitment and promotion, such as hiring a disabled candidate in a "tie-break" situation (i.e., where candidates are equally qualified). Thus, the Act may have a direct bearing on employers' day to day operations, especially encouraging them to think ahead and take precautionary steps to address hurdles that hinder disabled people. Clearly, lowering the threshold for reasonable adjustments means that employers may have to make more accommodation for disabled employees. This, however, does not alter things much in practice because the old law already required them to do so. Instead, by creating a more favourable climate for the disabled, firms may avoid potential tribunal and court cases that can be time-, costs- and emotion-consuming. Meanwhile, incumbent workers with disabilities may become more productive. Therefore, whether the Equality Act impedes or improves the labour market status of disabled people remains an empirical question, depending on enforcement of the law, actual costs and benefits to employers, and many more factors.

1.2.2 Related Literature

The pioneering paper evaluating the impact of the ADA is by DeLeire (2000a,b). Using data from the Survey of Income and Program Participation (SIPP), DeLeire (2000b) reveals that the employment rate of men with disabilities is 7.2 percent lower in the post-ADA period and that there are no observable changes in male wages.[9] In direct support of the above findings, Acemoglu and Angrist (2001) in their prestigious paper use the March Current Population Survey (CPS) data to show that the ADA is associated with a decline in the employment of disabled workers, but has no effect on their wages.[10]

Their findings, however, have been questioned on the grounds that the self-reported disability measures may not accurately reflect the *true* coverage of the disability law. On the one hand, fewer disabled people might describe themselves as being disabled once they obtain better jobs; on the other hand, the willingness to report health problems might

[9] Although other policy changes could have contributed to the change in employment, the author argues that the timing and magnitude of the changes are consistent with the ADA.

[10] They argue that only part of the effects can be accounted for by the increase in disability-related transfers. They also find that the measured effects are stronger in medium-sized firms and in states with higher ADA-related discrimination charge rates.

increase if the ADA removes the stigma attached to disability. Most notably, Kruse and Schur (2003) examine 14 alternative measures of disability and find both negative and positive effects (when more specific disability measures are used) of the ADA on disabled employment rates, depending on how disability is defined. They conclude that analysis of the employment impacts of the ADA is confounded by changes in the composition of people reporting a disability, the role of disability income, and the relative effects of business cycles on workers with and without disabilities. In contrast, Burkhauser et al. (2002) argue that differences in trends in self-reported work limitations and in health impairments data from US employment surveys are insignificant, and hence data on self-reported health contains useful information which can be used to estimate the disabled population.

An important line of research relies on state-level variation in disability discrimination laws prior to the ADA to identify whether or not the legislation was responsible for the employment decline during the 1990s. Beegle and Stock (2003) exploit variation in pre-existing legislation across states to generate treatment and comparison groups within a quasi-experimental framework. Compared with previous research, where evaluation of the ADA only captures the additional effect of the ADA over and above existing legislation, the advantage of their method is to control for pre-existing trends in outcomes that are common across states, since using state differences in the laws allows separation of those who were previously subject to legislation from those who were not in the same period (i.e., in different states). They reveal the negative effects of the disability discrimination laws on the relative earnings and relative labour force participation rates of the disabled. But once they control for employment trends that existed prior to the passage of the ADA, there is no such effect on the relative employment rates of disabled people. Jolls and Prescott (2004) disentangle the various components of the ADA (primarily anti-discrimination and reasonable accommodation) to determine which particular aspect of the legislation is responsible for its observed impacts. By comparing states that, due to their existing legislation are only subject to one (additional) component of the ADA, they are able to separate the effect of each of the elements. They find that the costs of "reasonable accommodation" for the disabled workers required by the ADA are likely to explain much

of the decline in employment of the disabled rather than the effect of increased firing costs for this group. They also argue that factors other than the ADA itself have contributed to the observed decline. Hotchkiss (2004) takes into account selection into the labour market and concludes that the predicted unconditional employment probability has not declined (and has actually increased) post ADA legislation. There is evidence that non-participants move into disability, which reduces the participation rate of the disabled. Using state-level data, the evidence suggests that the impact of the ADA has been limited, which Hotchkiss suggests may be due to prior state-level legislation crowding out the impact of the ADA.

There are almost no comparable studies existing in the UK which consider the impact of the DDA. One famous exception is Bell and Heitmueller (2009) who adopts a similar methodology to Acemoglu and Angrist (2001) to evaluate the impact of the DDA, based on data from both the British Household Panel Study (BHPS) and the Family Resources Survey (FRS). In line with the ADA, the paper shows that the DDA led to a decline or, at least, a level off in the employment rate of disabled people in the immediate post-DDA period. Possible explanations include "low take-up of financial support, low levels of general awareness about the Act among disabled people and employers, and limited knowledge about the true costs of required adjustments". Jones (2006), however, reaches an opposite conclusion using the LFS data. She reveals that the employment gap has narrowed for the disabled over the post-DDA period, consistent with positive effects of the DDA. Using the same LFS dataset, Jones, Latreille, and Sloane (2006) assess the impact of the DDA on the disabled and compare the effects by gender and by disability type. They claim that a substantial gap in wages and employment rate still exists after several years of operation of the DDA, especially for those with mental health problems. Following DeLeire (2000b), the authors distinguish between work-limited and non-work-limited disabled workers, finding positive effects of the legislation for men (i.e., less wage discrimination) while this is not the case for women. Jones (2009) uses the Health Survey for England (HSE) to investigate the labour market impact of the DDA and finds no evidence of a positive employment effect.

1.3 Identification Strategy

As argued by Acemoglu and Angrist (2001), the theoretical justification of the impact of disability legislation on the labour market status of the disabled are ambiguous. The goal of this work is to empirically identify the impact of the UK Equality Act 2010 on the labour market outcomes of disabled people. In this section, the 2010 policy reform is framed into Rubin (1974)'s causal effects model. Considering the potential sources of the selection bias, I formulate the methodology of evaluating the EA 2010 using a difference-in-difference estimator. The central part of the identification strategy relies on selecting an appropriate comparison group.

1.3.1 Treatment Effects Framework

The 2010 policy reform can be regarded as a natural experiment. Under Rubin (1974)'s causal effects framework, the "treatment" (policy variable of interest) in this natural experiment is the disability-related provisions in the Equality Act 2010. The population at risk is composed of those individuals who are potentially affected by the legislation change (i.e., people who are eligible under the new Act) and is, hence, the primary treatment group in this study—I call them the "EA disabled".[11,12] I focus on summative evaluation (rather than monitoring or process evaluation), so the success (or failure) of the EA will be assessed on the basis of tangible effects, which, in the present paper, are higher (lower) probabilities of employment and higher (lower) hourly wages among the target population.[13] Hence, the average treatment effect on the treated (ATT) of interest can be algebraically expressed as

$$E(Y_{it}^{(1)} - Y_{it}^{(0)} | i = Disable, t = Post) \tag{1.3.1}$$

[11] The precise definition of the "EA disabled" will be given in Section 1.4.

[12] In addition to the main treatment group, I also use several alternative measures to define the treatment group in order to guarantee the robustness of my results. A more detailed discussion about the advantage of having multiple treatment groups is deferred until Section 1.5.

[13] The description of monitoring, process evaluation and summative evaluation can be found in Cobb-Clark and Crossley (2003) and Heckman, Heinrich, and Smith (2002). Generally, monitoring is about comparing the observed outcomes of different groups, process evaluation distinguishes between the intended and actual implementation of a policy while summative evaluation lays more emphasis on program impact—whether a particular policy successfully achieves its objective.

where each agent i can be in the treated group ($Disable = 1$) or in the untreated group ($Disable = 0$ or $Nondisable$), and observed in the pretreatment period ($Post = 0$ or Pre) or post-treatment period ($Post = 1$); $Y_{it}^{(1)}$ (treated outcome) and $Y_{it}^{(0)}$ (untreated outcome) stand for two potential responses of the individual i at time t if he is or is not exposed to the treatment, respectively. Next, I formulate the methodology for evaluating the EA 2010, with special attention to a couple of identification issues.

1.3.2 Difference-in-Difference Estimator

In principle, the *actual* mean of the ATT can be identified from data on the post-Act outcomes of the EA disabled while $E(Y_{it}^{(0)}|i = Disable, t = Post)$ is the *counterfactual* outcome which measures what would have been the average outcome of the EA disabled had they not received the treatment that in reality they did receive.[14] Therefore, the essential task is to invoke an identifying hypothesis which can give me ways to estimate this counterfactual term utilising the available data. In another words, I need to find an appropriate comparison group.

The Choice of Comparison Group

The first idea is to exploit policy variation provided by time, that is, to compare the average outcome of the treatment group before and after the enactment of EA. However, we have to find evidence that, in the absence of the Act, there would be no difference in the average outcome of the EA disabled before and after the change in the law. This idea may be invalid attributed to macroeconomic/life-cycle effects or to temporal trends in the outcome variable. The former corresponds to confounding events that also changed around the time of the treatment, for instance, business cycles. If there is an expansion in the economy over the same period of the policy change, the EA disabled would have a higher probability of employment even without the introduction of the EA. In this case, I may

[14] This is the fundamental "missing data" problem in the standard policy evaluation literature. $Y_{it}^{(1)}$ and $Y_{it}^{(0)}$ can be seen in a parallel universe: it is impossible to observe a particular individual i who is both affected and unaffected by the Act at date t; for the treatment group, we observe the treated outcome $Y_{it}^{(1)}$, and for the comparison group, we observe the untreated outcome $Y_{it}^{(0)}$.

overestimate the causal effect of the EA on disabled employment. The latter occurs when treatment assignment is determined by transitory shocks to the pre-treatment outcome ("Ashenfelter's dip", Ashenfelter, 1978). For example, if there is a temporary drop in the wage profile of the EA disabled in the immediate pre-EA period, again, the pre-post approach will end up with an overestimation of the policy impact on the wages of disabled people. Appendix A.1.1 gives an algebra prospect of the first idea.

The second idea focuses on the group estimator which relies on demographic variation to distinguish the groups (i.e., taking a simple difference between the EA disabled and the non-disabled). This can also be viewed as a randomisation condition. But apart from the causal impact of the EA, there might be systematic differences between the EA disabled and the non-disabled that are also correlated with the outcome measures. As a result, the EA disabled would have had different untreated responses on average to their non-disabled counterparts, unless there had been randomised assignment to the treatment. An illustrative example is: if the non-disabled are a "selected group" who are more motivated to work anyway and would, therefore have higher employment and wages than the EA disabled even in the absence of the EA, it is likely that I would underestimate the effect of the policy change due to such negative "selection bias" (see Equation A.1.4 in the Appendix). Again, a detailed formulation and discussion of the second idea is provided in Appendix A.1.2.

The conventional difference-in-difference estimator (DD) combines the essence of the two ideas above: it essentially compares the EA disabled (treatment group) and the non-disabled (comparison group) before and after the implementation of the Equality Act 2010. It can simultaneously deal with two potential sources of confounding factors. Firstly, the presence of the non-disabled allows us to difference out the *common trends* experienced by both EA disabled and non-disabled individuals and thus isolate the impact of the EA from variation in the outcome that is unrelated to the EA. As noted earlier, such "bad" variation may involve macroeconomic conditions/state of the global economy and contemporaneous shocks to the outcome of interest. To see this, we postulate that the wages of *all workers* were falling prior to the passage of the Act due to, say, economic recession. Hence, any observed decline in the post-EA wage profile of the EA disabled would merely reflect part

of this long-run trend (rather than a negative policy effect) and will be cancelled out by using the wage outcome of the non-disabled (because "Ashenfelter's dip" also exists in the wage outcome of the comparison group). Secondly, the selection bias (i.e., systematic individual effects) resulting from the "cross section" estimator would also be eliminated through differencing, as long as it is time-invariant. The population difference-in-difference estimator for the ATT, denoted by DD, is given by:

$$\begin{aligned} DD \equiv\ & [E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Pre)] \\ & -[E(Y_{it}^{(0)}|i = Nondisable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Pre)] \end{aligned} \tag{1.3.2}$$

IMPLEMENTATION

The DD estimator 1.3.2 can be directly estimated in a linear regression model:

$$\begin{aligned} Y_{it} =\ & \beta_0 + \beta_1 Disable_i + \beta_2 Post_t + \beta_{DD}(Disable_i \times Post_t) \\ & +\delta X_{it} + \beta_3 Disable_i \times t + \varepsilon_{it} \end{aligned} \tag{1.3.3}$$

where the outcome variables are the employment indicator or the log real hourly wage variable. *Disable* is an indicator of disability status, and, therefore, β_1 captures disability main effect which is expected to exhibit a negative sign. *Post* is a time dummy taking on value one for the post-EA period (i.e., observations obtained after October 2010); β_2 thus reflects the average change in the outcome variable common to the EA disabled and the non-disabled. The key parameter of interest is β_{DD} on the interaction term $Disable \times Post$, which measures the outcome changes specific to the EA disabled (relative to the non-disabled) in the post-intervention period (relative to the pre-intervention period).[15]

[15]The link between the parameter of interest in the mean difference function, 1.3.2, and that in the regression equation, 1.3.3, is straightforward: $(E[Y_{it}^{(1)}|i = Disable, t = Post] - E[Y_{it}^{(0)}|i = Disable, t = Pre]) - (E[Y_{it}^{(0)}|i = Nondisable, t = Post] - E[Y_{it}^{(0)}|i = Nondisable, t = Pre]) = ((\beta_0 + \beta_1 + \beta_2 + \beta_{DD}) - (\beta_0 + \beta_1)) - ((\beta_0 + \beta_2) - \beta_0) = \beta_{DD}$. Therefore, β_{DD} is the difference-in-difference parameter which

In the regression set-up, X_{it} denotes the control variables added for the purpose of "double robustness" of the ATT estimator. It is also possible to include additional disability-specific time trends (i.e., $Disable_i \times t$)[16]. This trend difference-in-difference specification would be more robust and convincing when there are apparently unparalleled pre-existing trends in the outcome for the EA disabled and the non-disabled, which are likely to be extrapolated into the post-EA period.

It appears that the specifications above provide little evidence about the dynamics of the EA's effects: how rapidly employment and hourly wage change after the EA is adopted and whether such policy impact grows, stabilises, or fades as time passes (perhaps due to changing costs and enforcement). Therefore, in the next augmented model, I am interested in exploring how the treatment effects evolve over time. Specifically, I extend the two-period model (i.e., pre- v.s. post-EA period) to a multiple-period difference-in-difference by replacing the single *Post* dummy with a series of year dummies, which permits the policy effect to be expressed as annual changes relative to the base period, 2005. The resulting regression formula is:

$$Y_{it} = \beta_0 + \beta_1 Disable_i + \beta_2 Year_t + \beta_t (Disable_i \times Year_t) + \delta X_{it} + \varepsilon_{it} \tag{1.3.4}$$

where $Year$ is a vector of annual time-series dummies; each of the coefficients $\beta_{2006}, ..., \beta_{2013}$ on the disability×year interaction represents the causal impact of the EA in that particular year relative to 2005, the earliest year entered in the present analysis. For $t < 2010$, the pre-2010 disability×year interactions can provide pre-treatment specification checks, because my results hinge on the premise that any observed pattern of the policy impact does not predate the EA "experiment" (though it could reflect the possibility that the EA has been widely anticipated due to great media attention—the anticipatory effects). The hope is to find no statistically significant effect (either positive or negative) in the probability of employment and log hourly wages of the EA disabled in any pre-Act year.

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gives the impact of the EA. Accordingly, the "before-after" estimator is given by $E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Pre) = (\beta_0 + \beta_1 + \beta_2 + \beta_{DD}) - (\beta_0 + \beta_1) = \beta_2 + \beta_{DD}$ with bias being β_2, and the "cross-section" estimator equals to $E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post) = (\beta_0 + \beta_1 + \beta_2 + \beta_{DD}) - (\beta_0 + \beta_2) = \beta_1 + \beta_{DD}$ with bias being β_1.

[16] The t is a time trend variable, with the year 2005 normalised to zero.

It is worthwhile mentioning that the employment equation, which has a dichotomous dependent outcome, is estimated by a linear probability model because we need a linear specification to capture an unbiased difference-in-difference estimator.[17] Additionally, the wages are only observed for employed individuals, who may be systematically different from those not observed with wages (perhaps due to motivation, experience, education level, or other factors), possibly leading to sample selection bias in wage estimates. To alleviate this concern, I run the same DD wage regressions involving a Heckman correction for the first stage selection into employment (Heckman, 1979). I choose the number of dependent children in the family as my identifying variable.

1.3.3 Common Trend Assumption

The most crucial condition for identifying the ATT in a standard DD setting (see for instance Abadie, 2005) is the *common trend assumption*. It can be readily seen that the population DD estimator implies:[18]

$$DD \equiv ATT + SB_{post} - SB_{pre} \tag{1.3.6}$$

[17] The main concern is that linearity may lead to predictions outside of the [0,1] range, but this basically bites when the covariates are continuous, where the functional form assumption matters. With dummies (and their interactions) I am looking at mean differences, hence no over- or under-prediction.

[18] In essence, the equation 1.3.2 of population DD estimator, by subtracting and adding an identical term, can be written as:

$$\begin{aligned} & E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Post) \\ & +[E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post)] \\ & -[E(Y_{it}^{(0)}|i = Disable, t = Pre) - E(Y_{it}^{(0)}|i = Nondisable, t = Pre)] \\ = \; & ATT + \underbrace{[E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post)]}_{SB_{post}} \\ & - \underbrace{[E(Y_{it}^{(0)}|i = Disable, t = Pre) - E(Y_{it}^{(0)}|i = Nondisable, t = Pre)]}_{SB_{pre}} \end{aligned} \tag{1.3.5}$$

which suggests that the policy effect can be exactly identified when the *common trend assumption* $SB_{post} = SB_{pre}$ holds, or:

$$\begin{aligned} \Leftrightarrow \quad & E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post) \\ = \quad & E(Y_{it}^{(0)}|i = Disable, t = Pre) - E(Y_{it}^{(0)}|i = Nondisable, t = Pre) \end{aligned} \tag{1.3.7}$$

This expression states that, should there have been no EA, the expected outcome for the EA disabled and the non-disabled would have followed parallel paths over time. This hypothesis cannot be directly tested because it involves a counterfactual unobserved element, i.e., $E(Y_{it}^{(0)}|i = Disable, t = Post)$.

It is worthwhile mentioning that the key identifying condition (i.e., *common trend assumption*) corresponds to no "omitted interaction" between $i = Disable$ and $t = Post$, except for the 2010 policy reform under study (in other words, no other disability-specific shocks over the same period of changes in law). If correctly specified, Equation 1.3.3 produces an unbiased estimate of the average treatment effect of the EA 2010 (β_{DD}) under the identifying assumption.

In this case, I conduct pseudo tests to explore its plausibility. A standard way to test the plausibility of the *common trend assumption* is to compute a "placebo difference-in-difference"—that is, I generate the *Post* dummy for periods when there was no change in the law (before October 2010) and repeat the difference-in-difference with these placebo post dummies. Since the starting point of the present study is January 2005, I construct year dummies (one-year placebo post dummies or two-year placebo post dummies) allowing for comparisons within different time windows and allowing for overlap. I then run the identical DD regression replacing the true *Post* dummy with these placebo dummies.

The placebo DD coefficients based on the five one-year placebo dummies along with the true DD estimate are displayed in Table 1.1. None of the five placebo estimates is significantly different from zero at any conventional level, increasing my confidence in the validity of the proposed policy evaluation methodology.[19]

[19]Results based on one-year dummies reach the same conclusion. I choose to present the results based on the one-year dummies because there is empirical concern that the smaller the time windows, the more

1.3.4 POTENTIAL THREATS TO IDENTIFICATION

One of the major threats (mostly related to violation of the identifying hypothesis) comes from the existence of an "omitted interaction" between the group dummy ($i = Disable$) and the time dummy ($t = Post$), except for the treatment under consideration. In this regard, there are two potential issues in relation to disability, each of which concerns the presence of disability-specific time effects. First, fluctuations in the economic environment could generate disproportionate effects on people with disabilities. For example, disabled individuals may have especially pro-cyclical employment. In other words, they may be the "last in, first out" during an economic recession and especially helped by an economic boom when it is hard for firms to seek workers in a tightening labour market. Second, the Equality Act 2010 is not the sole policy instrument in the UK aimed at fostering the labour market outcome of disabled people, and thus a more meaningful assessment of the EA should also consider the development of other policy initiatives.

In addition, another potential difficulty in identification concerns the "composition bias"—compositional change of the disabled group. One implicit assumption behind the DD model is that the composition of the treatment group and comparison group must remain relatively stable over time to ensure before-after comparability. A similar concern—called "justification bias"—arises under circumstances where disability reporting is partially related to employment status.

To sum up, the major issues that are likely to jeopardise the soundness of the difference-in-difference estimator of the policy impact are disability-specific cyclical effects, trends in disability benefit and the endogeneity problem stemming from self-reported disability measures, all of which will be addressed later within the context of the LFS data.

1.4 DATA

The UK Labour Force Survey (LFS) is a nationally representative dataset conducted quarterly on a systematic random sample from approximately 60,000 private households consist-

likely the *common trend assumption* is to be verified.

ing of roughly 125,000 individuals in the UK. The LFS encompasses extensive information including disability and health status, household characteristics, individual demographic details and economic activities. Given the rotational sample design (each interviewee, once selected initially, remains in the survey for five consecutive quarters with 20 percent of the sample being refreshed each quarter), I utilise respondents in their first wave so as to exclude replicated observation of the same individual.[20]

The quarterly data are pooled over 36 quarters from 2005Q1 to 2013Q4 to create a repeated cross-sectional dataset extending the period before and after the implementation of the EA. For the purpose of my analysis, the sample is restricted to individuals aged 21-58 years (who are most persistently attached to the labour force) and not involved in self-employment, unpaid family business, agriculture, or the armed forces.[21] Observations with missing data with regard to key variables and a small amount of inconsistent responses (e.g., those with self-reported unemployment status but positive working hours/wages) are also excluded from the estimation sample. Since the LFS is drawn from a sample of the population, all analyses are weighted to ensure that estimates reflect survey sampling probabilities and to enable one to make inferences from the sample to the entire population of the UK.[22]

The principle employment measure refers to whether an individual did paid work in the reference week. Indeed, individuals are defined as employed if they are employees, and non-employed if they are either unemployed or inactive. I reclassify those who answer "Yes" to the question asking whether they have had a job from which they were absent as employees

[20]The LFS introduced such a longitudinal element in 1992 in Great Britain and in Winter 1994/95 in Northern Ireland.

[21]One might expect an unintended "displacement effect" which drives disabled people from paid employment to self-employment due to the substantial costs to employers brought about by the new Act. Alternatively, the reverse transition may occur if the anti-discrimination mandate reduces the impact of "push" into self-employment and employers improve the facilities and accommodations at the workplace (as noted earlier the effects can go either way). This leaves some scope for future research but I disregard self-employed people for several reasons: *i*) earnings are not reported for this group; *ii*) the above effects are likely to be very small; *iii*) this group is unlikely to be subject to labour market discrimination and thus less likely to be affected by changes in legislation; and *iv*) this group has more possibilities to affect the wage by obtaining other forms of income which may confound my evaluation of the impact of the EA on earnings.

[22]The main weight adopted is the person-weight variable to reflect population parameters.

so that people temporarily away from paid work are still defined as in employment.[23] The wage measure is the log of hourly wage in main job, which is derived by dividing gross weekly wage by usual hours worked per week.[24] To sidestep the influence on statistical results triggered by outliers, I exclude from the wage regression observations with extreme wages (i.e., ignoring the top (99% quantile) and bottom (1% quantile) values of the wage distribution). In addition, to account for inflation and determine the real hourly wage, I use the UK Retail Price Index (RPI) to deflate all posterior earnings to 2005Q1 prices.[25]

The LFS data provides a disability measure which complies with the disability definition in the DDA. The DDA defines a disabled person as someone "with a physical or mental impairment which has a substantial and long-term adverse effect on his/her ability to carry out normal day-to-day activities". As noted earlier, the definition of disability in the EA differs only slightly from the definition in the DDA (by removing a list of capacities that must be affected).[26] Therefore, the data allows identification of the group of disabled individuals that are qualified under the Equality Act. One further advantage of the LFS is that it also contains a work-limiting disability question which makes it possible to capture the work-limited disabled and the various combinations of disability definitions along dimensions of activity limitation and work limitation (see Figure 1.1).[27] The sensitivity of the main results to the difference in definition can be tested by estimating the same models using alternative measures of disability (e.g., work-limiting disabled only who are not covered by the EA). It is noted that since the disability measure in the sample is self-reported, it may be subject to endogeneity concerns. I will return to this issue later.

Figure 1.2 depicts the evolution of disability prevalence from 2005 to 2013 for the UK. On average the prevalence of disability in the working age population is 17%. It

[23] The employment definition in this paper appears to coincide the standard ILO definition of employment.

[24] The earnings question is only asked to people in their wave 1 and wave 5 (before Spring 1997 to wave 5 interviewees only).

[25] This is available from the Office for National Statistics RPI indices CHAW. http://www.ons.gov.uk/ons/datasets-and-tables

[26] That is, one of the following: mobility; manual dexterity; physical co-ordination; continence; ability to lift, carry or otherwise move everyday objects; speech, hearing or eyesight; memory or ability to concentrate, learn or understand; or perception of the risk of physical danger.

[27] Work-limiting disabled include those who have a long-term disability which affects the kind or amount of work they might do.

appears that in the pre-EA period, the percentage of disabled people among the working age population was flat or increasing, while it declined slightly in the immediate post-enactment period. Although the EA disabled exhibits some fluctuations before and after the introduction of EA, in general, it still seems safe to conclude that there is no apparent break in this disability measure in the post-reform period of the EA (which would otherwise indicate the presence of composition effects).

The descriptive statistics by disability status are reported in Table 1.2. The table reveals striking differences between the disabled and the non-disabled (in both total and employee samples). People with disabilities are paid about 1 pound less per working hour than their healthy counterparts. In line with existing literature, the gap in the employment is even more marked: the employment rate of disabled people is only half of that for the non-disabled. In general the disabled are older, less well educated, less likely to be married as well as have dependent children, and have more labour market experience. In the labour market, disabled workers are more likely to work part-time. In addition, I observe an apparent "occupational segregation" in the distribution of nine job categories: the disabled are under-represented in prestigious occupations and over-represented in less prestigious occupations, which is a plausible explanation for their lower average pay levels relative to the non-disabled.

1.5 Results and Analysis

1.5.1 Difference-in-Difference Estimates

This paper aims to assess the labour market impact of the EA on the disabled group based on a natural experiment created by the 2010 policy reform in the UK. Table 1.3 presents the initial results for employment outcome (Panel A) and wage outcome (Panel B). For the sake of brevity, only coefficients of interest are reported.[28]. Column I reports estimates of the basic difference-in-difference specification which only contains an indicator for EA

[28]The coefficient estimates for all additional controls are of their expected signs and magnitudes. Table A.2 and A.3 in the Appendix present a complete set of estimated coefficients for employment and wage equation, respectively.

disabled, a post-Act dummy, and their interaction. Column III estimates a model that includes a time trend variable interacted with a disability dummy so as to control for disability specific time trends as a potential source of "omitted interactions". In column V, I transform the pre-post specification into a year-to-year basis in order to explore the policy dynamics (Equation 1.3.4). The even-numbered columns reports estimates for each of the models augmented with standard demographic controls at personal, household and regional levels. The role of the covariates here is twofold. Above all, the EA disabled and non-disabled may differ in their personal characteristics, so it is important to control for differences in the outcome due to underlying individual demographic differences between observations in different groups rather than a true policy effect. Moreover, the inclusion of relevant covariates will reduce the regression residual variance and yield a more efficient estimate of β_{DD}.

As expected, disabled individuals have significantly lower probabilities of employment and hourly wages than the non-disabled. These facts are stable across all specifications, indicating around 40 percentage points fewer employment opportunities and 10 log points lower hourly wages for people with EA disabilities. It should not be surprising that β_1 changes dramatically once demographic attributes are included as regressors because the EA disabled and the non-disabled have apparently distinct characteristics which could be correlated with the outcomes. Second, and more importantly, the estimated coefficients on the *Post* variable (β_2) and eight year dummies (not reported, only in columns V-VI) are all of sizeable magnitudes and highly significant in both panels, implying that there are macroeconomic shocks and/or transitory trends in employment probabilities and hourly wages common to the disabled and the non-disabled groups.

Now let us focus on the causal impact of the EA 2010. The estimate on the difference-in-difference term (β_{DD}) in column I of panel A shows that the EA is associated with a statistically significant 4 percentage point increase in the probability of being employed for the EA disabled relative to the non-disabled after the EA came into effect. It is encouraging to observe, from columns II-IV of the top panel, that the estimated positive treatment effect is insensitive to the inclusion of observable characteristics (from 0.04 to

0.036, and from 0.035 to 0.038 in trend specification) and/or disability-specific time trends (from 0.04 to 0.35, and from 0.036 to 0.038 in model with covariates), which rules out the possibility that the observed effects on employment can be explained by characteristics differences between the EA disabled and the non-disabled groups or any long-run trend in disabled employment (the time trend coefficient is small and insignificant). The pre-post specification above provides no intuition about the dynamics of the EA's effects. Figure 1.3 depicts the set of $Disable \times Year$ estimates ($\beta_{2006} - \beta_{2013}$) resulting from the multiple period DD specification in columns V-VI. Specifically, the relative employment probabilities of the EA disabled were statistically insignificant and close to zero until 2009 but increased significantly by 2.9 percentage points in the year of policy adoption (2010) and continued to grow thereafter by an additional 1.1 to 1.7 percentage points. Controlling for demographic characteristics, as is done in column VI, hardly changes this pattern. Therefore, the results from the multiple period DD model confirm the findings of a strongly positive causal impact of the EA on disabled employment, and, as suggested by the pre-2010 interactions, unfold further evidence of no anticipatory response to the changes in the law.

Panel B presents estimates for treatment effects of the EA on the log hourly wages (conditional on working).[29] The coefficient of 0.028 on the $Disable \times Post$ interaction in column I suggests that after removing disability main effects and common time effects, the relative hourly wages of the EA disabled went up by 2.8 log points after the new Act became effective. This difference-in-difference estimate decreases slightly by 0.6 log points after controlling for personal characteristics (column II), again revealing limited evidence that differences in individual demographic characteristics across the two groups can explain the observed wage increase for disabled people. The relative hourly wages of the EA disabled increase significantly more (a 2.5 log point gain from 0.022 to 0.047) in column IV where I estimate a model including disability specific linear time trends (after

[29] As noted earlier, failing to control for selection into employment may lead to biased and inconsistent estimates due to sample selection problem. To address this concern, I also estimate a Heckman selection model using the number of dependent children as the instrument for selection. The results are found to be remarkably similar to those reported below. For example, the estimates on the $Disable \times Post$ paralleled to columns I-IV of panel B are 0.026, 0.022, 0.040 and 0.047, after adjustments for potential sample selection. The full set of results from the "Heckit model" are available in the Appendix.

controlling for personal characteristics), implying a pre-existing downward trend in the hourly wages of the EA disabled (the time trend coefficient is negative and statistically different from zero at the 1 percent level of confidence).

It can be seen from the bottom panel of Figure 1.3 which visualises the DD estimates from the hourly wage regressions on a year-to-year basis, the lack of any statistically significant change in the relative hourly wages of the EA disabled before the EA adoption, and the sizeable increases in the subsequent years starting from 2010, are consistent with the EA exerting a positive effect on the wages of the EA disabled. According to the results, relative hourly wages of the EA disabled increased a statistically significant 3.5 log points in the year when EA was introduced. The following two years witnessed similar increases in disabled people's hourly wages (relative to the non-disabled) with estimates of around 3.8 log points. Interestingly, the DD coefficient becomes smaller and loses its significance in 2013 which suggests that the EA's treatment effects on the hourly wages of the EA disabled may be short-lived. The inclusion of personal characteristics appears to mitigate the magnitudes of the estimated coefficients but hardly eliminates the general pattern of results.

1.5.2 Business Cycle Effects

There are reasons to be cautious about interpreting the findings that relative employment probabilities and relative hourly wages of the EA disabled increased in the periods after October 2010 as "treatment effects" of the EA.

First of all, given that the Equality Act 2010 was introduced at a time when the UK economy had just recovered from the 2008-2009 depression, which was then followed by a technical recession in 2012, business cycles could have contributed to the post-Act employment patterns of the EA disabled (irrespective of the real impact of the EA), consequently creating an overestimated treatment effect.[30] Therefore, any post-EA analysis should take into account the possibility of differential trends among the EA disabled and

[30]There are similar concerns associated with the ADA in the US, whose passage accorded with the 1991-1992 slowdown in the US economy.

the non-disabled owing to business cycles.

In this spirit, I gauge the importance of cyclical effects by using the regional unemployment rate as a proxy for general business cycle movements. In particular, an alternative specification of Equation 1.3.3 including demographic characteristics is estimated (preferably with a disability linear time trend specific to hourly wage regressions—remember that the trend coefficients are never statistically significant in the employment equation), and I introduce the regional unemployment rate, as well as its interaction with disability status to allow for the possibility that economic cycles differentially affect people with EA disabilities. While a negative correlation between employment and the regional unemployment rate is naturally anticipated, the cyclical behaviour of the real hourly wage is somewhat mixed. The parameter on the $Unemployment\ rate \times Disable$ interaction term measures whether the relative employment (or hourly wage) of the EA disabled is disproportionately high/low when the region's unemployment rate is low/high. Column II of Table 1.4 and Table 1.5 display the relevant results. The unemployment rate is strictly negative and statistically significant when employment is the outcome, as expected, whereas it is positively correlated with the hourly wage. The coefficients on the cyclical-disability interaction suggest that the EA disabled are more sensitive to changes in labour market tightness. For example, the probability of employment is 1 percent lower for every 1 point increase in the unemployment rate but is 1.2 percent lower for those with EA disabilities (despite being marginally significant). Interestingly, although I find evidence that the EA disabled suffer disproportionately in economic upturns and downturns, the estimated impact of the EA is robust to the inclusion of disability-specific cyclical control.

In summary, one possible explanation for the relative increase in employment and hourly wages of the EA disabled after October 2010 is that some other change occurred in the economic environment which affected this group differentially. I thus purge the effects of general business cycle movements from the treatment effects of the EA by using the unemployment rate of different regions in the UK. The results show that the treatment effect, $Disable \times Post$, rises after controlling for the disability specific cyclical effects. Therefore, it does not appear that my findings in Table 1.3 are influenced by the business

cycle effects.

1.5.3 Other Disability-Specific Policies

It has been argued that disabled people who receive the disability benefit from disability income programmes may face strong disincentives to become employed (due to fear that they might lose disability transfers). If this is true, the labour supply of disabled people will be affected by trends in the participation in disability programmes such as Incapacity Benefit (IB), Disability Living Allowance (DLA), and Severe Disablement Allowance (SDA). The potential role of disability income has been extensively discussed in the US work. DeLeire (2000b) claims that disability benefit is unlikely to explain his estimated decline in employment given that the change in employment in the post-ADA period was a break rather than a continuation of a trend and that disability benefits did not change significantly during his period of analysis. Moreover, the employment losses occurred among groups that are less likely to participate in SSI and SSDI programmes (young and highly-skilled workers). Acemoglu and Angrist (2001) investigate the role of disability income in several ways, concluding that SSI and disability insurance trends cannot account for most of the post-ADA decline in the relative employment of disabled males and females aged 21-39. In contrast, Bound and Waidmann (2002) find that the growth in the Social Security Disability Insurance (SSDI) program in the 1990s (as a consequence of changes made in the 1980s) played a central role in accounting for the fall in disabled employment during the 1990s. David and Duggan (2006) also highlight the adverse effects on employment of increased SSDI take-up. It is useful to examine whether the enactment of the Equality Act 2010 coincided with a general expansion or contraction in the number of the EA disabled receiving non-labour income from other disability programmes in the UK. A word of caution is appropriate here. It is reasonable to assume that changes in disability income only matter in terms of employment probability and are of less concern when looking at the wage outcome of the disabled.

In the UK, disabled individuals who have difficulty in walking or looking after themselves (need help with personal care) are entitled to receive Disability Living Allowance

(DLA), which is an *extra costs* benefit intended to provide help towards additional costs incurred as a consequence of being disabled. Disabled people incapable of work because of illness or disability are eligible for Incapacity Benefit (IB) when they are below the state pension age and have made any national insurance contribution (see Table 1.6 for a brief review of UK disability policies). The LFS data allow identification of benefit recipients for eight disability programmes, among which DLA and IB account for a large percentage. Figure 1.4 documents the evolution of receipt of disability welfare among the EA disabled group, as well as the contributions that different disability policy initiatives have made to the overall trend in disability benefit. It seems that there has been a long-term downward trend in the fraction of EA disabled people receiving transfers from disability income programmes (dropped from 39 percent in 2005 to 34 percent in 2013).[31] As referred to earlier, work disincentives associated with disability income will lead to a reduction in the labour supply of disabled people, and it is possible that the relative employment gain of the EA disabled can be explained by the fact that the number of EA disabled claiming disability benefits declined over the same period of as the EA's enactment.

According to Bound (1989)'s estimate, roughly half of the disabled individuals receiving disability welfare would have otherwise chosen to work if they were deprived of the current benefits. So in order to account for the 4-percentage-point increase in the relative employment of the EA disabled, we need to observe a 8-percentage-point decline in disability programme participation rates during the sample period, which is obviously greater than the 5 percent decrease presented in Figure 1.4. Even applying a more conservative estimate provided by Parsons (1980), i.e., 0.63, would suggest a need for a 6.35 drop in the percentage of disability income claimants from 2005 to 2013, which is much closer to, but once again larger than the 5 percent decline given by the LFS data. Taken together,

[31] It is not surprising that the decline in disabled welfare recipients is mainly a result of those who are involved in Incapacity Benefit (IB), showing a substantial decrease since 2008, since IB was replaced by Employment and Support Allowance (ESA) as a consequence of a decision made by the Welfare Reform Act 2007. Moreover, the Department of Work and Pensions started a rolling programme in April 2011 under which all existing Incapacity Benefit claimants were re-assessed using the Work Capability Assessment (WCA). Those deemed to have full capability for work were transferred to the Jobseeker's Allowance (JSA). Those who passed the assessment were moved to ESA. Those who failed were disqualified from both ESA and IB. Nevertheless, declining numbers of claimants continued to receive Incapacity Benefit until their claims were re-assessed.

these calculations imply that trends in disability programmes do not account for the entire increase in the post-EA employment of the disabled relative to the non-disabled.

To further examine the role of disability transfer in accounting for the improvement in relative disabled employment, I narrow down the sample to the "nonrecipient-only" group, by simply dropping those disabled individuals who benefit from disability programmes. Estimates excluding disability income beneficiaries are shown in column III of Table 1.4. It appears that dropping the transfer recipients has little impact on the estimated treatment effect of the EA on disabled employment: the point estimate slightly shrinks from 4 to 3.7 percentage points and remains highly significant at the 99% confidence interval.

I next focus on the full sample but add a control for beneficiary status to the model, i.e., a dummy for receiving disability income interacted with the indicator for EA disabled. This regression control method is found to reduce the magnitude of the estimated EA impact more than simply using the sub-sample of non-recipients In spite of this, however, the difference-in-difference estimate (β_{DD}) remains statistically significant with a coefficient of 2.6 percentage points, which is reported in column IV of Table 1.4.

Overall, the investigation suggests that trends in disability income cannot explain satisfactorily the boost in the relative employment probabilities of the EA disabled following the adoption of the EA.

1.5.4 Compositional Change Analysis

Due to the fact that health status is self-assessed in the survey data, my policy evaluation strategy is further complicated by changes in the composition of those who report having an EA disability. In other words, the disability measure used in this paper may be itself *endogenous* if there is a change in the reporting behaviour in response to the enactment of the EA (it is a common criticism regarding the subjective disability measure and is discussed at great length by Kruse and Schur, 2003).

To be more concrete, some of the survey respondents might change their disability status after the adoption of the EA based on the social environment as well as their own personal characteristics (e.g., working conditions, social attitudes towards disability,

severity of impairments, employment status, etc.). On the one hand, the introduction of the EA, which facilitates workplace accessibility and improves disabled workers' employability, may cause some individuals not to deem themselves as being disabled (under-reporting case); on the other hand, the willingness to declare a disability might increase in the aftermath of the EA's enactment because public awareness comes to the forefront of policy discussion or because the Act has successfully removed the stigma attached to disability (over-reporting case).[32] The former effect would result in the self-reported "EA disabled" being increasingly concentrated among those with more severe disabilities after legislative change, creating the appearance of lower levels of employment (or lower wages) amongst this group even if the EA has improved the employment (or wages) of the EA disabled in general. In contrast, the latter effect will lead to an overestimate of the causal impact of the policy if individuals who flow into the disability population are less severely disabled after the changes in law. In Acemoglu and Angrist (2001), this process is described as the "composition bias". A similar concern is called "justification bias". More specifically, the unemployed or non-participants may be disproportionately more likely to over-report disability in order to justify their lack of employment. If this occurs after the operation of the EA, there is a chance that such bias will produce a false disemployment effect (with a worsening in disabled employment even if more disabled people have obtained employment).

I approach this issue in three ways. First, a straightforward way is simply to check the descriptive statistics. According to Figure 1.2, there is no apparent break in the self-reported disability rate once the EA was adopted in October 2010. The prevalence rates fluctuate slightly over time in the range of 16% to 18%. I also explore the Labour Force Survey Five-Quarter Longitudinal Dataset (apart from the repeated cross-sectional data used for the main analysis), which gives me the opportunity to create a short panel that straddles the period before and after the implementation of the EA 2010. In the longitudinal LFS, it is possible to track each individual and to see whether he/she changed

[32] Even some healthy people will have an incentive to misreport their health status in order to be eligible for benefits under the EA and thus might claim themselves to be EA disabled.

their disability status in response to the EA. Table 1.7 presents the proportion of survey respondents who are inconsistent in their answer to the question regarding their health conditions. The one of interest has information on five consecutive quarters from April 2010 to June 2011 (the data span a period before and after the operation of the EA 2010). Other years are also examined because they can provide benchmark rates as to how likely people are to change their health status. Briefly, the results from the short panel analysis reveal little evidence of changes in people's reporting behaviour in the policy year, and, together with the facts in Figure 1.2, it seems safe to conclude that disability endogeneity does not plague the main findings in Table 1.3.

Second, to address the disability endogeneity issue in a more convincing way, I regress disability status (*Disable*) on the *Post* dummy as well as standard demographic controls. Results from the linear probability model (probit yields similar results) are reported in Table 1.8. The coefficient in column I indicates that there is no significant relationship between the disability status and whether the EA exists or not. As noted above, the unemployed or labour market non-participants are disproportionately more likely to describe themselves as being disabled after the policy adoption. In addition, one possible consequence of compositional changes is that the EA disabled are concentrated among the more severe group (when the situation of disabled people is improved and they no longer deem themselves to be disabled) or among the less severe group (when there is less discrimination and disabled people are more willing to declare their health status). As a further check on whether these are confounding the main results, I conduct the same regression on the sub-samples of employed and unemployed (columns II-III) to investigate the possibility of "justification bias", and redefine the dependent variable *Disable* (columns IV-V) to see whether there is change in disability severity among the EA disabled ("compositional bias"). In any case, the estimated coefficients are fairly small and never statistically significant, once again suggesting that compositional effects are not driving the main findings. The raw data reflected by the bar chart (Figure 1.5) confirm the evidence of no compositional changes after the enactment of the EA.

A final investigation with respect to the composition issue is motivated by Abadie

(2005) who argues that the *common trend assumption* may be implausible if pre-EA characteristics that are believed to be related to the outcome evolution differ between the treated and the comparison units. Referring back to Section 1.4, individuals belonging to disabled and non-disabled groups differ considerably in their personal characteristics, and there is a chance that unknown shocks affect people with distinct demographic characteristics differently. If the composition of the EA disabled or the non-disabled group changes over time, it is likely that changes in the demographic composition of the treatment and comparison groups produce a spurious correlation between the EA and the observed labour market pattern of the disabled. I control for such effects by adding into regressions the interaction between characteristics controls X and the post EA indicator. In this case, I am able to extend identification to situations where compositional differences (that can be observed through X) between the EA disabled and the non-disabled give rise to non-parallel dynamics in the outcome measure. As previously stated, apart from the effects of the observable variables included in X, the average outcomes for the EA disabled and the non-disabled would have followed parallel paths in the absence of the Act. This can be regarded as a conditional version of the *common trend assumption* in the difference-in-difference framework, which is appealing especially when variables that are thought to be correlated with the outcome dynamics are unbalanced between the treatment and comparison groups. The corresponding results are presented in column V of Table 1.4 for employment equation and column III of Table 1.5 for hourly wage equation. I find that, for disabled employment, the results are remarkably insensitive to this change (from 0.026 to 0.027). It is interesting to discover that the estimated treatment effect of the EA on the relative hourly wages of the EA disabled rises from 0.021 to 0.064 after controlling for possible compositional changes across the treatment and comparison groups. Thus, if anything, the estimate of β_{DD} tends to understate the positive wage effect of the EA on disabled people.

1.6 DIFFERENCE-IN-DIFFERENCE-IN-DIFFERENCE

So far I have labelled two dimensions: time and group. Indeed, besides time and group, the richness of the dataset provides a third dimension in which the policy varies. Unlike earlier UK disability legislation, the Equality Act 2010 only applies to Great Britain (experimental region), leaving Northern Ireland untouched (non-experimental region). As the policy variable presents time, individual and regional variation, it would be very useful to impose a difference-in-difference-in-difference (DDD) research design that applies higher-order contrasts to draw causal inferences.

1.6.1 IDENTIFICATION

More specifically, the DDD identification strategy not only relies on pre- and post-treatment variation that exploits timing (*pre v.s. post*) but also on the comparison of different groups within the same region (*EA disabled v.s. non-disabled*) and the same group from both treated and untreated regions (*Great Britain v.s. Nothern Ireland*). Let $j \in \{GB, NI\}$, the standard DDD estimator for the ATT can be specified as

$$\begin{aligned} DDD \equiv & \{[E(Y_{it}^{(1)}|i = Disable, j = GB, t = Post) - E(Y_{it}^{(0)}|i = Disable, j = GB, t = Pre)] \\ & -[E(Y_{it}^{(0)}|i = Nondisable, j = GB, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, j = GB, t = Pre)]\} \\ & -\{[E(Y_{it}^{(0)}|i = Disable, j = NI, t = Post) - E(Y_{it}^{(0)}|i = Disable, j = NI, t = Pre)] \\ & -[E(Y_{it}^{(0)}|i = Nondisable, j = NI, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, j = NI, t = Pre)]\} \end{aligned} \tag{1.6.1}$$

Accordingly, I estimate the following regression equation

$$\begin{aligned} Y_{ijt} = & \beta_0 + \beta_1 Disable_i + \beta_2 Post_t + \beta_3 GB_j \\ & + \beta_4 (Disable_i \times GB_j) + \beta_5 (GB_j \times Post_t) + \beta_6 (Disable_i \times Post_t) \\ & + \beta_{DDD} (Disable_i \times GB_j \times Post_t) + \delta X_{it} + \varepsilon_{ijt} \end{aligned} \tag{1.6.2}$$

where GB is the dummy variable equal to 1 if in Great Britain and others are defined as before[33]. The treated observations are those of a certain demographic group ($i = Disable$) in a certain region ($j = GB$) after the policy implementation ($t = Post$). The coefficient on the third-level interaction term ($Disable \times GB \times Post$) is the key parameter of interest, i.e., the difference-in-difference-in-difference parameter, β_{DDD}. It measures the change in the relative outcome of the EA disabled (using the non-disabled as a comparison group) before and after the EA in Great Britain versus the same change in Northern Ireland where the EA does not apply.

Importantly, the DDD identification strategy simultaneously removes the "main effects and lower-level interactions effects" (Meyer, 1995). In terms of main effects, β_1 controls for the time-invariant disability main effects, β_2 controls for the time-invariant region main characteristics, and β_3 controls for the period-to-period changes in the outcome variable that affect both groups and both areas. In terms of lower-level interactions effects, the second-level interaction terms control for the characteristics of the EA disabled in the experimental region that are constant across time (β_4), the changes over time in the experimental region that are common to both groups (β_5), and the time-varying disability effects that are common across regions (β_6). In fact, β_6 is crucial in this study: it allows us to isolate the true policy impact from confounding effects associated with the "omitted interaction" between $i = Disable$ and $t = Post$. More concretely, such influences that differentially affect the EA disabled, such as cyclical effects, time varying compositional differences and any development in other disability programmes are permissible within this DDD framework—provided that they are nationwide, they will be captured by the interaction term $Disable \times Post$ in Equation 1.6.2. As a result, the *common trend assumption*

[33]There is some evidence of multicollinearity given the mean variance inflation factor (over 30). This is perhaps due to the fact that I have a fairly small sample of EA disabled in Northern Ireland, and, therefore there is a high correlation between the triple difference term $Disable_i \times GB_j \times Post_t$ and the second-order interaction term $Disable_i \times Post_t$. When the model is difficult to identify in full generality, one can simply drop some of the second level interactions or put some structure on these terms (Angrist and Pischke, 2008). I thus also estimate a model in which I proxy $Disable \times Post$ by disability-year interactions to alleviate concern about multicollinearity, and to allow for more specific time-varying disability effects that are common across the experimental and non-experimental regions.

under DD (which is very strong and hard to satisfy in practice) can be relaxed here.[34] The interpretation of the above condition is quite straightforward: it says that, in the absence of the Act, the experimental and nonexperimental regions should have undergone the same outcome variation over time in the treatment group and in the comparison group. This is a fairly weak identifying assumption (compared with the *common trend assumption*), because it simply requires there to be no contemporaneous shock that disproportionally affects the EA disabled in Great Britain between the pre- and post-reform period, i.e., no "omitted interaction" between the group dummy ($i = Disable$), the region dummy ($j = GB$) and the time dummy ($t = Post$), except for the treatment under study. Because of the nature of the triple-difference model, it is more likely to generate a more convincing

[34] To rigorously derive the identifying condition, Equation 1.6.1 can be expressed as

$$
\begin{aligned}
DDD \equiv\ & E(Y_{it}^{(1)}|i=Disable, j=GB, t=Post) - E(Y_{it}^{(0)}|i=Disable, j=GB, t=Post) \\
& +\{[E(Y_{it}^{(0)}|i=Disable, j=GB, t=Post) - E(Y_{it}^{(0)}|i=Nondisable, j=GB, t=Post)] \\
& -[E(Y_{it}^{(0)}|i=Disable, j=GB, t=Pre) - E(Y_{it}^{(0)}|i=Nondisable, j=GB, t=Pre)]\} \\
& -\{[E(Y_{it}^{(0)}|i=Disable, j=NI, t=Post) - E(Y_{it}^{(0)}|i=Nondisable, j=NI, t=Post)] \\
& -[E(Y_{it}^{(0)}|i=Disable, j=NI, t=Pre) - E(Y_{it}^{(0)}|i=Nondisable, j=NI, t=Pre)]\} \\
=\ & ATT + \underbrace{\{[E(Y_{it}^{(0)}|i=Disable, j=GB, t=Post) - E(Y_{it}^{(0)}|i=Nondisable, j=GB, t=Post)]}_{SB_{post} \text{ in GB}} \\
& - \underbrace{[E(Y_{it}^{(0)}|i=Disable, j=GB, t=Pre) - E(Y_{it}^{(0)}|i=Nondisable, j=GB, t=Pre)]\}}_{SB_{pre} \text{ in GB}} \\
& - \underbrace{\{[E(Y_{it}^{(0)}|i=Disable, j=NI, t=Post) - E(Y_{it}^{(0)}|i=Nondisable, j=NI, t=Post)]}_{SB_{post} \text{ in NI}} \\
& - \underbrace{[E(Y_{it}^{(0)}|i=Disable, j=NI, t=Pre) - E(Y_{it}^{(0)}|i=Nondisable, j=NI, t=Pre)]\}}_{SB_{pre} \text{ in NI}} \\
=\ & DD_{GB} - DD_{NI} \\
=\ & ATT + (SB_{post,GB} - SB_{pre,GB}) - (SB_{post,NI} - SB_{pre,NI}) \qquad (1.6.3)
\end{aligned}
$$

Clearly, the following identifying assumption must hold to ensure the validity of the DDD estimator for the treatment effect

$$
\begin{aligned}
& [E(Y_{it}^{(0)}|i=Disable, j=GB, t=Post) - E(Y_{it}^{(0)}|i=Nondisable, j=GB, t=Post)] \\
& -[E(Y_{it}^{(0)}|i=Disable, j=GB, t=Pre) - E(Y_{it}^{(0)}|i=Nondisable, j=GB, t=Pre)] \\
=\ & [E(Y_{it}^{(0)}|i=Disable, j=NI, t=Post) - E(Y_{it}^{(0)}|i=Nondisable, j=NI, t=Post)] \\
& -[E(Y_{it}^{(0)}|i=Disable, j=NI, t=Pre) - E(Y_{it}^{(0)}|i=Nondisable, j=NI, t=Pre)] \\
\Leftrightarrow\ & SB_{post,GB} - SB_{pre,GB} = SB_{post,NI} - SB_{pre,NI} \qquad (1.6.4)
\end{aligned}
$$

and credible set of results compared to the conventional DD analysis that exploits less variation (see Gruber, 1994; Yelowitz, 1995, for example).

1.6.2 Results

Results from the triple-difference specification (Equation 1.6.2), which are tabulated in the right panel of Table 1.4 and 1.5, appear to convey consistent results. Indeed, the alternative explanations considered above all concern the time-varying disability effects (i.e., the "omitted iteration") and they are effectively captured through the $Disable \times Post$ interaction term. The triple-difference estimate (β_{DDD}) suggests that changes in legislation have a positive impact on the relative hourly wages of the EA disabled in Great Britain (after differencing out similar changes in Northern Ireland), with estimates ranging from 6.8 log points to 9.8 log points, which are even greater in magnitude than those derived from the DD specification. The key results for the employment regression generally hold under the DDD specification: the estimated coefficients of interest are similar in sign and magnitude (despite being statistically weaker due to the large standard errors of the Northern Ireland sample). In sum, results from the triple-difference model further reinforce the evidence of positive treatment effects of the EA on the relative employment and hourly wages of the EA disabled.

1.7 Heterogeneous Policy Effects

Given the inherent nature of disability, one can explore the heterogeneous effect along a number of interesting dimensions, including the type, duration, and severity of disability (Jones et al., 2007). Indeed, several studies (see for example DeLeire, 2000b; Beegle and Stock, 2003; Jones, Latreille, and Sloane, 2007) have highlighted the importance of identifying the heterogeneous treatment effect in the context of policy evaluation. Although I do not have retrospective information on the age of disability onset, I can still focus on the type of disability (mental and physical) and the severity of disability (less severely disabled and more severely disabled).

In Table 1.9, columns I-II report the estimated parameters on the disabled group dummy and the time indicator, and the DD estimates of interest are presented in column III. Regarding the employment outcome (Panel A), I find that the Equality Act significantly impacts both more severely and less severely disabled individuals. Regarding the wage outcome (Panel B), the point estimates indicate that the policy change has a slightly larger influence on the hourly wage of the more severely disabled relative to that of the less severely disable (0.070 v.s. 0.063). However, the interval estimates for these two groups seem to be overlapped, at the 95 percent level. When it comes to the disability type, the estimates for mobility disability, internal disability and other types of disability exhibit patterns that are generally similar to each other, for both employment and wage outcomes. Notably, people with sensory disabilities appear to be the only group who is not significantly influenced by the EA. Reassuringly, these findings are confirmed by the triple difference estimates presented in column IV.

Therefore, it is safe to conclude that the EA 2010 benefits almost every disabled sub-group. There seems to be no significant difference in the policy effect between the less severely disabled and the more severely disabled. It is also worth noting that both DD and DDD estimates indicate that people with sensory impairments are not the beneficiaries of this law change, pointing to the need of a more detailed legislation that can satisfy the specific needs of certain sub-groups.

1.8 Discussion and Conclusion

The Americans with Disabilities Act (ADA) in the US and the Disability Discrimination Act (DDA) in the UK have triggered a fierce debate among academics. This paper fits into the debate by examining the Equality Act (EA) 2010, arguably one of the most important pieces of legislation introduced in Great Britain over the past decade. Designed to protect different disadvantaged groups in society, the EA streamlines previous legislation within a single Act and, more importantly, strengthens the law in several aspects. Disability is the area that has changed the most and is hence the focus of this paper. The seven-year

anniversary of the implementation of the Act is now approaching. Yet, given the relative newness of the Act there is still no empirical evidence to inform policymakers on the impact and efficacy of the policy.

Exploiting exogenous variations (in time, group and space) provided by this natural experiment, I investigate the labour market impact of the EA for disabled people. The DD and DDD estimates suggest that the new Act is associated with improvements in both the relative employment and the relative wages of the disabled in the post-EA period. These results are robust to a large number checks on alternative explanations including disability-specific time trends, changes in disability programme participation rates, and composition effects. The findings expand upon existing UK evidence that focuses exclusively on the impact of the DDA.

The present evidence of a positive impact of the EA is in line with Jones (2006), but is more sanguine than most work on the ADA and Bell and Heitmueller (2009)'s analysis of the DDA. The net effect of the EA depends on the relative importance of different provisions as well as enforcement of legislation (e.g., firms' understanding of and engagement with the Act). On the positive side, the expanded rights enshrined in the EA such as the new rule against "pre-employment health checks" may dust barriers to employment for disabled people and raise awareness of their employment potential, thereby increasing the labour supply of the disabled. For existing disabled employees a fairer working environment may boost their incentives to stay in their jobs and enhance their productivity at work, leading to a corresponding (better) payoff. Benefits may also arise from reduced likelihood of complicated and costly litigation process,[35] a more diverse pool of labour (and hence improved skill matching with vacancies and ability to deal with diverse customers), and simplification gains[36]. On the negative side, the technical improvements to the law, as outlined earlier, are likely to elicit unanticipated adverse effects through additional mandates and costs imposed on employers. In the absence of

[35]The fee for bringing claims in employment tribunals is £1,200, consisting of an issue fee of £250 and a hearing fee of £950.

[36]The simplification and standardisation of the EA will likely result in increased compliance and better information, effectively reducing the number of tribunal and court cases out of ignorance and hence save money for employers.

effective enforcement mechanisms, this may hamper the labour market fortunes of disable people. Most notably, the reasonable accommodation component of legislation has been most blamed for the decline in employment rates and wages (Jolls and Prescott, 2004). Nonetheless, this does not necessarily matter for the EA for two reasons. First, research has shown that "employers who make special provision for disabled employees often find that the actual costs are low" (Bell and Heitmueller, 2009, p. 480). Second, most aspects of physical adjustments (e.g., disabled access to buildings) often induce just one-off costs. It is thus likely that after the passage of the new Act firms only need to make minor modifications to their workplaces since such a provision existed in the old law during the previous years. On balance, it seems safe to conclude that the EA can bring more benefits than costs to employers and disabled employees and therefore has consequently caused the observed increases in employment and earnings of people with disabilities.

From a policy perspective, this initial investigation into the EA has important implications that a more consolidating legislative framework (e.g., EA) covering various vulnerable groups may be more effective than a dedicated law (e.g., DDA) targeting a specific group, and an enforcement system covering all inequalities and human rights (e.g., the Equality and Human Rights Commission) may be more efficient than a single enforcement authority (e.g., the Disability Rights Commission). Normally when a government issues a new policy, familiarisation costs arise because firms will need to familiarise themselves with the new law. With this in mind, we can speculate that introducing an EA-type law would be more cost-effective as compared with introducing a series of similar policies.

There are at least three scopes for further research. First, since I focus on the period of 2005-2013, the policy effect I captured should therefore be interpreted as a medium-term impact of the EA. Clearly, more empirical evidence is needed in order to shed light on its longer-term effects. Second, it would be interesting to probe the results further by looking at more aspects of disability heterogeneity. Third, besides objective outcomes (i.e., employment and wages) measured here, understanding the policy effect on subjective outcomes will paint a more complete picture of the impact of the EA. Among these, job satisfaction is one promising outcome to explore.

Figures and Tables

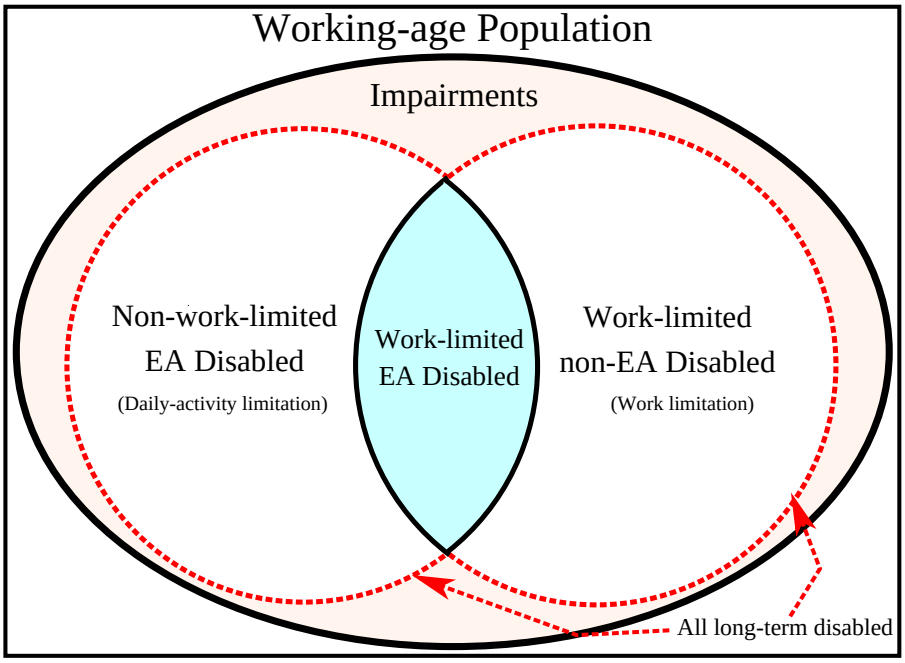


Figure 1.1: Disability Concetptualisation.

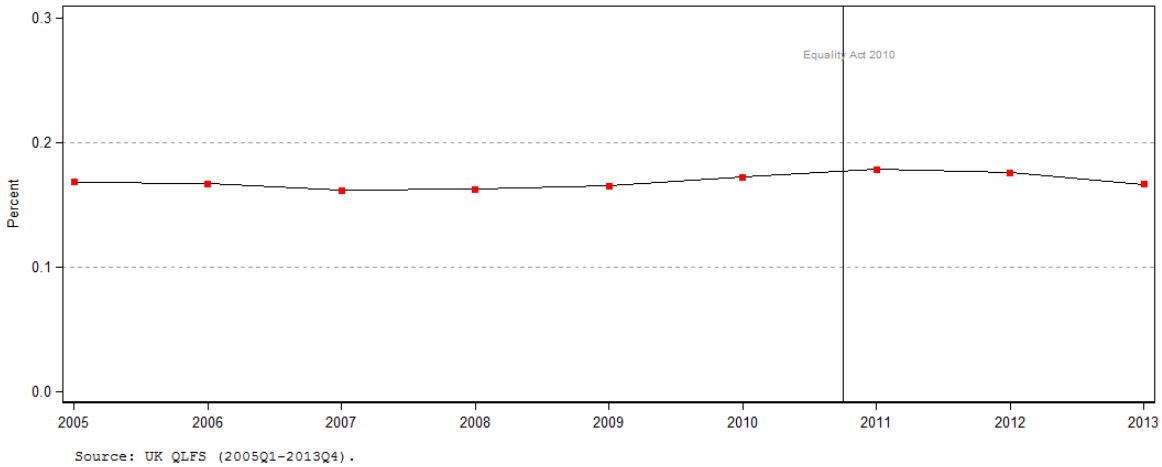


Figure 1.2: Disability Prevalence (QLFS2005-2013).

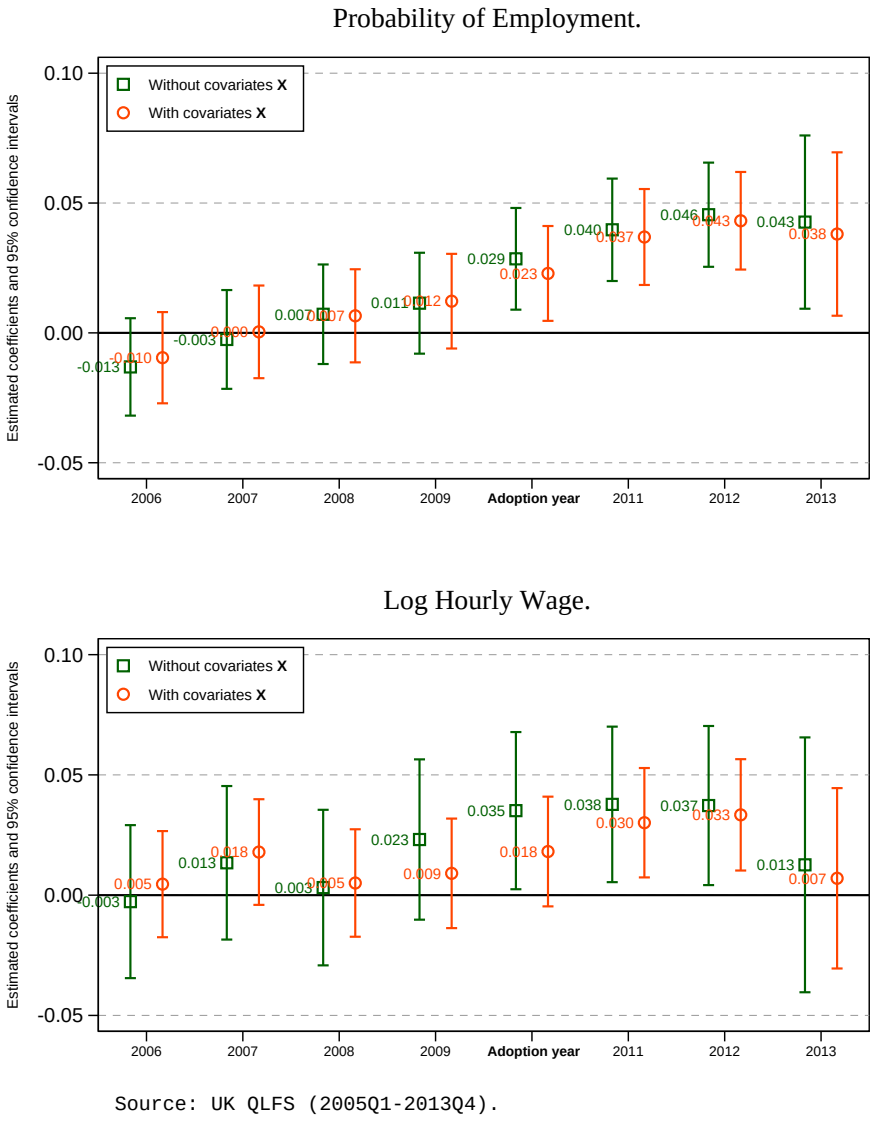


Figure 1.3: Estimated Impact of Equality Act 2010 on Employment and Log Hourly Wage for Years Before, During, and After Policy Adoption (QLFS 2005-2013).

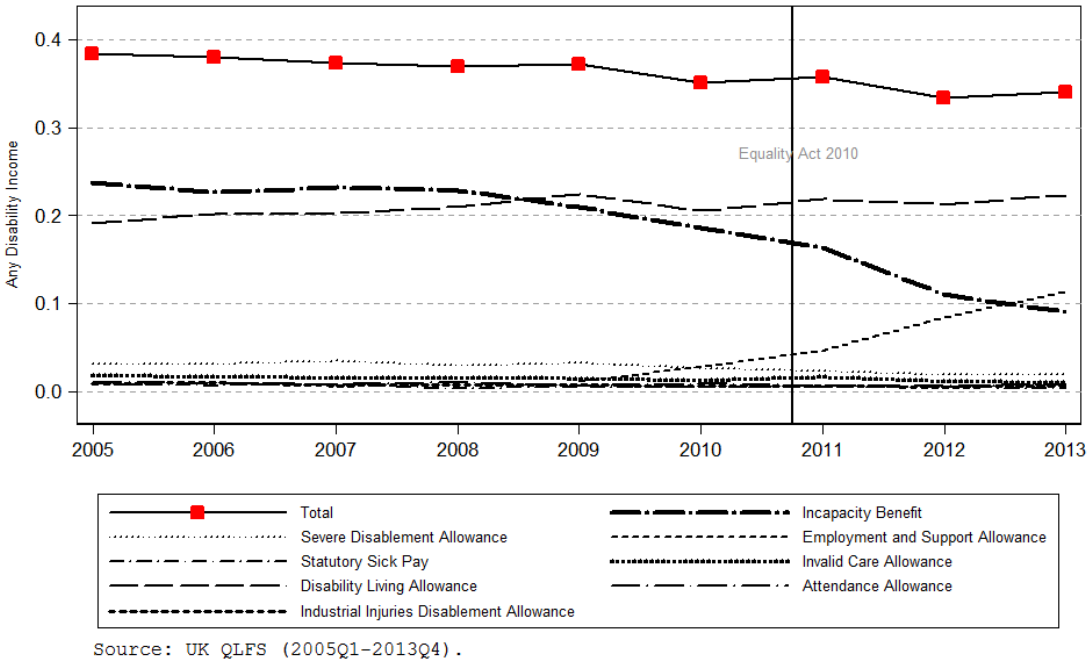


Figure 1.4: Participation in disability welfare programmes among the EA disabled.

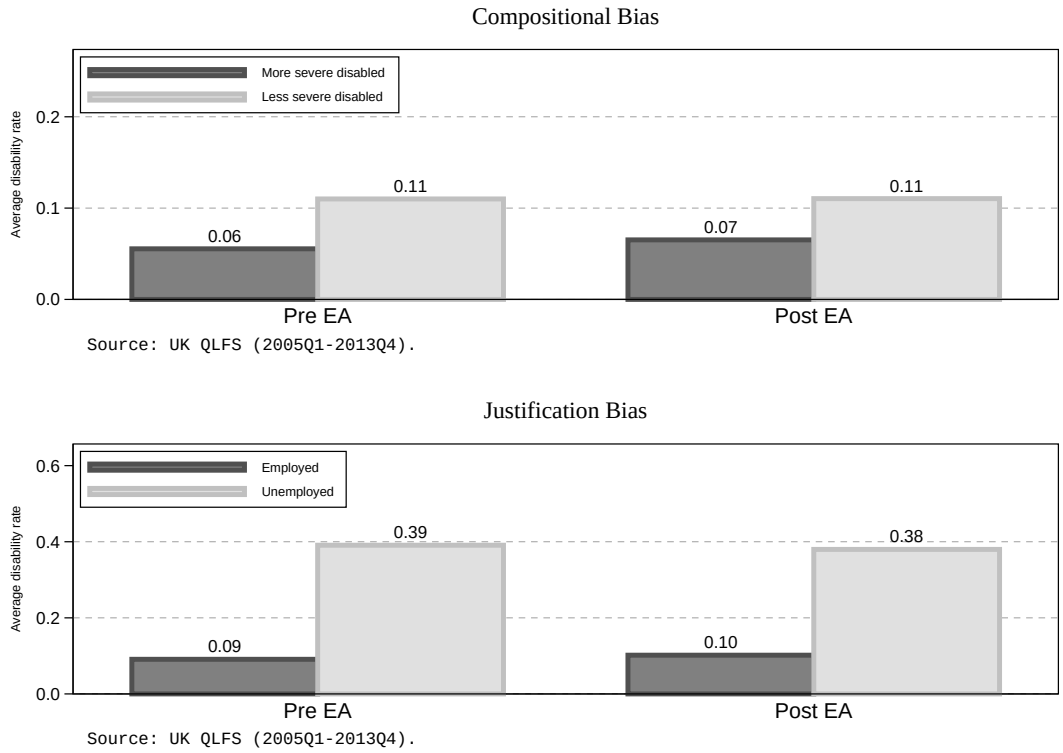


Figure 1.5: Justification bias and compositional bias

Table 1.1: Placebo DD Estimates (QLFS 2005-2013).

	Baseline	05-06	06-07	07-08	08-09	09-10
Panel A: Employment						
Disable (β_1)	–0.398***	–0.401***	–0.414***	–0.404***	–0.394***	–0.390***
	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Post (β_2)	–0.014***	–0.005	0.003	0.000	–0.019***	–0.003
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Disable×Post (β_{DD})	0.040***	–0.013	0.011	0.010	0.004	0.010
	(0.005)	(0.010)	(0.009)	(0.010)	(0.010)	(0.011)
N	288633	73993	77505	75462	72277	60660
Panel B: Log Hourly Wage						
Disable (β_1)	–0.100***	–0.110***	–0.113***	–0.097***	–0.107***	–0.087***
	(0.005)	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)
Post (β_2)	–0.059***	–0.002	–0.004	–0.018***	0.026***	–0.034***
	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Disable×Post (β_{DD})	0.028***	–0.003	0.016	–0.010	0.020	0.001
	(0.009)	(0.016)	(0.016)	(0.016)	(0.017)	(0.018)
N	162335	39746	43138	43144	41003	34309

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).

Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variables are probability of employment and log hourly wage. LFS survey weights are employed in all regressions to ensure the sample representativeness. The baseline regression corresponds to Column I of Table 1.3, in which pre-EA period is from January 2005 to September 2010 (2005Q1-2010Q3) and post-EA period is from October 2010 to December 2013 (2010Q4-2013Q4). In the following columns, only data preceding the date of the EA (October 2010) are used, and pre- and post-periods have to be redefined accordingly. For example, year pair 05-06 compares the change in outcomes of interest between year 2005 and year 2006 for the EA disabled (relative to the nondisabled).

Table 1.2: Descriptive Statistics (QLFS 2005-2013).

	Disabled		Nondisabled	
Variable	Before	After	Before	After
Employment (D)	0.410	0.437	0.813	0.800
Age	43.776	43.435	37.877	37.628
Male (D)	0.436	0.428	0.477	0.483
Married (D)	0.574	0.557	0.675	0.665
White (D)	0.897	0.884	0.878	0.855
Number of dependent children	0.675	0.701	0.853	0.853
Qualification Dummies				
Degree or equivalent (D)	0.110	0.148	0.253	0.315
Other higher education (D)	0.073	0.082	0.093	0.092
GCE A-level or equivalent (D)	0.166	0.176	0.207	0.211
GCSE A*-C or equivalent (D)	0.211	0.233	0.215	0.211
Other qualification (D)	0.135	0.124	0.118	0.093
No qualification (D) - base	0.306	0.236	0.114	0.077
Region Dummies				
North East (D)	0.055	0.048	0.041	0.040
North West (D)	0.134	0.118	0.119	0.110
Yorkshire and Humber (D)	0.095	0.092	0.085	0.086
East Midlands (D)	0.075	0.076	0.073	0.070
West Midlands (D)	0.086	0.090	0.089	0.086
East England (D)	0.073	0.080	0.092	0.091
London and South East (D) - base	0.218	0.231	0.268	0.284
South West(D)	0.069	0.076	0.075	0.074
Wales (D)	0.061	0.054	0.045	0.042
Scotland (D)	0.105	0.108	0.087	0.088
Northern Ireland (D)	0.029	0.027	0.025	0.029
N	36083	14370	181985	67455
Employed Sample				
Hourly wage (£/hour)	9.697	9.376	10.737	10.120
Hours worked per week	36.004	35.740	38.102	37.593
Potential work experience (years)	25.728	25.284	20.240	19.846
Experience square (years)	782.059	764.128	538.813	524.928
Part time (D)	0.283	0.292	0.207	0.218
Industry Dummies				
Electricity and water (D)	0.013	0.012	0.014	0.014
Manufacturing (D)	0.118	0.102	0.140	0.122
Construction (D)	0.044	0.040	0.056	0.049
Hotel and restaurants (D)	0.184	0.189	0.173	0.182
Transport and communication(D)	0.069	0.058	0.069	0.062
Banking and finance (D)	0.134	0.143	0.165	0.171
Public administration (D)	0.386	0.399	0.332	0.345
Other services (D) - base	0.046	0.053	0.045	0.049
Occupation Dummies				
Managers, directors and senior officials (D) - base	0.128	0.085	0.158	0.096
Professional occupations (D)	0.111	0.187	0.148	0.219
Technical occupations (D)	0.143	0.129	0.159	0.152
Administrative and secretarial (D)	0.148	0.138	0.132	0.123
Skilled trades (D)	0.067	0.067	0.079	0.079
Personal service (D)	0.106	0.115	0.083	0.093
Sales and customer service (D)	0.092	0.102	0.068	0.080
Process, plant and machine operatives (D)	0.079	0.065	0.071	0.060
Elementary occupations (D)	0.126	0.113	0.102	0.098
N	11704	5089	109262	41649

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).

Note.—(D) refers to dummy variables. Before/after is defined as observations pre/post the law change in October 2010. Data are for individuals aged 21-58. I exclude those who are in self-employment, unpaid family business, agriculture, or arm forces. Hourly wages are in 2005 prices. Descriptive statistics are weighted by LFS sample weights.

Table 1.3: The Estimated Impact of Equality Act 2010 on Employment and Log Hourly Wage (QLFS 2005-1013).

	(I)	(II)	(III)	(IV)	(V)	(VI)
	Panel A: Employment (N=288,633)					
Disable (β_1)	–0.398***	–0.352***	–0.400***	–0.351***	–0.401***	–0.356***
	(0.003)	(0.003)	(0.005)	(0.004)	(0.007)	(0.007)
Post (β_2)	–0.014***	–0.022***	–0.014***	–0.022***		
	(0.002)	(0.002)	(0.002)	(0.002)		
Disable×Post (β_{DD})	0.040***	0.036***	0.035***	0.038***		
	(0.005)	(0.005)	(0.009)	(0.008)		
Disable×2006 (β_{2006})					–0.013	–0.010
					(0.010)	(0.009)
Disable×2007 (β_{2007})					–0.003	0.000
					(0.010)	(0.009)
Disable×2008 (β_{2008})					0.007	0.007
					(0.010)	(0.009)
Disable×2009 (β_{2009})					0.011	0.012
					(0.010)	(0.009)
Disable×2010 (β_{2010})					0.029***	0.023**
					(0.010)	(0.009)
Disable×2011 (β_{2011})					0.040***	0.037***
					(0.010)	(0.009)
Disable×2012 (β_{2012})					0.046***	0.043***
					(0.010)	(0.010)
Disable×2013 (β_{2013})					0.043**	0.038**
					(0.017)	(0.016)
Disable×t			0.001	–0.001		
			(0.002)	(0.001)		
	Panel B: Log Hourly Wage (N=162,335)					
Disable (β_1)	–0.100***	–0.047***	–0.095***	–0.031***	–0.110***	–0.055***
	(0.005)	(0.003)	(0.008)	(0.006)	(0.012)	(0.008)
Post (β_2)	–0.059***	–0.074***	–0.059***	–0.074***		
	(0.003)	(0.002)	(0.003)	(0.002)		
Disable×Post (β_{DD})	0.028***	0.022***	0.037***	0.047***		
	(0.009)	(0.006)	(0.014)	(0.010)		
Disable×2006 (β_{2006})					–0.003	0.005
					(0.016)	(0.011)
Disable×2007 (β_{2007})					0.013	0.017
					(0.016)	(0.011)
Disable×2008 (β_{2008})					0.003	0.005
					(0.016)	(0.011)
Disable×2009 (β_{2009})					0.023	0.009
					(0.017)	(0.012)
Disable×2010 (β_{2010})					0.035**	0.018
					(0.017)	(0.012)
Disable×2011 (β_{2011})					0.038**	0.030***
					(0.016)	(0.012)
Disable×2012 (β_{2012})					0.037**	0.033***
					(0.017)	(0.012)
Disable×2013 (β_{2013})					0.013	0.007
					(0.027)	(0.019)
Disable×t			–0.002	–0.006***		
			(0.003)	(0.002)		
Demographic characteristics	No	Yes	No	Yes	No	Yes
Disable×linear time trend	No	No	Yes	Yes	No	No
Disable×year dummies	No	No	No	No	Yes	Yes

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).

Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variables are probability of employment and log hourly wage. LFS survey weights are employed in all regressions to ensure the sample representativeness. Column I includes a disability dummy, a post dummy, and their interaction. Column III controls for disability specific linear time trends. Column V includes a disability dummy, a series of year dummies, and a full set of disability× year interactions (with 2005 as the reference year). Column II, IV and VI add demographic characteristics to each of the above specifications correspondingly: covariates for employment regressions are age (four 10-year groups), gender, ethnicity, education (six qualification groups), marital status, number of dependent children, and ten region groups; covariates for wage regressions are similar, except that dependent children is excluded and working experience (and its square), hours worked, part time, nine industry groups, and nine occupation groups are included.

Table 1.4: Alternative Specification — Employment (QLFS 2005-1013).

	Difference-in-Difference (DD)					Triple-Difference (DDD)			
			Disability Income						
	Baseline	Cyclical Effects	Nonrecipient Sample	Full Sample	Compositional Changes	Including Northern Ireland			
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)
Disable (β_1)	–0.352***	–0.339***	–0.138***	–0.168***	–0.169***	–0.567***	–0.509***	–0.563***	–0.504***
	(0.003)	(0.010)	(0.011)	(0.009)	(0.009)	(0.012)	(0.012)	(0.013)	(0.012)
Post (β_2)	–0.022***	–0.004*	–0.001	–0.001	–0.043***	0.007	–0.001	0.010	–0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.009)	(0.009)	(0.008)	(0.009)	(0.008)
Disable×*Post* (β_{DD})	0.036***	0.040***	0.037***	0.026***	0.027***	0.015	0.009		
	(0.005)	(0.006)	(0.007)	(0.005)	(0.006)	(0.023)	(0.022)		
GB (β_3)						0.009*	–0.007	0.004	–0.012**
						(0.005)	(0.005)	(0.005)	(0.005)
GB×*Post* (β_5)						–0.019**	–0.019**	–0.023***	–0.021**
						(0.009)	(0.009)	(0.009)	(0.009)
Disable×*GB* (β_4)						0.168***	0.156***	0.170***	0.158***
						(0.012)	(0.012)	(0.012)	(0.011)
Disable×*GB*×*Post* (β_{DDD})						0.024	0.026	0.035**	0.037***
						(0.024)	(0.022)	(0.014)	(0.013)
Unemployment rate		–0.010***	–0.010***	–0.010***	–0.010***				
		(0.001)	(0.001)	(0.001)	(0.001)				
Unemployment rate×Disable		–0.002	–0.007***	–0.001	–0.001				
		(0.002)	(0.002)	(0.001)	(0.001)				
Receive any benefit×Disable				–0.502***	–0.501***				
				(0.004)	(0.004)				
Demographic characteristics	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Cyclical control	No	Yes	Yes	Yes	Yes	No	No	No	No
Benefit control	No	No	No	Yes	Yes	No	No	No	No
Compositional control	No	No	No	No	Yes	No	No	No	No
R^2	0.212	0.213	0.144	0.261	0.262	0.118	0.219	0.110	0.215
N	288633	288633	268616	288633	288633	299893	299893	299893	299893

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).

Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variable is probability of employment. LFS survey weights are employed in all regressions to ensure the sample representativeness. The baseline regression in Column I corrsponds to the basic difference-in-difference equation (1.3.3) with demographic controls (Column II of panel A in Table 1.3). In Column VIII-IX I proxy *Disable* × *Post* by disability-year interactions (not tabulated in the table for parsimony) to alleviate concern about multicollinearity, and to allow for more specific time-varying disability effects that are common across experimental and non-experimental regions.

Table 1.5: Alternative Specification — Log Hourly Wage (QLFS 2005-1013).

	Difference-in-Difference (DD)			Triple-Difference (DDD)			
				Including Northern Ireland			
	Baseline	Cyclical Effects	Compositional Changes				
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
Disable (β_1)	–0.031***	–0.049***	–0.057***	–0.049	–0.032	–0.036	–0.020
	(0.006)	(0.012)	(0.012)	(0.031)	(0.021)	(0.028)	(0.020)
Post (β_2)	–0.074***	–0.091***	–0.157***	–0.063***	–0.068***	–0.061***	–0.067***
	(0.002)	(0.002)	(0.023)	(0.014)	(0.010)	(0.014)	(0.010)
Disable×*Post* (β_{DD})	0.047***	0.021***	0.064***	–0.040	–0.054		
	(0.010)	(0.007)	(0.010)	(0.052)	(0.038)		
GB (β_3)				0.099***	0.151***	0.099***	0.151***
				(0.008)	(0.006)	(0.008)	(0.006)
Disable×*GB* (β_4)				–0.052*	–0.015	–0.063**	–0.020
				(0.031)	(0.022)	(0.027)	(0.019)
GB×*Post* (β_5)				0.004	–0.006	0.002	–0.007
				(0.015)	(0.010)	(0.014)	(0.010)
Disable×*GB*×*Post* (β_{DDD})				0.068	0.076*	0.098***	0.087***
				(0.053)	(0.039)	(0.023)	(0.017)
Unemployment rate		0.009***	0.009***				
		(0.001)	(0.001)				
Unemployment rate×Disable		0.000	0.009***				
		(0.002)	(0.002)				
Demographic characteristics	Yes	Yes	Yes	No	Yes	No	Yes
Disable×linear time trend	Yes	Yes	Yes	No	No	No	No
Cyclical control	No	Yes	Yes	No	No	No	No
Compositional control	No	No	Yes	No	No	No	No
R^2	0.528	0.529	0.530	0.007	0.529	0.007	0.529
N	162335	162335	162335	167704	167704	167704	167704

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).

Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variable is log hourly wage. LFS survey weights are employed in all regressions to ensure the sample representativeness. The baseline regression in Column I corrsponds to the basic difference-in-difference equation (1.3.3) with demographic controls and disability specific linear time trend (Column IV of panel B in Table 1.3). In Column VI-VII I proxy *Disable* × *Post* by disability-year interactions (not tabulated in the table for parsimony) to alleviate concern about multicollinearity, and to allow for more specific time-varying disability effects that are common across experimental and non-experimental regions.

Table 1.6: Disability Benefits Programmes in the UK.

Compensatory Benefits	for those who become sick or disabled as a result of "serving the nation" whether in a military or ordinary occupational capacity	Industrial Injuries Disablement Benefit (IIDB) Supplemental Security Income (SSI)
Earnings Replacement Benefits	for those unable to earn as a results of sickness or disability	Statutory Sick Pay (SSP) Incapacity Benefits (IB) Employment and Support Allowance (ESA) Severe Disablement Allowance (SDA) Invalid Care Allowance (ICA)
Extra Cost Benefits	help with additional costs incurred as a result of health condition or disability	Attendance Allowance (AA) Disability Living Allowance (DLA) Personal Independence Payment (PIP)
Means-tested Benefits	top up income to a minimum level, the exact level being determined by the number of people in the household, any special needs, and housing costs	Income Support (IS) Disabled Person's Tax Credit (DPTC) Housing Benefit

Note.—The Incapacity Benefit (IB) began to be phased out when the Welfare Reform Act 2007 introduced Employment and Support Allowance (ESA) as a replacement benefit in 2008. The Personal Independence Payment (PIP) was introduced by the Welfare Reform Act 2012 and was intended to replace Disability Living Allowance (DLA) gradually.

Table 1.7: Changes in Reporting Behaviour (QLFS 2005-1013)

Rolling of the data	%
April 2004-June 2005	0.057
April 2005-June 2006	0.058
April 2006-June 2007	0.069
April 2007-June 2008	0.060
April 2008-June 2009	0.061
April 2009-June 2010	0.079
April 2010-June 2011	0.077
April 2011-June 2012	0.080
April 2012-June 2013	0.064

Source.–UK Labour Force Suvey Five-Quarter Longitudinal Data (2004-2013).

Table 1.8: Regression Results for Testing the Compositional Changes (QLFS 2005-2013)

	Total Sample (I)	Employed Sample (II)	Nonemployed Sample (III)	More Severe Disabled (IV)	Less Severe Disabled (V)
Post	0.000	0.006	–0.012	–0.001	0.001
	(0.005)	(0.004)	(0.011)	(0.003)	(0.004)
Demographic characteristics	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.090	0.023	0.218	0.064	0.031
N	288633	216500	72133	288633	288633

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).
Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level.

Table 1.9: Regression Results by the Disability Heterogeneity

	Difference-in-Difference (DD)			Triple-Difference (DDD)
	Disable (β_1)	Post (β_2)	*Disable*× *Post* (β_{DD})	*Disable* × *GB* × *Post* (β_{DDD})
	(I)	(II)	(III)	(IV)
Panel A: Employment				
Disability Severity				
More severely disabled	-0.256***	-0.042	0.032***	0.028
Less severely disabled	-0.147***	-0.042	0.031***	0.039**
Disability Type				
Physical	-0.153***	-0.041	0.026***	0.040**
Mobility	-0.013***	-0.037	0.070***	0.014
Sensory	0.033**	-0.037	0.035	0.072
Internal	0.050***	-0.037	0.064***	0.075***
Mental	-0.296***	-0.041	0.032***	-0.005
Other	-0.163***	-0.041	0.043***	0.071**
Panel B: Log Hourly Wage				
Disability Severity				
More severely disabled	-0.080***	-0.147	0.070***	0.097**
Less severely disabled	-0.050***	-0.147	0.063***	0.083***
Disability Type				
Physical	-0.058***	-0.147	0.059***	0.092***
Mobility	-0.046***	-0.146	0.049***	0.086***
Sensory	-0.040**	-0.146	0.023	0.086
Internal	-0.021***	-0.146	0.041***	0.095***
Mental	-0.093***	-0.147	0.086***	0.041
Other	-0.040***	-0.147	0.066***	0.069*

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).
Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variable is log hourly wage. LFS survey weights are employed in all regressions to ensure the sample representativeness. The DD specification corresponds to Column V of Table 1.4 for employment and Column III of Table 1.5 for log hourly wage. The DDD specification corresponds to Column VI of Table 1.4 for employment and Column V of Table 1.5 for log hourly wage.

Chapter 2

Sons or Daughters? Gender, Child Migration and Health of Parents Left Behind

2.1 Introduction

"Rear sons for help in old age and store up grains against famine".

Chinese Proverb

The question of how migration affects household members left behind has been and continues to be an important issue for researchers and policymakers. For elderly people, the enjoyment of good health is obviously crucial for their well-being in old age.[1] Nonetheless, the economic literature on the impact of adult children's migration on the health of elderly parents left behind provides mixed results, both in the context of international and internal migration. Several studies find that the migration of adult children has a negative impact on the health of the left-behind parents (Antman, 2010, 2016; Ao, Jiang, and Zhao, 2015;

[1] Health is a special form of human capital that depreciates with age.

Mosca and Barrett, 2016), while others find the opposite results that parents can benefit from children's migration where their health is concerned (Kuhn, Everett, and Silvey, 2011; Böhme, Persian, and Stöhr, 2015). Meanwhile, the underlying mechanism through which migration exerts such effects is still not fully understood. In particular, while it is useful to know *whether* a child's migration influences the health of the remaining parents, we believe that it is also of paramount importance to understand *who* contributes most to the observed effects of migration on elderly health: migrant sons or migrant daughters?

In this paper, we aim to bridge the existing gap by explicitly disentangling the migration effect of sons and daughters on the health of elderly parents left behind, an important distinction, which has largely been neglected thus far. It is intuitively obvious that migrant sons and migrant daughters may behave very differently in terms of their contributions (e.g., money, time, emotion) to elderly parents at home, depending on their expected roles in old-age support, their conditions in destination areas, and the strength of their ties to parents at home (Le Goff, 2016). For instance, the migration impact on health could be positive for elderly parents who have migrant sons particularly, if men are more likely to obtain a well-paid job in the city and to send remittances back home. Alternatively, it could be that migrant daughters maintain stronger links with their older parents at origin through remittances and more contact, resulting in better health for their left-behind parents. Given that migrant sons and migrant daughters can contribute disproportionately towards the intergenerational transfers to their elderly parents, we extrapolate that the gender of the migrant child would affect the health outcomes for the left-behind elderly differently.

China provides a useful and interesting setting. Besides an enormous ageing population and massive migration flows, China has a family-based care system in rural areas which especially favours sons over daughters, as reflected in a famous Chinese proverb: "Rear sons for help in old age and store up grains against famine". In Chinese rural society, sons are traditionally the primary caregivers for their aged parents. Recently, however, a few studies have found that the increasing migration of rural females enhances the socio-economic status of women, and daughters play an increasingly critical role in family support of elderly parents (see e.g., Song, Li, and Feldman, 2012). The Great Migration in China and

the gain in female bargaining power that it entails can thus provide a fruitful opportunity to learn about the gender-specific migration effect on parental health. With the rise in the cost of providing care after migration, and the changes in jobs, earning capacity, and socio-economic status of female migrants, one may want to know whether "more sons" still implies a "healthier and happier old age".

We seek to answer the following questions. What is the causal impact of adult children's internal migration on the health of their elderly parents left behind in sending areas? Is the impact on the elderly parent dependent on the gender of the migrant child? What drives the gender-biased migration effect? As a result, we attempt to shed additional light on the relationship between child migration and elderly health, by rigorously distinguishing between the role of sons' and daughters' migration in parental health outcomes.

To explore the above questions, we draw data from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative survey that gathers detailed personal and family information on elderly participants aged 45 and over and their spouses of any age. Crucially for the analysis, the CHARLS survey encompasses a rich set of questions on respondents' health, which allows us to gain a clear picture of how children's migration is associated with various dimensions of elderly health outcomes. The outcomes cover not only subjective measures but also more objective measures. In addition to the CHARLS, we make use of another high-quality micro dataset—the Rural-Urban Migration in China (RUMiC), as the RUMiC questionnaire contains *direct* measures of individual risk attitudes which we can exploit to support the rationale underlying our empirical strategy.

Establishing a causal link between child migration and elderly health is a challenging task in the presence of the endogeneity of migration. The identification of the migration effect is plagued by the fact that children make migration decisions according to the health status of their parents (reverse causality), or that children self-select into migration on the basis of unobservable characteristics (selection bias). For example, healthier children could have healthier parents, and they also have a higher probability to migrate. Further biases are caused by unobservable third factors simultaneously affecting the migration decision of the child and the health of the elderly parent (omitted variable bias). For example,

households that have recently experienced a crop failure might send children to the city as a shock-coping strategy, and might also cut down on health-related expenditures (e.g., food), thus leading to a spurious negative correlation between children's migration and the health outcomes of the left-behind parents.

To address these concerns, we propose a novel estimation strategy which exploits an unusual and credibly exogenous variation in children's characteristics: the Chinese zodiac sign associated with their year of birth.[2] To show the link between astrology and migration we combine the following two facts. First, research has shown that risk attitudes (e.g., Jaeger et al., 2010) and personality traits (e.g., Jokela, 2009) are important psychological determinants of the migration decision. Second, considerable evidence exists to suggest that birth signs greatly influence a person's character, behaviour, and real-life outcomes (e.g., Johnson and Nye, 2011). In Chinese astrology, different zodiac animals symbolise different characters and Chinese people hold a strong belief that they share similar qualities with their birth animal. For example, Tigers always think of themselves as risk-taking, ambitious, extrovert, and so on (which we will call *migration-prone* attributes); Goats usually regard themselves as risk-averse, gentle, introvert, and so on (which we will call *migration-averse* attributes). An elderly parent who has more children born in the Year of the Tiger is, therefore, more likely to see a child migrate, compared to an elderly parent who has more Goat children. We therefore take advantage of the variation in children's Chinese zodiac signs as a source of exogenous variation in their propensity to migrate. We show that the Chinese zodiac sign is a strong predictor of a child's probability of migrating to the city. We subsequently use the RUMiC data to probe into the mechanism behind the predictive power of astrology. Interestingly, we find that a person's Chinese zodiac sign is significantly associated with his/her attitude towards risk, and since migration is a risky choice, the effect of astrology may operate through this behaviour channel.

Overall, the results reveal a striking gendered pattern in the migration effect on parental health outcomes. Daughters' rural-urban migration results in an improvement in the health

[2]Every Chinese person, according to their date of birth, has a unique zodiac animal that accompanies him/her for life. In order, the twelve animals are Rat, Ox, Tiger, Rabbit, Dragon, Snake, Horse, Goat, Monkey, Rooster, Dog and Pig.

of the left-behind elderly, reflected in elderly parents' self-reported health, physical health (body mobility and functional capacity), cognitive ability and subjective well-being. In contrast, we find no similar beneficial effects on elderly health outcomes when sons migrate. This holds great promise for Chinese would-be parents, as our conclusion casts doubt on the conventional belief that only sons can be relied on in old age, whilst in China's rural areas the cost of raising a girl is actually much lower than raising a boy. Our findings will also be important to policymakers, as we suggest that policies and programmes targeted specifically at female migrants can effectively promote elderly health.

This paper contributes to a burgeoning body of literature on the migration consequences for the sending communities, and more specifically to the research which looks within the household and aims to identify the migration impact on the outcomes of the left-behind. Distinguishing the migration effects based on child's gender also connects this paper with literature on the economics of the family which investigates the intra-family or intra-household heterogeneity related to gender (e.g., Thomas, 1994; Duflo, 2003; Antman, 2012b, 2015).[3] The basic idea behind these studies is directly linked to the test of the unitary model of household decision-making. Still, there is very little evidence that the gender of the migrant affects the impact on health outcomes of the parents left behind, and our paper provides a first attempt at addressing this issue. In addition, the identification strategy that we employ brings the paper into line with the strand of the migration literature that exploits the variation in fixed demographic composition to instrument for the endogenous migration decision (e.g., Chen, Jin, and Yue, 2010; Antman, 2016).[4] While some demographics such as gender mix are often explored, our instrumental variables rely on an unexploited and, we argue, more exogenous source of variation in the astrological characteristics of children. To the best of our knowledge, this is the first paper to overcome the migration endogeneity by instrumenting using a person's birth sign. Finally, we also

[3] Thomas (1994), Duflo (2003) and Antman (2015) find that more resources in the hands of women improve the outcomes for girls and not boys. Antman (2012b) presents similar evidence that a father's international migration enhances the education outcomes for girls and not boys.

[4] Chen, Jin, and Yue (2010) study peer migration in China and their IVs rely on whether a household has a girl firstborn. Antman (2016) counts on sex and married ratios of adult children as the IVs for children's Mexico-US migration.

contribute to the *Astronomics*,[5] a still narrow branch of literature that highlights astrological influences on economics, by presenting fresh evidence that astrology also predicts migration behaviour.

The paper proceeds as follows. Section 2.2 provides the institutional, conceptual, and empirical background. Section 2.3 describes the data used in the analysis and Section 2.4 lays out the identification strategy. Estimation results on the relationship between child migration and elderly health are presented in Section 2.5 followed by a discussion about possible channels in Section 2.6. The paper concludes in Section 2.7.

2.2 BACKGROUND

2.2.1 INSTITUTIONAL CONTEXT

China is a developing country where rapidly ageing population, increasing labour migration and family-based social support networks co-exist. It is estimated that the proportion of elderly Chinese will increase from under 10 percent in 2000 to about 30 percent in 2050 (United Nations, 2002). The growth of the elderly cohort has been happening concurrently with rapid industrialisation and urbanisation since the period of economic reform in 1978. Higher agricultural productivity led to a surplus labour force in rural areas and, in parallel, the rise in the foreign investment inflows in urban areas created high demand for low-priced labour, triggering massive rural-to-urban migration flows. According to a recent survey (National Bureau of Statistics of China, 2015), there are approximately 274 million rural-to-urban migrants in China, arguably the largest movement of the labour in human history. The mobility of the Chinese population is regulated by a strict household registration system (*hukou*). Although partially reformed, the *hukou* system remains in place and continues to shape the pattern of internal migration flows. Migrant workers without local

[5] At the microeconomic level, Bennett and Barth (1973) investigate whether individuals with a horoscope ruled by the planet Mars (i.e., Aries and Scorpio) are more likely to pursue military occupations; Wong and Yung (2005), Johnson and Nye (2011) and Sim (2015) focus on one of the auspicious Chinese zodiac signs, i.e., Dragon and show that timing of birth affects microeconomic outcomes such as education and earnings. No previous work has, however, tried to examine the impact of astrology on a person's migration intention. See, for example, Chamberlain, Cheung, and Kwan (1991) and Lucey (2000), for evidence at the macroeconomic level.

hukou are restricted in terms of job opportunities and access to social benefits and public services such as education, healthcare, unemployment insurance, housing subsidies, and pensions, which effectively discourages them from bringing their whole family to cities (i.e., family migration). As a consequence, a vast number of individuals (mostly children, women and the elderly) are left behind in rural villages.

The social security system in rural parts of China, however, either does not exist or has limited capacity to meet the needs of elderly people. Additionally, the laws[6] and the norm of filial piety (*xiao*) make it both a legal and moral responsibility for adult children to take care of their aged parents. Therefore, in Chinese rural villages, adult children are the main caregivers for their elderly parents.[7] Statistics from the CHARLS survey reveal that a substantial proportion of elderly respondents rely primarily on their children for support in old age (Figure 2.1). Notably, this number manifests salient rural-urban disparity (78.2% vs. 45.2%), reflecting the inadequate power of the institutional support mechanism in China's rural areas. As children's support is provided through geographical proximity, the family separation that migration entails presents a potential disruption to the established patterns of kin-based care for elderly parents. Yet, as economic opportunities are more promising in urban areas, migrant children are able to compensate their parents with more monetary transfers for their absence. So it is possible for elderly parents left behind to maintain good health while their children are working elsewhere. In the next subsection, we build up a simple conceptual framework about the main channels through which children's migration can influence the health outcomes of the left-behind parents.

[6]The main pieces of legislation in this regard are the Constitution (Article 49), the Marriage Law (Article 21), and the Law on Protection of the Rights and Interests of the Elderly.

[7] Generally, an *adult-child caregiver* can be defined as an adult child who provides monetary, time and emotional assistance to an elderly parent who has economic, physical, and/or cognitive difficulties living independently because of age. Caregiving tasks can range from simple help such as grocery shopping, to complex procedures such as medical assistance. Whatever the specific tasks, in China adult children usually spend money, time and energy to accomplish the caregiving duties, and the caring responsibility may be shared among siblings.

2.2.2 Conceptual Framework

To provide a simple conceptual framework, we start with the description of the health production function developed by Grossman (1972) and applied by McKenzie and Hildebrandt (2006) to a migration context.[8] The health status of an elderly parent at a fixed point in time is determined as follows:

$$ParentHealth = f(X, \underbrace{M,}_{\text{monetary}} \underbrace{T, E, K,}_{\text{nonmonetary}} D, G, \varepsilon)$$

where X denotes observable parental attributes (such as age, gender, education, etc.). M, T and E stand for monetary (e.g., health services, nutrition), time (e.g., physical care), and emotional (e.g., contact, visits) inputs invested into the parent's health. K indicates health knowledge and D indicates environmental factors (e.g., disease environment, health infrastructure). G is biological endowment (e.g., genetic factors), which is usually unobserved. ε denotes random health shock. There are four main channels through which children's migration may influence the health of the elderly parent, consisting of the monetary channel (M) and the non-monetary channels (T, E, K). We next briefly explain the hypotheses with respect to each channel.

Firstly, the income effect of remittances (M) is likely to alter parental health in a positive way. More money allows elderly parents to buy more health-related inputs[9] (since health is a normal good) and to better mitigate the impact of negative health shocks. Note that there are other important considerations here, such as incentives to remit, situations in destination cities, and migrants' ties to the left-behinds. In contexts in which remittances are precarious, the gender of the migrant child becomes crucial. For example, it is possible that women are inherently more altruistic and thus migrant daughters are likely to send more remittances back home. Another possibility is that employment opportunities in the city are brighter for men and therefore migrant sons have a better chance of making

[8] In the paper, the authors study the impact of parental migration on the health outcomes of the children left behind in Mexico.

[9] For example, Böhme, Persian, and Stöhr (2015) find that international remittances allow elderly parents in Moldova to improve their diet and to shift time from subsistence farming to leisure and sleep.

financial transfers to parents left behind.

Secondly, an absent child obviously means fewer time inputs (T) into parental health function. Yet this channel is complicated by two important factors. First, children's time support may be close substitutes so that remaining siblings will care for the parents while migrants are away (Antman, 2012a). In China, when a child migrates, it is very common for the remaining household members (normally the spouse of the migrant child or another child) to take care of the household. The second factor is that the migration decision itself might be adjusted among siblings to ensure that elderly parents receive plenty of old-age support (Stöhr, 2015). Therefore, migration of children does not necessarily imply that parents lose the instrumental help from children.

Thirdly, there is evidence that the migration of children causes psychological pain for elderly parents left behind (Mosca and Barrett, 2016; Antman, 2016). In China, however, most of the migration is circular or temporary in nature (due to the *hukou* restrictions), and hence it is possible for migrants to visit their parents several times per year or at least during Chinese New Year. Even if a face-to-face visit is impossible, children can compensate their parents with frequent contact. We show below that migrant daughters are more likely to provide such emotional support to their parents. In fact, rather than being lonely or anxious, it seems more likely that rural parents would feel proud of having children in the city, which not only brings more income but also generates a superior social status among their peer villagers, and in turn influences their mental satisfaction positively. This is especially true in rural China where traditional notions advocate "bring honour to ancestors". Migration may also reduce the trifles of family conflicts and help to build more harmonious family relations.

Finally, there might be a transfer of health knowledge and attitudes (K) from migrant children to left-behind parents. Migrants may send back information about more advanced health practices, healthy lifestyle behaviours and new norms about diet (McKenzie and Hildebrandt, 2006), which will lead to greater awareness of health issues and more efficient use of health inputs among elderly parents. Again, if daughters tend to maintain stronger links to their parents at home, we can deduce that the positive effect of better

health knowledge will be concentrated on parents who have migrant daughters in the city. Unfortunately, insufficient data on the health knowledge precludes us from exploring this channel.

In theory, it is hard to judge whether the migration effect are predominantly positive or negative, as this will depend on the relative importance of the four channels described above as well as the local conditions of the country studied. Additionally, it is important to bear in mind that the potential effects within each channel are also likely to differ depending on the gender of the migrant child.

2.2.3 Related Literature

An important strand of the economic literature has attempted to identify the migration impact (of parents, children and spouses) on household members left behind (see Antman, 2013, for an overview). Nevertheless, most of the focus has been on analysing the effect of parental migration on the human capital development of children who stay behind in sending communities (Hanson and Woodruff, 2003; Cox-Edwards and Ureta, 2003; McKenzie and Hildebrandt, 2006; McKenzie and Rapoport, 2011; Antman, 2012b; Mu and De Brauw, 2015). The left-behind elderly, albeit equally vulnerable, remain an overlooked group.

With regard to the migration effect on elderly health outcomes, the limited literature has come to ambiguous conclusions. In the only study using experimental data, Gibson, McKenzie, and Stillman (2011) find no significant impact of international migration on the health of the older adults left behind. Two papers by the same author—Antman (2010) and Antman (2016)—reveal that a child's U.S. migration leads to poorer self-reported health, obesity and worse mental health for elderly parents remaining in Mexico. A negative migration impact on elderly health is also observed by Ao, Jiang, and Zhao (2015) in the case of internal migration in China and Mosca and Barrett (2016) in the case of international migration in Ireland. Contrary to the preceding studies, Kuhn, Everett, and Silvey (2011) and Böhme, Persian, and Stöhr (2015) demonstrate optimistic evidence of positive migration effects on parental health outcomes. Using data from Indonesia, Kuhn, Everett, and Silvey (2011) report that children's internal migration results in health gains

for their elder parents left behind, as measured by better self-reported health, reduced mobility limitations, and lower mortality rates. Similarly, Böhme, Persian, and Stöhr (2015) detect a positive impact of children's international migration on the self-rated health, body mass index (BMI) and body mobility of the older parents left behind in Moldova. They attribute the positive migration effects to the income effect of remittances, which allows elderly parents to eat a more nutritious diet and to allocate more time to health-promoting activities (leisure and sleep).

Despite very interesting explorations, the aforementioned papers have all tended to estimate the *overall* migration effect on parental health and have rarely addressed this issue from a gender-based perspective (those that have, have only looked at the gender of the elderly parent).[10] Not considering the potential gender differences in child migration impact might result in an incomplete understanding of migration effects on elderly health. In the present paper, we complement the existing literature by differentiating between the role of sons' and daughters' migration in parental health outcomes. We show that sons' and daughters' migrations have remarkably different impacts on the health of the elderly parents left behind. This highlights the importance of taking into account the gender of the migrant child, if the main research interest is to better understand the role of child migration in elderly health and to give more detailed policy recommendations.

2.3 DATA

2.3.1 DATA SOURCES AND SAMPLE

The data employed originates from the China Health and Retirement Longitudinal Study (CHARLS), a collaborative research project carried out by a team of scholars from the China Center for Economic Research at Peking University, the University of Southern Cal-

[10] The only exception is Mosca and Barrett (2016). However, they focus exclusively on elderly parents' mental heath outcomes. Moreover, when exploring the effects by child's gender they utilise a small sample of older parents who have only one migrant child (and exclude those who have more than one child who has migrated), while their estimated negative effect of migration may be downwardly biased for this particular group of parents. Thus, their findings cannot be easily extrapolated to broader settings and the elderly population in general.

ifornia, and the University of Oxford.[11] The design of the CHARLS follows closely the Health and Retirement Survey (HRS) in the US and other influential ageing surveys in the world such as the Survey of Health, Ageing and Retirement in Europe (SHARE) and the English Longitudinal Survey of Ageing (ELSA) (see Zhao et al., 2013, for a detailed description of the CHARLS dataset). It is nationally representative and covers 450 rural villages/urban communities (primary sampling units) in 150 counties located in almost all provinces of China.[12] The national baseline was conducted in 2011-2012 (wave I) and a follow-up survey took place in 2013-2014 (wave II). Recently, the 2014 follow-up survey (wave III) has been released, but it only contains life history data. We limit our analysis to the 2013 survey for two reasons. First, there appear to be problems in the 2011 survey with the measurement of child migration.[13] Second, unlike Antman (2016), very few CHARLS parents have experienced a change in their children's migration status over the two-year time window, which effectively rules out the possibility of applying fixed effects models to our study. The survey interviewed randomly selected elderly respondents (aged 45 and above) and their spouses (of any age), resulting in a total sample of 18,605 elders residing in 10,822 households in 2013. The key benefit of the CHARLS lies in the availability of extensive measures of health status, alongside detailed information about socio-demographics, household characteristics, intergenerational transfers and migration experiences. We also extract information about the village from the accompanying village/community survey (administered to the village/community office). This allows us to control for potential confounding factors that are correlated with both child migration and elderly health (e.g., availability of medical facilities).[14]

[11] All data are publicly accessible at the project website: http://charls.ccer.edu.cn/charls/.

[12] The sampling frame covers 28 out of 31 provinces across mainland China. Tibet is excluded from the study. Two other provinces, Hainan and Ningxia, are excluded due to very small size of population. In the Appendix we provide the geographical distribution of the sampled counties.

[13] In the CHARLS, there are two questions that can be used to identify a child's migration status. The first question asks "How many months in the past year did the child live away from home", and the second asks "Where does the child normally live now". The latter question usually produces a more instructive measure because it captures *current* migrants as opposed to non-migrants or returnees. This preferred question is available for *all* children in the 2013 survey, but is only available for *non-coresident* children in 2011. It is thus likely that such inconsistency may introduce noises to the child migration variable.

[14] Village-level variables were constructed using the 2011 village/community survey since the 2013 survey has not yet become available.

For the purpose of this study, we restrict the sample to individuals who are aged 55 and older and who reside in rural areas. We only select the subset of parents with economically active children (18 years and above). The reason for doing this is that we want to focus on children who migrate exclusively for labour-related reasons, and that children under 18 years old are still in school and are thus unlikely to fully support their parents. We exclude parents who have any child settled abroad (only 136 cases).[15] Accordingly, we are left with 7,946 observations of elderly parents.

The independent variables of interest relate to sons' and daughters' rural-urban migration. The CHARLS asks explicitly "Where does the child normally live now?" and the subsequent question asks about the type of location in which the child lives (city, county, town or village). Based on these two questions we define migrant children as those who are living outside their own village and residing in urban areas (city, county or town) at the time of the survey. This yields 53.4 percent of the elderly sample as parents with migrant children. Of this group, 40 percent of parents have migrant sons only, 30.1 percent of parents have migrant daughters only, and 29.9 percent of parents have both migrant sons and daughters.

The outcome variables of interest pertain to the health of elderly parents. To gain a comprehensive insight into the migration impact on parental health, we investigate a variety of dimensions of elderly health outcomes. The first outcome we examine is self-reported health status (SRH), a subjective measure of overall health that is usually available in household surveys and widely employed in the economic literature. Specifically, we use a dichotomous indicator equal to one if the elderly parent describes his/her health status as "excellent", "very good", or "good" (compared to "fair", "poor", or "very poor"). Despite the fact that SRH is a useful composite measure of global health and an important predictor of other health problems, e.g., mortality (Idler and Benyamini, 1997), it could be subject to several sources of bias due to its inherent subjectivity, such as reporting heterogeneity, justification bias, and measurement error (Baker, Stabile, and Deri, 2004). Therefore, we will next explore more objective indicators of physical and mental health.

[15] International migration is beyond the scope of this research.

In the physical dimension, we provide two measures respectively related to mobility and functionality. First, mobility-related problems are essential to the elderly because restricted body movement can easily lead to physical inactivity and even unexpected falls and injuries in old age. We construct a mobility index ranging from 9 (very poor body mobility) to 36 (very good body mobility) based on a set of activities: running, walking, getting up from a chair, climbing, stooping, kneeling, extending arms above the shoulder, carrying weights, and picking up a coin. The second measure evaluates the respondent's ability to perform activities of daily living (ADLs)[16] and instrumental activities of daily living (IADLs)[17] independently. Based on the answers to questions about twelve functional activities, we obtain a functional score between 0 (complete dependence) and 12 (complete independence). The elderly parent with a score of 9 or above (corresponding to respondents being able to perform at least nine activities without any difficulty) is defined as having good functional capacity.[18] The two physical health measures used here, albeit also subjective, are often considered to be more objective than SRH, as they elicit information on very specific facts about daily movement and daily living rather than "opinions on physical well-being" (Bratti and Mendola, 2014).

To gauge the mental health of elderly parents, we firstly use an instrument available in the CHARLS survey, that is, the CES-D-10 (10-item CHARLS version of the Center for Epidemiological Studies Depression Scale). This includes mood- and emotion-related questions which ask the respondent whether s/he has: felt bothered by things, found it hard to concentrate, felt depressed, felt everything was an effort, felt hopeful, fearful, restless, happy, lonely or as though they could not get going (all refer to the week prior to the interview). We calculate a total depression score (0-30) accordingly, where higher score indicates worse mental health. A dichotomous indicator for poor mental health is then built using the cut-off point of 8, which is set following Radloff (1977)'s 16 threshold for

[16] ADLs include bathing, dressing, eating alone, toileting, continence and transferring (walking across a room).

[17] IADLs include housekeeping, preparing meals, shopping, managing money, taking medicine, laundry, using the telephone and transferring (driving or using public transport).

[18] The average score for elderly parents in our sample is 10.79. We also replicated our analysis fixing the threshold of this dichotomous indicator at 10 and the results are insensitive to this change.

a 20-item case. Cognitive skills are particularly vital for the elderly population in China where important life decisions are often made without professional advice and where levels of cognitive ability are low. Our cognitive measure is based on the respondent's ability to recall a list of words in a memory test conducted in the interview. In particular, the respondent is asked to repeat ten common Chinese words both immediately after hearing them (*immediate* recall) and four minutes later (*delayed* recall). We construct an index for episodic memory by averaging the number of immediate and delayed words recalled, which ranges from 0 (very poor cognitive ability) to 10 (very good cognitive ability).

The final outcome we consider is a welfare outcome, subjective well-being (SWB), which has recently gained great prominence in economics and health economics in particular (Oswald and Powdthavee, 2008; Akay et al., 2014; Mentzakis et al., 2013).[19] It is worth noting that the SWB is not a health outcome in its own right but there is strong evidence that high SWB (e.g., life satisfaction, happiness, optimism) contributes to better health and longevity (e.g., Diener and Chan, 2011). Owing to its clear and positive relation to health, the SWB acts as an effective input into parental health production function and may give us the chance to explore channels underlying the health benefits of migration.[20] Following the standard approach, we use a dummy variable indicating whether the respondent is satisfied with life or has felt happy over the survey's reference week. In the Appendix we provide more details about the definition and construction of the parental health outcomes mentioned above (e.g., specific items of the CES-D-10 and the answer categories).

In our sample, approximately 20 percent of elderly parents report good general health, 88 percent report good functional health, 45 percent report poor mental health, and 46 percent report good subjective well-being. The elderly parents score an average of 31.2 points for mobility and recall an average of 2.8 simple words in the memory test.

[19] In the case of China, Akay et al. (2014) use SWB to proxy for migrant' utility and argue that "understanding the welfare impact of remittances is of great importance especially in countries such as China".

[20] For example, as noted in Section 2.2, one possible channel for increased elderly mental health lies in the fact that migrant children are often their parents' major source of pride. If this is indeed the case, it is most likely to be reflected in a high level of SWB among elderly parents who have children in the city.

2.3.2 DESCRIPTIVE STATISTICS

Table 2.1 presents descriptive statistics for the 7,946 elderly parents in our analytical sample, with a *t-test* for differences in means between parents with and without internal migrant children displayed in the last column. A typical elderly parent in our sample is about 65.6 years old and has, on average, 1.5 adult daughters and 1.7 adult sons. Only 7.6 percent of elderly parents report having a single child. This is not surprising because the one-child policy is not strictly implemented in rural areas. Notably, more than half of the rural parents have at least one child currently in the city (4,241 observations), which mirrors the magnitude of the internal migration flows in China. Thereof, 60 percent have at least one internal migrant daughter and about 70 percent have at least one internal migrant son.[21] Elderly parents with migrant children differ systematically from those without along a number of observable dimensions. For instance, those in the former group are better educated, have better Mandarin skills, more daughters and sons, and fewer grandchildren. They are also more likely to be *Han* Chinese, have health insurance, have more than one child and are less likely to have access to tap water. In terms of remittances, parents with one or more children in the city are more likely to receive remittances, compared to parents all of whose children are in rural areas (86.4% vs. 71%). Parents of migrant children also report a higher amount of remittances on average, more than double the amount received by parents with no migrant children (4419 vs. 2081 RMB per year).

There appear to be important differences in health outcomes between elderly parents depending on the migration status of their children. In particular, the unconditional mean of four out of six parental health measures (i.e., body mobility, ADLs/IADLs, cognitive ability and SWB) is significantly higher among parents with migrant children in the city than those with no migrant children, suggesting a positive correlation between child migration and elderly health.

Finally, the instrumental variables exhibit significant differences between elderly parents with and without migrant children in the city, showing that parents of migrant children

[21] These percentages do not add up to 100% because overlap is possible, i.e., 29.9 percent of parents have both daughters and sons who have migrated to the city.

have a higher fraction of daughters and a higher fraction of sons born in the year of the migration-prone Chinese zodiac signs. In the next section, we will explain at length how we construct the zodiac IVs for children's migration.

2.4 IDENTIFICATION STRATEGY

In order to investigate the gender-specific effects of children's migration on the health and well-being of their elderly parents left behind we therefore estimate the following regression model:

$$Y_{ihv} = \beta_d MigDau_{hv} + \beta_s MigSon_{hv} + X_{ihv}\gamma + \varepsilon_{ihv} \quad (2.4.1)$$

where the dependent variable, Y_{ihv}, will be either health or well-being outcome of an elderly parent i in household h of village v. $MigDau_{hv}$ and $MigSon_{hv}$ are dichotomous indicators of migration: $MigDau_{hv}$ is equal to one if the elderly parent has at least one daughter currently in urban areas and zero otherwise, and $MigSon_{hv}$ is equal to one if the elderly parent has at least one son currently in urban areas and zero otherwise. Hence, there are four groups of elderly parents: 1) those with no migrant children (reference group); 2) those with migrant daughters only; 3) those with migrant sons only; and 4) those with both migrant daughters and migrant sons. X_{ihv} denotes a vector of control variables consisting of parent, household, and village characteristics: gender, age, age squared, *Han* ethnicity, a dummy for good Mandarin, marriage indicator, a set of education dummies (illiterate, can read or write, elementary school, middle school and above), a dummy indicating whether the elderly parent has any health insurance, number of daughters and sons, average age of children, number of grandchildren, size of household, household assets,[22] a dummy for whether the elderly parent has only one child, a dummy variable for whether the village has any medical facility (e.g., hospital, health clinic, medical post), a dummy variable for

[22]To proxy for household wealth, we use the principal components analysis (PCA) to construct a single household asset index that aggregates information on household ownership of consumer durables and housing characteristics (see the Appendix). This index is generally considered to contain less noise (e.g., recall bias, seasonality) than the traditional income- and expenditure-based measures, and has been increasingly seen in development economics (see e.g., McKenzie, 2005).

whether the village has access to tap water, number of rainy and snowy days, and distance from the village to the closest pollution site. Province dummies are also included to control for region-specific attributes that may affect parents' outcomes.[23] Since both mothers and fathers of the same child are involved in the estimation sample, we cluster the error term ε_{ihj} at the level of the household to allow for arbitrary correlation within households.

The coefficients of interest in equation 2.4.1 are β_d and β_s, indicating how daughters' and sons' migrations affect the health outcomes of the elderly parents left behind. Under linearity and additivity assumptions, the effect of having migrant children of both genders is equal to the sum of the effects of having a daughter and having a son in the city, i.e., $\beta_d+\beta_s$. As noted in the introduction, the identification of the migration effects is plagued by the endogeneity of migration. First, the causal impact is complicated by the fact that children make migration choices according to the health status of their parents, although the direction is unclear *a priori*. On the one hand, children may respond to adverse parental health by migrating themselves to the city, where they could earn more money and obtain advanced health knowledge for their parents' treatment; On the other hand, children may avoid or postpone migration as they may feel obliged to provide daily care to their ill parents (Giles and Mu, 2007). Second, endogeneity could arise if children self-select into migration on the basis of unobservable characteristics. The well-known "healthy migrant hypothesis" claims that migrants are non-randomly drawn from the upper health distribution (Riosmena, Wong, and Palloni, 2013). If health is positively correlated within a household (e.g., due to genetic links) such that healthy parents are more likely to have healthy children (Antman, 2016), the selection would bias conventional estimates of the effect of child migration on parental health outcomes. An intuitive example would be a genetically deficient household in which inherited diseases deprive adult children of migration opportunities and predispose their older parents to bad health. Third, there could be unobservable third factors that are correlated with both the migration decision

[23] Controlling for city-level fixed effects delivers very similar estimates. As the 2013 survey was fielded between July 2013 and January 2014, we also estimated models including a set of dummies for the month of the interview and again the results are very robust. The full set of results controlling for the city and time effects will be available from the authors upon request.

of the child and the health of the parent. Potential omitted factors include household- and village-level shocks such as household asset shocks, diseases, crop failures, and sound local policies, which are very difficult to observe even in a rich dataset. Therefore, estimating equation 2.4.1 by Ordinary Least Squares will yield biased estimates of β_d and β_s and a credible identification strategy is required.

To bolster the causal impact of migration on elderly health, we propose an instrumental variable (IV) procedure inspired by a novel and credibly exogenous variation in the demographic characteristics of children, that is, their Chinese zodiac sign. The Chinese zodiac, also known as *Shengxiao*, is based on a twelve-year cycle with each year symbolised by an animal. The twelve zodiac animals are Rat, Ox, Tiger, Rabbit, Dragon, Snake, Horse, Goat, Monkey, Rooster, Dog and Pig. While the Western zodiac (horoscope) is based on the month of the year, the Chinese zodiac is determined by the lunar year in which a person was born. In the West, despite the fact that polls differ in estimates of how many people actually "believe" in astrology, the average percentage is around 20% to 30%.[24] According to an astrology awareness survey in England, 100 percent of respondents "know their star sign", 89 percent "know the star signs of people they have relationships with", 70 percent "read their horoscopes regularly", and 85 percent agree that "the description of their star sign accurately reflects their personality" (Blackmore and Seebold, 2001). Although we could not find corresponding official surveys on astrology belief in China, considering that the Chinese zodiac has penetrated into various aspects of the Chinese folk culture and is frequently used by the Chinese in life decisions (such as marriage decisions, fertility decisions, making friends and screening potential employees), we believe that the awareness of and belief in astrology should be significantly higher in China, especially in rural areas (where superstition still prevails) and among older generations.

More importantly, "the substantive content of astrology is its predictive ability" (Bennett and Barth, 1973, p. 473). Indeed, the Chinese have long believed that the animal ruling the birth year influences a person's temperament, personality and other important

[24] According to the 2009 Harris Poll, 26 percent of Americans believe in astrology. Estimates from the 2005 Gallup Poll reveal that 26 percent of Americans, 25 percent of Canadians and 24 percent of British people claim that astrology is "something they believe in".

characteristics (e.g., Goodkind, 1991). The saying is: "This animal hides in your heart". According to Chinese astrology, each of the zodiac animals has unique characteristics or qualities, some of which, as we will show below, might predict migration behaviour. It is therefore possible to exploit the astrological variation in children's Chinese zodiac to instrument for the endogenous migration decision. To be more concrete, we define two zodiac groups on the basis of migration-related attributes associated with each animal: *migration-prone* versus *migration-averse*. The former group comprises animals that are more extrovert, active, aggressive, curious, risk-loving, and so forth (Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog), while animals in the latter group are more introvert, calm, gentle, conservative, risk-averse, and so forth (Snake, Goat, Rooster and Pig). Our instruments for migration are the shares of children that are born in the Year of the migration-prone Chinese zodiac signs, computed separately for male and female children of the elderly parent. Since the CHARLS explicitly asks respondents about their children's Chinese zodiac signs we are able to combine this information with total number of daughters and sons to obtain the respective shares. Note that as there are two endogenous migration variables, we have two first-stage regressions, one for daughters' migration,

$$MigDau_{hv} = \alpha_1 Z_1 + \alpha_2 Z_2 + X_{ihv}\delta + \mu_{hv} \tag{2.4.2}$$

and one for sons' migration,

$$MigSon_{hv} = \pi_1 Z_1 + \pi_2 Z_2 + X_{ihv}\lambda + \upsilon_{hv} \tag{2.4.3}$$

where the instruments in these equations are Z_1 and Z_2, indicating the respective share of daughters and sons born in the year of the migration-prone Chinese zodiac animals. It is important to note that in the regression model we have controlled for the number of daughters and the number of sons. The variation we exploit to identify the migration effect thus relies on differences in the zodiac composition (and not in the number) of children across elderly parents.

Why should beliefs in astrological signs, which could be irrational or incorrect, affect

the individual's behaviour and in particular—propensity to migrate? To understand the link between astrology and migration, we combine several important facts and arguments. First, there is a growing body of literature investigating the behavioural aspects of migration. Crucially, it has been well established that risk attitudes (Guiso and Paiella, 2004; Jaeger et al., 2010; Akgüc et al., 2015) and personality traits (Silventoinen et al., 2008; Jokela et al., 2008; Jokela, 2009) are important psychological determinants of migration, with individuals who have a high risk tolerance, high extraversion, high sociability, greater openness to experience, and low agreeableness being more likely to migrate. Second, there is ample (scientific and non-scientific) literature documenting the non-negligible role of astrology in human character and human behaviour. Setting aside the voluminous literature on psychology (see e.g., Standen, 1975; Mayo et al., 1978) and restricting attention to the economic literature, Johnson and Nye (2011) cast some light on the underlying mechanism. Appealingly, they find that seemingly irrational superstitious beliefs (i.e., the Dragon is superior to other Chinese zodiacs) can translate into observational behaviour through greater human capital investment in the process of child-rearing and upbringing. Another possibility, which is more subtle, refers to the psychological hints that might be properly launched by astrological beliefs—the simplest story in our context being that a person whose Chinese zodiac is Tiger decides to give up the familiar environment and migrate for an uncertain but more promising prospect, just because "I am born to be a risk taker". This phenomenon is called self-attribution or self-fulfilling belief (e.g., Wong and Yung, 2005; Johnson and Nye, 2011).

The rationale that underlies our identification strategy is thus the following: because the Chinese zodiac sign (exogenously given by year of birth) shapes risk attitudes and personality traits, which are important psychological predictors of migration, an elderly parent who has a higher fraction of children born under the migration-prone Chinese zodiacs is also more likely to have at least one migrant child in the city.

Our empirical strategy of using Chinese zodiac sign as IVs rests on the key assumption that the Chinese zodiac is orthogonal to μ_{hv} and υ_{hv}, the so-called exclusion restriction. In other words, the fraction of children born under the migration-prone zodiacs should

affect parental health only through its effect on the likelihood that the elderly parent has migrant children in the city. As a person's sign of birth is exogenously determined by the year s/he was born, it is very unlikely to be correlated with any unobservable inputs into parental health function. Nevertheless, as the first study that we know of to use astrological variation as IV for migration, we also discuss its potential limitations and perform relevant robustness checks accordingly. In particular, we address the following three arguments: the *business cycle effects*, the *Dragon preference effects*, and the *children generosity effects*.

The first concern relates to the possibility that there are business cycle effects, where children born in certain cohorts exhibit time trends in certain aspects which might also be correlated with parental health. We know that children from the same birth cohort are hit by the same shock (e.g., a revolution). If children's attitudes or inputs towards their parents were changed by the shock and if the impact of the shock was persistent, this would amount to cohort-specific time trends which are unobservable and are thus contained in μ_{hj}. Since our zodiac IVs make use of information about the year of birth, the exclusion restriction may be violated. To illustrate, children with early life exposure to the *Great Famine* (1959-1961) may wish never to experience again the lack of food and thereby devote a considerable amount of their income to family diet later in life. Another possibility is that children born before and after the *one-child policy* (1979) might be systematically different in their relationship with and their support for their parents. To address this problem, we include a full set of 62 dummies indicating children's years of birth. These birth year dummies should remove any systematic effects on parental health that are related to time trends common to all children in a birth cohort. The results are reported in Table 2.7. It is reassuring to find that adding these powerful controls does not change our conclusions.

Another potential concern is that parents' fertility choices could be endogenous. It might be the case that some parents carefully plan the birth of their children according to the Chinese zodiac because certain creatures are deemed to be more auspicious than others. If parents who have successfully achieved a "lucky" baby are a selected group of parents who have more advanced health knowledge, and since health knowledge affects health outcomes (see the health production function in Section 2.2), this would invalidate our identification

strategy. In this regard, we raise the following arguments. First, in China, it is much more likely that parents time fertility in response to the gender, rather than the zodiac sign, of a planned child. Especially in rural China, the strong boy preferences make it even more likely that fertility timing adjustment is gender-driven instead of astrology-driven. Second, astrology-based fertility trends are only observed in certain Asian societies such as Hong Kong, Taiwan, Singapore, and South Korea. Such evidence is, however, very lacking in mainland China (Johnson and Nye, 2011). Third, this type of zodiac selection, if anything, should apply only to the sign of Dragon. While Chinese people believe that children born in the Year of the Dragon are more fortuitous and superior (Johnson and Nye, 2011; Sim, 2015), opinions may vary from person to person in terms of the remaining eleven Chinese zodiacs.

Combining the previous points, we do not think that the astrology-based fertility decision is likely to pose a threat to the exclusion restriction in our context. Nevertheless, we still deal with this issue in two ways. We first provide descriptive statistics on the distribution of children born in each of the twelve Chinese animal years. Encouragingly, we find no evidence of a fertility boom in the Year of the Dragon. We also address the Dragon preferences argument more directly by excluding from our estimation sample elderly parents who have one or more Dragon children. We show below that our results are not affected by a potentially endogenous fertility outcome.

Another worry still remains as to whether a child's sign of birth affects parental health in ways independent of migration even if the Chinese zodiac can be argued to be purely exogenous. As discussed by Antman (2016), variations in children's sex and married mix can also be translated into differences in their contributions to the elderly parents. If, for example, children with certain Chinese zodiac signs are more generous to their parents in nature, we might encounter a similar concern here. We take care of this problem following Antman (2016)'s suggestions. We firstly add children's remittances as an exogenous control variable and, secondly, as an endogenous variable and use the share of married children as a third instrumental variable. It is important to note that the latter model also serves as a more comprehensive specification in which we are able to examine whether children's

migration affects elderly health in ways other than monetary contributions (Antman, 2016). We find that controlling for children's generosity to parents does not have a large impact on our main results.

To sum up, we believe that our IVs relying on children's Chinese zodiac sign provide us with credibly exogenous variation in the likelihood of children's internal migration.

2.5 Results

This section is organised as follows. In the first portion of the results we aim to understand how our instrument—share of children with the migration-prone zodiac animals—affects migration, channelled through its influences on the psychological determinants of migration.[25] Before analysing the first stage results, we provide two interesting pieces of evidence that support our identification strategy. In particular, we first utilise the CHARLS child-level data to show that being born under the migration-prone Chinese zodiacs increases a child's probability of migrating to the city. We then focus on one important psychological channel through which this could happen, namely, preferences over risk, and use the RUMiC data to assess the relationship between Chinese zodiac signs and individual risk attitudes. The second portion of the analysis centres on the estimation of the causal impact of daughters' and sons' rural-urban migration on parental health outcomes as well as a number of sensitivity checks to guarantee the robustness of our estimates. In summary, we hope to answer two questions: 1) Does the Chinese zodiac sign reliably predict migration behaviour (first-stage)? 2) Does migration of daughters and sons causally and differently affect the health of the elderly parents left behind (second-stage)?

[25] For simplicity purposes, we consider a single instrumental variable created for *all* children (i.e., IV=number of children born under migration-prone zodiac signs/total number of children) rather than the corresponding gender-specific shares.

2.5.1 Does The Chinese Zodiac Sign Affect Migration Propensity?

Chinese Zodiac Signs and Migration: CHARLS Child-Level Data

An interesting starting point for our empirical investigation is to learn about the association between a child's Chinese zodiac and his/her migration propensity. Ideally, we would need precise variation at the child level to study this relationship. Yet, the migration variables and the zodiac instruments discussed so far are all measured at the household level, and hence may provide limited information on such variation. For this reason, we take advantage of the child level data, where the unit of observation becomes each different child of the elderly parent. Table 2.2 displays summary statistics for the sample of 14,142 CHARLS children, comparing between children with migration-prone zodiac signs (N=9,594) and children with migration-averse zodiac signs (N=4,548). Most crucially for our analysis, the probability of migrating to urban areas demonstrates important differences between these two groups. Children who were born under the sign of migration-loving creatures, as compared with children born under migration-averse ones, have on average a greater chance of engaging in rural-urban migration (0.293 vs. 0.277). The t-statistic (2.000) implies that the difference between these two groups of children defined by their Chinese zodiac sign is statistically significant at the 5 percent level.

We next run a simple probit regression of a child migration dummy on an indicator for whether the child's Chinese zodiac sign is a migration-prone animal, together with a bunch of standard controls for migration. The probit estimates are presented in Table 2.3 with the main coefficient of interest (δ_1) reported on the first line. Our preferred specification incorporates the most comprehensive set of controls (column (4)). When no control is added (column (1)), having a migration-prone Chinese zodiac is linked with a 2.7 percentage point increase in the probability of migrating to the city (significant at the 1 percent level). Reassuringly this coefficient remains virtually unchanged in column (2) once we control for child characteristics and family background (2.6 percent effect, at the 1 percent significance level). We find that when village attributes (column (3)) and province dummies (column (4)) are added to the regressions, the point estimates on the child zodiac

variable go slightly down but are still strictly positive (0.022 and 0.019) and statistically significant at the 5 percent level.[26] All these statistically significant estimates point to the predictive ability of astrology in a child's migration behaviour.

To summarise, we find that the Chinese zodiac sign is a strong and highly significant migration predictor. In particular, being born under the migration-prone zodiac animals leads to approximately 2 percentage point increases in the migration likelihood for an average adult child after controlling for standard migration determinants. These results lend enormous support to the validity of our empirical strategy.

Chinese Zodiac Signs and Risk Attitudes: RUMiC Data

In the following, we resort to another Chinese survey—the Rural-Urban Migration in China (RUMiC; for a detailed description, see Akgüç, Giulietti, and Zimmermann, 2014)—in order to study the connection between Chinese zodiac signs and risk attitudes. The RUMiC data represent two major advantages for our purposes. First, direct measures of individual risk preferences are not always available in survey data (including the CHARLS). In the second wave of the RUMiC Rural Household Survey (RHS, 2009),[27] there is a direct question on general risk attitudes. Crucially, this self-assessed general risk question is the only one of the survey questions that has been experimentally validated, and turns out to be not only behaviourally relevant but also the best global predictor of actual risky behaviour (see e.g., Dohmen et al., 2011; Jaeger et al., 2010). Second, the RUMiC contains specific information on a respondent's date of birth (year, month and day). Since we know in the data also the *month* and the *day* of birth, we are able to exploit an additional variation in a person's zodiac sign, that is, his/her Western horoscope (i.e., Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces). This

[26] There are also a number of other interesting correlations. For instance, being a female, more educated, or being the eldest child enhances migration probability, whereas the number of children, the number of grandchildren, or being the single child in the household significantly reduces the likelihood of migrating to the city. In line with the literature (Munshi, 2003; Giulietti, Wahba, and Zenou, 2014), the fraction of migrants from the same rural village predicts a considerable change in the probability of migration (14.6 percent increase, at the 1 percent significance level), suggesting the influential role of *weak ties* in individual migration decisions.

[27] The RUMiC database comprises three independent surveys: the Rural Household Survey (RHS), the Urban Household Survey (UHS), and the Migrant Household Survey (MHS).

merit of the data allows us to dig deeper into the predictive ability of astrology—because we could make a useful comparison between the Chinese animal sign and the Western sun sign. Indeed, using the Western zodiac sign to predict the risk attitudes of a Chinese person amounts to an intuitive placebo experiment.[28] The expectation is that only the Chinese zodiac and not the Western zodiac can predict the risk attitudes of the individuals in our sample. We will show later that this is indeed the case.

This part of the analysis is motivated by two considerations. Firstly, despite the fact that the migration classification of the twelve Chinese zodiac animals (*migration-prone* or *migration-averse*) is built on common knowledge of Chinese astrology as well as conventional wisdom and social experience among the Chinese, one might still worry that such grouping is somewhat arbitrary. We will use the RUMiC data to show that these two groups of individuals are very different in terms of their risk attitudes. Secondly, and perhaps more importantly, we hypothesised in Section 2.4 that beliefs in one's birth animal can translate into migration behaviour through shaping personal characteristics which are psychological predictors of migration decisions. Among these psychological factors, attitude towards risk should be the first to bear the brunt because they play a role in almost every important individual decision and migration per se is a risky choice. Thereby, the presence of a statistically significant correlation between Chinese zodiac signs and risk attitudes would support the plausibility of this fundamental hypothesis we made for identification.

We do obtain supportive evidence from the RUMiC results. The most important finding is that the Chinese zodiac sign significantly reflects the risk preferences of the rural Chinese, but the Western zodiac sign does not. This implies the significant role of astrological beliefs in the formation of personal characters. While due to data availability we have to focus on risk attitudes here, this conclusion can easily be generalised to other personal

[28] It is worthwhile mentioning that although Western horoscopes have gained some popularity in China, the traditional animal sign is deeply embedded in China's cultural heritage and is typically used by the Chinese in their daily life. In fact, both the knowledge level of and the belief in Western astrology are fairly poor in Chinese villages where traditional cultural beliefs still dominate the value system. In addition, the influence of the Western zodiac should be particularly pronounced among China's younger generations, if anything. Given that our population of interest comprises Chinese rural residents with a mean age of around 49 (refer to Table B.1 in the Appendix), it is plausible to expect that only the Chinese zodiac sign would matter here.

attributes that are related to migration, e.g., personality. Moreover, we are able to attribute causality to our findings, as the Chinese zodiac sign (determined by year of birth) is naturally exogenous with respect to risk preferences. Establishing a causal link between the Chinese zodiac and risk attitudes is the key to understanding the mechanism underlying the astrological prediction of migration behaviour: a person's Chinese zodiac sign *causally* affects their attitude towards risk, and thus their propensity to migrate to another place. In the Appendix we present and discuss relevant descriptive statistics and estimation results based on the RUMiC sample.

First Stage Results

We now turn to the first stage of the 2SLS estimation. The first stage estimates in the context of this paper are meaningful in their own right because they may have profound implications for behavioural theories of migration. In other words, as we have demonstrated the ability of the Chinese zodiac signs to predict individual risk attitudes, a strong first stage correlation between migration propensity and Chinese zodiac IVs is hence a clear indication of the importance of psychological drives in the migration decision process. Table 2.4 shows the results from estimating the two first stage regressions for having migrant daughters (Equation 2.4.2) and for having migrant sons (Equation 2.4.3), reported in column (1) and (2) respectively. In the case of daughters' migration (column (1)), a one-unit increase in the fraction of daughters born under migration-prone Chinese zodiac signs raises the probability of having a migrant daughter by 11 percentage points, whereas the share of sons with migration-prone Chinese zodiac signs generates a positive, but not statistically significant effect. Interestingly, a similar pattern is evident in column (2) where the dependent variable is an indicator for whether the elderly parent has a migrant son in the city. We can see that the fraction of sons born under the sign of migration-loving zodiac animals has a positive (point estimate 0.100) and highly significant impact on the likelihood of seeing a son migrate, while the variation in the parallel measure for daughters does not seem to affect the migration probability of sons. In fact, the coefficient on the daughter-specific zodiac IV in column (2) is very close to zero and not statistically

significant. The above pattern is not only reassuring but very useful: since the gender-specific share of children born under migration-seeking zodiac signs appears to be only a strong predictor of having a migrant child of that specific gender (and not of the other), we have derived two orthogonal instruments—one for daughters' migration and one for sons' migration—to explore the gender-specific migration effects on parental health outcomes.

One potential concern within the instrumental variable context is the bias resulting from weak instruments (Bound, Jaeger, and Baker, 1995). The predictive power of two astrological instruments is confirmed by the Kleibergen-Paap *rk* Wald *F* statistic which tests the weak identification of the equation as a whole, as well as the standard first-stage *F* statistics, which are tests of whether the endogenous regressors are separately identified. As reported at the bottom of Table 2.4 the Kleibergen-Paap *rk* Wald *F* statistic has the value 17.25, well above the corresponding Stock-Yogo critical value at a very conservative threshold (10% maximal IV size), i.e., 7.03 (Stock and Yogo, 2005). According to the Staiger and Stock (1997)'s "larger than 10" rule of thumb, the two standard *F* statistics provide additional information on the strength of the zodiac IVs, suggesting that the coefficients on the two child migration variables are also individually identified. Therefore, we conclude that children's Chinese zodiac signs are strong predictor of their propensity to migrate and weak identification does not pose a problem in our analysis.

2.5.2 Does Daughters' and Sons' Migration Affect Parental Health Outcomes?

Main Results

Table 2.5 presents the OLS and IV results for elderly health outcomes: self-reported health (column (1)), two measures of physical health (column (2) and (3)), two measures of mental health (column (4) and (5)), and one welfare outcome (column (6)). The linear probability model (LPM) and IV-LPM are employed for the four outcomes which are measured as binary variables: SRH, ADLs/IADLs, depression and SWB. All estimation results use robust standard errors, adjusted for heteroscedasticity as well as correlation of the error

term between parents in the same household. For the sake of simplicity, the table reports only the coefficient estimates of daughter migration and son migration variables. The full set of regression estimates are shown in Table B.4 in the Appendix.

As discussed before, the OLS estimates are biased, since migration is endogenous. Therefore, we do not make any causal inferences from the OLS results. They serve as a useful benchmark for comparison purposes. The estimates obtained with OLS, presented in the upper panel of Table 2.5, indicate that having a migrant daughter in the city is significantly positively correlated with the physical health (0.389 for mobility and 0.035 for functionality) and cognitive skills (0.104) of the elderly parents left behind. As for sons column (6) suggests that having a son currently in the city significantly improves the cognitive capacity of the remaining parents (0.157), while it is statistically insignificant in every other parental health dimension.

We now turn to our 2SLS estimates, where daughters' migration and sons' migration are instrumented with the fraction of daughters and the fraction of sons born under the migration-prone Chinese zodiac signs. At a first glance, the coefficients on the daughter migration dummy become larger in size and more significant in general relative to the OLS results, whereas the only significant effect of the migration of sons loses its significance after instrumenting. In column (1) we present the IV results with subjective general health as the outcome variable. We find that having daughters who migrate to the city is associated with a statistically significant 33.6 percentage point increase in the likelihood of reporting excellent, very good, or good health. However, when it comes to sons, we find a smaller and insignificant positive effect (9.3 percent increase) of their migration on the self-rated health status of the elderly parents.

As for physical health, we see that elderly parents with daughters living in the city are 3.645 points more mobile on the (9-36) scale than parents who do not see their children migrate (column (2)). The effect is statistically significant at the 5 percent level. Furthermore, the magnitude of the estimate in column (3) implies that elderly parents who have at least one migrant daughter are 22.3 percentage points more likely to be able to perform the ADLs and IADLs independently (significant at the 5 percent level). Although

a decline in body functioning is generally deemed as inevitable in old age, this process can be mitigated. Among the most effective methods are those that involve physical activity (e.g., provision of exercise facilities) and better diets (e.g., intake of micro-nutrients), which can obviously be achieve more easily if more money is available. Hence, it is plausible to deduct that the pecuniary channel of migration is most likely to account for the positive findings here. Still, the relevant coefficients from sons are close to zero (0.539 and 0.010) and statistically insignificant, suggesting that having a migrant son does not significantly affect the physical health outcomes of the rural parents left behind.

With regard to mental health, column (4) suggests that elderly parents with migrant children (either daughters or sons) appear not to be statistically different in their depressive symptoms compared with parents with no migrant children. The estimated coefficients get larger in the IV specification relative to those obtained with the OLS (0.163 vs. 0.005 for daughters and 0.107 vs. 0.019 for sons) but are still statistically insignificant. These results are consistent with the interpretation that rural parents do not necessarily suffer emotional stress when their children migrate to the city—either they may receive more contact from children thanks to modern telecommunication technology, or they may increase other forms of social contact (e.g., interacting with friends or relatives) and/or participate in more social activities (e.g., playing Mahjong). In column (5) we see that the migration of daughters has a positive and strongly significant effect on the cognitive ability of their older parents staying behind, with a coefficient of 1.046 at the 5 percent significance level. This is indeed a sizable impact, as the average parent in our sample can only recall 2.8 simple words in the memory test. Once again, we do not find any significant effect from sons. The coefficient of sons' migration is small (0.268) and insignificant. Interestingly, once migration endogeneity is taken into account, the estimated migration effect on subjective well-being becomes significant for daughters and shows that elderly parents who have emigrating daughters are 49 percentage points more likely to feel happy or satisfied with their life. The effect is significant at the 1 percent level. For sons we find a positive (0.058), but not significant effect of their migration on the subjective well-being of the elderly parents.

Overall, all of the statistically significant coefficient estimates point to an improvement

in parental health outcomes as a result of their children's rural-urban migration. More appealingly, the gendered pattern of the migration impact is very striking: the estimated beneficial effects are entirely driven by having migrant daughters rather than migrant sons in the city. Specifically, the out-migration of rural daughters is found to significantly enhance various dimensions of elderly health outcomes, including self-reported general health, body mobility, functional capacity, cognition, and subjective well-being. In contrast with daughters' results, Table 2.5 does not document any statistically significant changes in the health of the elderly parents in response to the migration of their sons, which is sharply against the traditional belief of "rear sons for help in old age" in Chinese patrilineal rural society. One possible explanation relates to the increase in daughters' roles in family support resulting from their migration. We will return to this issue in Section 2.6.

Robustness Checks

In the section that follows, we intend to show that our results are very robust by performing a large number of checks. The relevant results are presented in Table 2.6-2.10. We focus on the preferred IV estimates.

As a first check, we undertake a placebo test on our identification strategy by running the same IV regression on a set of elderly health outcomes that are very unlikely to be affected by children's rural-urban migration status. This placebo exercise follows the same spirit of Antman (2016). The basic idea is that if the health gains come from the direct effect of the instruments themselves rather than from children's migration, then we should still expect to observe significant effects on the "fake" outcomes of elderly health. In particular, we consider three alternative health outcomes of elderly parents. The first outcome pertains to the respondents' early life health status, namely their self-reported overall health before the age of fifteen.[29] The second outcome is a dummy variable indicating the presence of any chronic diseases diagnosed by a doctor.[30] Unlike other more general

[29]The CHARLS asks "How would you evaluate your health during childhood, up to and including age 15", again on a five-point scale "excellent", "very good", "good", "fair", or "poor".

[30]The fourteen chronic conditions covered by the CHARLS survey are: hypertension, dyslipidaemia, diabetes or high blood sugar, cancer or malignant tumours, lung disease, liver disease, heart problems, stroke, kidney diseases, stomach or other digestive diseases, emotional problems, memory-related diseases,

health conditions that may possibly change over a short period of time, chronic diseases such as cancer, diabetes and asthma are more dependent on genetic endowment or long-run factors (e.g., cumulative exposure to toxic substances) than on migration episodes. The third outcome utilises the retrospective information on duration of disability. Namely, we create a dummy variable for whether the respondent became disabled before having their first child and thus under no circumstances could this placebo health measure have been caused by child migration since the child was not even born. The regression results of this test are listed in Table 2.6. As predicted, all coefficient estimates on the child migration variable are negligible and not significantly different from zero at any conventional level. This provides great support for the validity of our instrumental variable strategy.

In the second robustness check (see Table 2.7), we control for potential business cycle effects by introducing into our regression model a series of dummies that capture the year of birth for all the children of elderly parents. In doing so, we take out any systematic differences in parental health that are associated with unobserved time trends, such as historic events and macroeconomic conditions commonly experienced by children in the same birth cohort. The specification including the birth year dummies yields very similar results (the only exception being the estimate for the migration effect of daughters on cognition), indicating that differential time trends across birth cohorts could not explain our findings. Because the inclusion of these precise controls effectively rules out almost any other plausible explanation regarding unobserved time effects that are associated with our instruments (and that are correlated with parental health), we have greater confidence in the causal interpretation of our results.

In the third robustness check, we address potential endogeneity in elderly parents' fertility decisions by providing both qualitative (see Figure 2.2) and quantitative (see Table 2.8) evidence. Figure 2.2 shows the distribution of birth rates based on our child-level sample. Each bar indicates the fraction of children born in the year of a given zodiac animal. Reassuringly, we do not detect any obvious spike (boost in fertility) in the Year of the Dragon, suggesting that the Dragon preferences argument is less of a problem in

arthritis or rheumatism, and asthma.

our strategy. Turning to the regression results, we do lose some predictive power in our instruments in the specification excluding elderly parents with Dragon children. The reason for this is that the Dragon is a very migration-seeking creature and therefore our zodiac measures in this new specification (without the Dragon) is much less precise. Yet, it is reassuring to find that the pattern of our main results remains the same.

In our fourth robustness check, we account for children's generosity to their elderly parents by directly controlling for children's remittances (see Table 2.9). Panel A reports the results when children's economic transfers are treated as an exogenous control variable. We see that the point estimates are almost identical to the ones of our benchmark analysis and the coefficients on the children remittances variable are generally insignificant (except for being marginally significant in self-reported health). In Panel B we report the results of the specification where the remittances variable is regarded as endogenous and instrumented using the married ratio of children. We find the same qualitative results and similarly significant estimates of the impact of having migrant daughters in the city.

We perform a final robustness check in order to lend further credence to the validity of our instrumental variable strategy (see Table 2.10). More specifically, we re-estimate all models by (1) excluding villages which are located in minority-concentrated provinces, i.e., Xinjiang, Inner Mongolia, Guangxi, Yunnan, Guizhou and Qinghai (Panel A); (2) limiting the sample to households in which both the elderly respondent and the spouse are *Han* Chinese (Panel B);[31] and (3) combining the restrictions in (1) and (2) (Panel C). This is because one might be concerned that ethnic minorities could have different zodiacal beliefs, although we think that this is quite unlikely given their assimilation into *Han* culture. We can see from the table that, in all instances, the estimated effects we obtain are very similar to those obtained from the full sample.

[31]The CHARLS survey does not contain information on the ethnicity of the children of elderly respondents. But if both of the parents are *Han* people, it is almost impossible for the child to be a minority.

2.5.3 HETEROGENEITY

We now investigate heterogeneity in the child migration effect according to parental characteristics and household characteristics. In particular, we split the data along the following dimensions: gender (mother and father), age (≤65 and 65+), household income (above and below the mean), and living arrangements (live alone or with an elderly spouse and live with other household members).

Table 2.11 shows the regression results by subgroup. We report only the parameter estimates of the daughter migration variable because (as for the full sample) none of the coefficients on the son migration dummy are statistically significant. As is often the case, the strength of the instruments is relatively weaker due to smaller cells in the sub-samples. A word of caution is thus appropriate regarding interpretation and comparison of the results. With that said, we can see that there seem to be no apparent gender-biased patterns in the results when distinguishing between the gender of the parent (Panel A). The table documents a similar enhancement in self-rated health, functioning, and subjective well-being for mothers and fathers, but a statistically significant increase in body mobility only for mothers and a statistically significant rise in cognitive ability only for fathers. It thus appears that both mothers and fathers benefit from their daughters' internal migration.

Turning to Panel B of Table 2.11 where we split the sample by the age of the elderly parent, the results are very interesting. We find remarkable differences in terms of age, with the positive migration impact of daughters concentrated on the older cohort of the elderly parents. For the younger cohort, though, their health outcomes are not significantly affected by migration in any of the regressions performed. One potential explanation is that parents aged below 65 may still be physically and economically active and hence have a lower marginal utility of remittances relative to the older ones.

We focus next on Panel C of Table 2.11, where we divide the sample into households whose income is above and below the mean. Interestingly, the positive effect of having migrant daughters is more pronounced among elderly parents from relatively poorer households (in terms of both magnitude and statistical significance). We see that parents

from higher-income households respond more strongly to daughters' migration only when it comes to the mobility outcome. It is conceivable that a rich household will invest in health (e.g., diet and fitness) as long as the benefits outweigh the costs. Poor households, however, will not be able to afford a more nutritious diet or an exercise facility even if such investment promises a positive return. Importantly, our findings indicate that the migration of daughters can be an effective way to relax the credit constraints which have been faced by these marginal parents.

Finally, we examine whether the living arrangements of the elderly parents play a role (Panel D). This is an instructive consideration for two reasons. First, since it is rather hard for the empty-nest elderly to find close substitutes for the absent child, they may represent one of the most vulnerable left-behind groups. Second, understanding how the effect varies by living arrangements would have significant policy implications. As a consequence of accelerated population ageing, the number of empty-nest households has been increasing quickly in China. In the absence of family support, elderly people who live alone may resort to social care which, as we discussed earlier, is generally under-provided in rural areas. Turning to the corresponding IV estimates, the results are strikingly different between elderly parents living by themselves and living with others. For parents who co-reside with other household members, daughters' internal migration is found to significantly improve their self-rated health, physical health, and subjective well-being. For parents who live on their own, however, having daughters in the city generates a positive, but insignificant impact on their health. It is thus important for the government to build up a well-established social security system to accommodate the care needs of this disadvantaged group.

2.6 How Is Parental Health Affected?

The results presented in the previous section indicate a causal and robust positive impact of children's migration, in particular, the migration of daughters, on the health of older parents remaining in rural villages. It would be interesting to dig further into the underlying

channels through which such gender-biased impact may operate. We address this in the following two ways.

We start by checking specifically whether intergenerational transfers, namely money, time and emotional inputs (as mentioned in the conceptual model described in Section 2.2), that elderly parents receive from children differ by children's migration status and by gender of the migrant children. For sake of simplicity, we compare three groups: parents with migrant daughters only, parents with migrant sons only, and parents with no migrant children (i.e., exclude the cases where the elderly parents have both daughters and sons who have migrated to the city). The descriptive results (listed in Table 2.12) show that migrant sons and migrant daughters both contribute financially in terms of remittances to their elderly parents. Although remittances from migrant daughters are smaller in magnitude, daughters tend to have a higher likelihood of remitting once they migrate (85.2% vs. 83.4%). Therefore, although having sons is advantageous in terms of economic support, as the socio-economic status of migrant daughters improves, the traditional gender difference in the economic support provided by sons and daughters is found to be weakened. These findings are consistent with the evidence stressed by Le Goff (2016): "while female migrant workers are disadvantaged in the workforce and on average earn less than male migrant workers, they tend to maintain closer links with their relatives, behave more altruistically, and have a greater sense of sacrifice and duty towards their families at home".

We argued before that, on top of financial transfers, migrant children are also likely to compensate elderly parents for their absence with frequent contact via telephone or mails. In this aspect, migrant sons make significantly less contact with their older parents when they are away from home relative to migrant daughters. In detail, parents with only at least one migrant daughter report significantly more frequent contact than do parents with only migrant sons (63.009 vs. 47.566). This is consistent with view that women serve as kinkeepers in adult child-parent relationships. Focusing on a smaller sample of parents with functional limitations, again we could observe that migrant daughters are more likely to provide care (0.209 vs. 0.150) and also provide care for longer hours (17.656 vs. 11.873) when parents need help. A further issue which remains unexplained is why migrant

children are able to provide time assistance that often requires physical presence, and why migrant daughters are doing better in this regard. This could possibly be explained by the circular or repeat pattern of the rural-urban migration flow in China so that migrant workers shuttle back and forth between home and destination and females, given their disadvantages in employment and stronger links with families at origin, tend to migrate shorter distances than males (e.g., migrate within the same province). This hypothesis is confirmed by the numbers reported in Table 2.12: parents with only at least one migrant daughter meet their children 85.830 times per year, corresponding to approximately 1.65 times per month, which is significantly higher than do parents with only migrant sons. In fact, it is well established that daughters are more likely than sons to be emotionally close to and provide assistance to their parents in old age (Spitze and Logan, 1990). We add to the existing evidence by showing that this also holds true after children's migration.

These results pulled together, albeit purely qualitative, provide suggestive evidence that the asymmetric effects of migrant daughters and migrant sons may be explained by the greater importance of time and emotion over monetary inputs into the parents' health production and the more critical role that daughters play in parental old-age care after migration.

We next replace the dependent variable in the benchmark IV regression with eighteen "channel variables" that are informative of the monetary and non-monetary channels through which child migration may affect elderly health. Even though the CHARLS survey does not include information on time use, nutrition or health knowledge, we can still provide rich evidence here. The measures we consider within the monetary channel include health-related household expenditure (i.e., medical, fitness and food) and healthcare utilisation; within the non-monetary channel we explore measures including farm work, the probability of engaging in social activities, the number of social activities, hours of sleep, number of meals, and caring for grandchildren. We find suggestive evidence that elderly parents with migrant daughters are more likely to increase other forms of social contact and have more meals per day. The results also show that migrant households are significantly more likely to invest in health-related goods, namely food and fitness. We find

no evidence that the positive migration impact is operating through increasing the use of health-care.

Summarising, we find that if the left-behind parents are able to maintain contact with their migrant children and benefit from remittances at the same time, their health would improve. The findings that beneficial effects are purely from the out-migration of rural daughters are in line with some sociology literature on intergenerational support and migration in China. Song, Li, and Feldman (2012), for example, documents that children's migration enhances the role and function of daughters in the family support for the elderly. Our findings point to the fact that migrant rural women are playing an increasingly important role in their parents' old-age support. Rural-urban migration in China might thus have altered and modernised the familial norms that favour sons as the main care providers.

2.7 CONCLUSION

In this paper we analyse the impact of adult children's internal migration on the health of their elderly parents left behind in rural China and compare its effect by gender of the migrant child. Our estimates reveal two main findings of novelty, which may deserve more attention.

Firstly, we draw on, for the first time in the economic literature, exogenous variations in children's astrological characteristics (i.e., their Chinese zodiac sign) to instrument for the endogenous migration choice. Our first stage results suggest that a one-unit increase in the fraction of daughters (sons) born under migration-prone Chinese zodiac animal signs raises the likelihood of having migrant daughters (sons) in the city by 11 (10) percentage points. While it has long been believed that astrology could have an enormous impact on microeconomic behaviour (Bennett and Barth, 1973), there is no direct evidence on whether birth signs (the Western zodiac and the Chinese zodiac) do, in fact, influence individuals' migration decisions. Our results provide new evidence that confirms the ability of astrology to predict human behaviour and migration behaviour in particular. Future research could

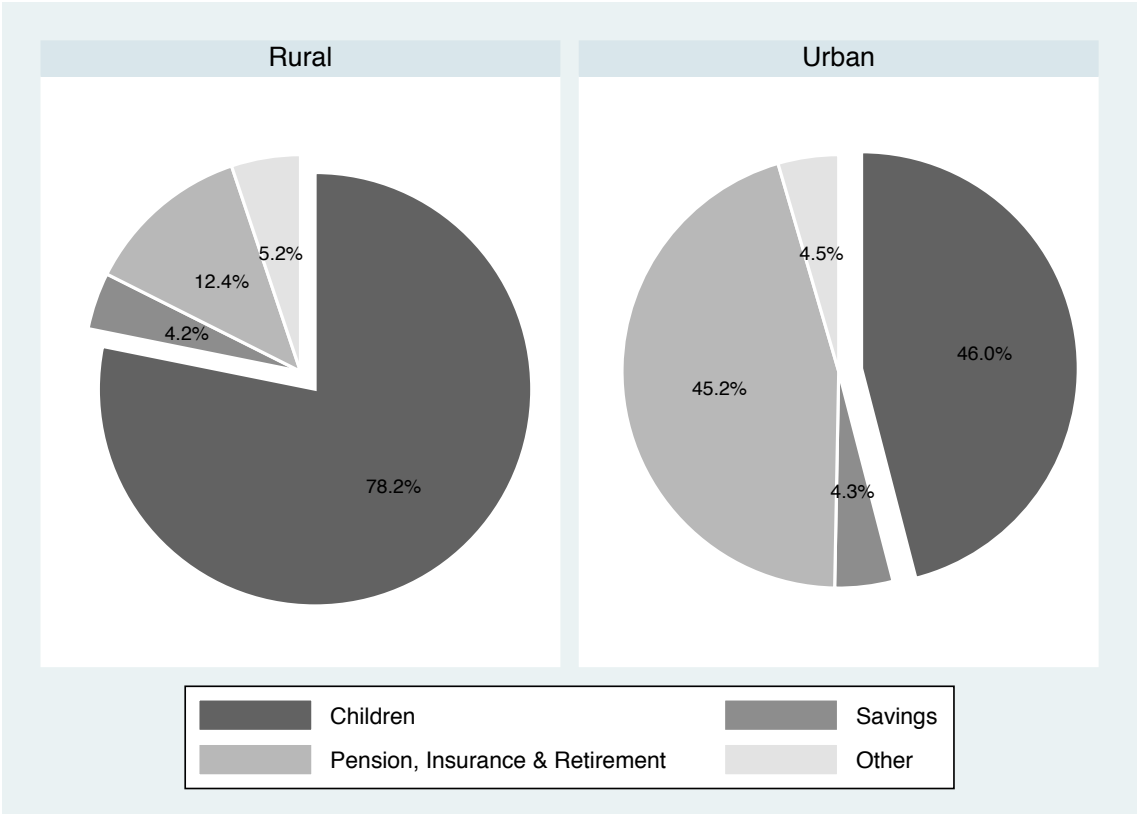
explore whether such astrological prediction is also found for the Western star signs for Western people, and for other risk- or personality-related microeconomic outcomes, for example, entrepreneurial decisions.

Secondly, our main results add to the current literature on the relationship between child migration and parental health by discovering a remarkable gendered pattern in the estimated migration effects. In particular, we find that left-behind parents could benefit from the ability to send their daughters to the city, which improves their self-reported health, physical health, mental health, and subjective well-being. The migration of sons, however, creates no similar beneficial effects, which is contrary to traditional expectations. The positive effects of daughters' migration are particularly prevalent among older parents (aged 65+), poorer parents (household income below the mean), and parents who live with other household members. Note that this does not rule out the possibility that other dimensions of old-age well-being that are not considered here could be positively affected by the migration of sons.

From a policy perspective, the potential benefits of daughters' migration on elderly health point to the need for more detailed gender-based government policies and programmes aimed at, first, promoting equal rights and obligations for old-age support between sons and daughters and, second, broadening the benefits of female migration.

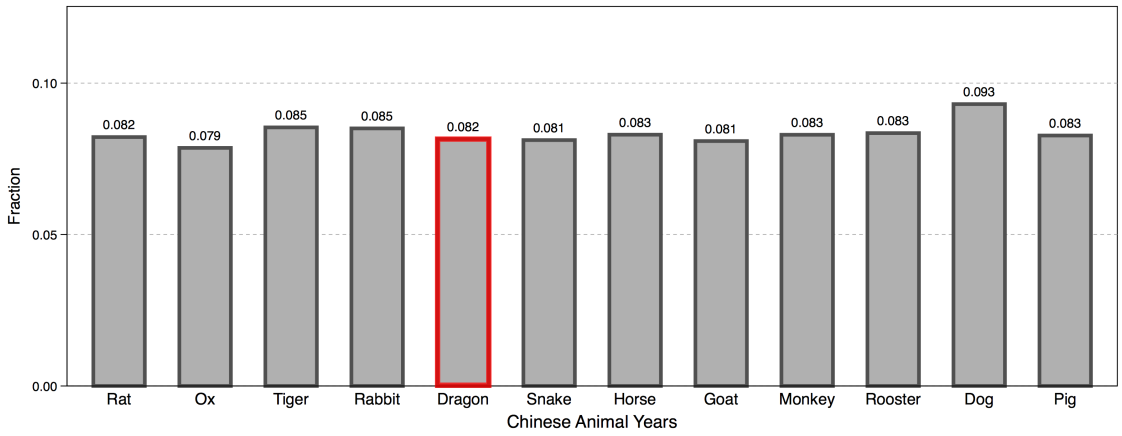
Figures and Tables

Figure 2.1: Main Sources of Old-Age Support by Rural/Urban Status (CHARLS 2011 & 2013).



Source.—Authors' own calculations from the CHARLS national survey 2011 (wave I) and 2013 (wave II). The relevant question in the survey questionnaire asks elderly participants "Who do you think you can rely on for old-age support?"

Figure 2.2: Distribution of Birth across the Twelve Chinese Animal Years.



Source.—Authors' own calculations from the CHARLS child-level data (2013).

Table 2.1: Descriptive Statistics (CHARLS 2013).

	Full Sample		**Has Migrant Child**		**No Migrant Child**		**Diff. in**
	Mean	SD	Mean	SD	Mean	SD	**Means**
Dependent Variables: Parental Health Outcomes							
Self-reported Health (0/1)	0.209	0.407	0.206	0.404	0.212	0.409	–0.007
Body mobility (9-36)	31.176	5.415	31.347	5.298	30.981	5.540	0.366***
ADLs/IADLs (0/1)	0.883	0.322	0.890	0.313	0.874	0.332	0.016**
Depressive symptoms (0/1)	0.446	0.497	0.440	0.497	0.453	0.498	–0.013
Cognitive ability (0-10)	2.847	1.821	2.951	1.851	2.728	1.778	0.223***
Subjective well-being (0/1)	0.459	0.498	0.469	0.499	0.446	0.497	0.023**
Demographic and Household Characteristics							
Female (0/1)	0.500	0.500	0.493	0.500	0.508	0.500	–0.015
Age (years)	65.582	7.776	65.552	7.702	65.617	7.861	–0.065
Han ethnicity (0/1)	0.929	0.256	0.936	0.245	0.921	0.269	0.015**
Good Mandarin level (0/1)	0.111	0.314	0.120	0.325	0.101	0.301	0.019***
Married (0/1)	0.854	0.353	0.876	0.330	0.829	0.377	0.047***
Has health insurance (0/1)	0.968	0.175	0.973	0.162	0.963	0.188	0.010**
Illiterate (0/1) - reference group	0.371	0.483	0.347	0.476	0.398	0.490	–0.051***
Can read or write (0/1)	0.223	0.416	0.214	0.410	0.233	0.423	–0.019**
Elementary school (0/1)	0.217	0.412	0.219	0.414	0.214	0.410	0.005
Middle school and above (0/1)	0.190	0.392	0.220	0.414	0.155	0.362	0.065***
Household assets	0.022	2.271	0.016	2.178	0.029	2.373	–0.013
Household size	3.630	1.947	3.373	1.812	3.924	2.053	–0.551***
Number of daughters	1.473	1.139	1.564	1.163	1.368	1.101	0.196***
Number of sons	1.666	1.036	1.744	1.064	1.577	0.996	0.167***
Number of grandchildren	0.680	1.007	0.585	0.965	0.789	1.042	–0.204***
Mean age of children (years)	37.974	7.359	37.963	7.146	37.986	7.598 86	–0.023
Has only one child (0/1)	0.076	0.264	0.042	0.200	0.114	0.318	–0.073***
Has migrant daughter	0.320	0.467	0.600	0.490	0.000	0.000	0.600***
Has migrant son	0.373	0.484	0.699	0.459	0.000	0.000	0.699***
Receive remittances from children (0/1)	0.792	0.406	0.864	0.343	0.710	0.454	0.154***
Remittances from children (/1000 RMB)	3.329	7.114	4.419	8.574	2.081	4.635	2.338***

Continued..

Continued..

	Full Sample		Has Migrant Child		No Migrant Child		Diff. in Means
	Mean	SD	Mean	SD	Mean	SD	
Village Characteristics							
Presence of medical facility (0/1)	0.817	0.387	0.822	0.383	0.811	0.392	0.011
Has access to tap water (0/1)	0.439	0.496	0.412	0.492	0.470	0.499	–0.058***
Number of rainy days	52.897	39.717	53.580	40.229	52.114	39.113	1.466
Number of snowy days	7.254	14.201	6.962	12.096	7.589	16.275	–0.627**
Distance to closest pollution site (km)	97.052	267.730	98.788	270.360	95.064	264.710	3.724
Instruments							
Migration-prone zodiac daughter (%)	0.545	0.442	0.573	0.434	0.513	0.450	0.060***
Migration-prone zodiac son (%)	0.617	0.416	0.636	0.406	0.594	0.426	0.042***
Observations	7,946		4,241		3,705		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013). All variables refer to year 2013 (wave II) except village-level characteristics which refer to year 2011 (wave I).

Note.—Migration-prone zodiac refers to any of the eight signs of the Chinese zodiac animal: Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog. */**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table 2.2: Descriptive Statistics (CHARLS Child-Level Data 2013).

	Migration-Prone Zodiac		**Migration-Averse Zodiac**		**Diff. in**
	Mean	SD	Mean	SD	**Means**
Dependent Variable					
Migrate to the city (0/1)	0.293	0.455	0.277	0.447	0.016**
Demographic and Household Characteristics					
Female (0/1)	0.465	0.499	0.473	0.499	–0.008
Age (years)	39.819	8.889	39.721	8.915	0.098
Married (0/1)	0.889	0.314	0.890	0.313	–0.001
Illiterate (0/1) - reference group	0.067	0.250	0.076	0.265	–0.09*
Can read or write (0/1)	0.123	0.329	0.134	0.341	–0.011*
Elementary school (0/1)	0.285	0.451	0.261	0.439	0.024***
Middle school and above (0/1)	0.525	0.499	0.529	0.499	–0.004
Eldest child (0/1)	0.314	0.464	0.330	0.470	–0.016*
Only child (0/1)	0.023	0.151	0.027	0.162	–0.004
Household assets	–0.198	2.202	–0.178	2.244	–0.019
Household size	3.524	2.030	3.589	2.084	–0.065*
Number of children	1.577	0.918	1.576	0.897	0.001
Number of grandchildren	0.235	0.763	0.232	0.741	0.002
Village Characteristics					
Paved road (0/1)	0.588	0.492	0.602	0.489	–0.014
Has road passing through (0/1)	0.925	0.264	0.925	0.263	–0.000
Village outmigration rate (%)	0.296	0.265	0.283	0.259	0.013***
Has access to tap water (0/1)	0.441	0.497	0.445	0.497	–0.004
Number of rainy days	54.832	40.844	54.207	40.346	0.625
Number of snowy days	7.675	15.447	7.151	14.269	0.524*
Distance to train station (km)	60.488	122.837	58.172	121.550	2.316
Distance to bus stop (km)	4.304	10.972	4.350	11.357	–0.047
Located in non-mountainous areas (0/1)	0.671	0.470	0.693	0.461	–0.022***
Observations	9,594		4,548		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013). All variables refer to year 2013 (wave II) except village-level characteristics which refer to year 2011 (wave I).

Note.—Migration-prone zodiac refers to any of the eight signs of the Chinese zodiac animal: Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog; Migration-averse zodiac refers to any of the four signs of the Chinese zodiac animal: Snake, Goat, Rooster and Pig.

*/**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table 2.3: Probit Estimates of the Effects of Chinese Zodiac Signs on Children's Migration Propensity (CHARLS Child-Level Data 2013).

	Dependent Variable: **Migrate to the City**			
	(1)	(2)	(3)	(4)
Migration-prone zodiac (δ_1)	0.027***	0.026***	0.022**	0.019**
	(0.010)	(0.009)	(0.009)	(0.009)
Female		0.015	0.022**	0.024***
		(0.010)	(0.009)	(0.009)
Age		0.006	0.005	0.004
		(0.005)	(0.004)	(0.004)
Age^2		–0.000**	–0.000	–0.000
		(0.000)	(0.000)	(0.000)
Married		–0.006	–0.004	–0.004
		(0.016)	(0.016)	(0.016)
Can read or write		0.073***	0.083***	0.078***
		(0.027)	(0.028)	(0.028)
Elementary school		0.109***	0.125***	0.122***
		(0.026)	(0.026)	(0.026)
Middle school and above		0.218***	0.243***	0.241***
		(0.024)	(0.022)	(0.022)
Eldest child		0.031***	0.032***	0.034***
		(0.009)	(0.009)	(0.009)
Only child		–0.062***	–0.051**	–0.041*
		(0.023)	(0.024)	(0.025)
Household assets		0.003	0.007**	0.009***
		(0.003)	(0.003)	(0.003)
Household size		–0.032***	–0.032***	–0.033***
		(0.003)	(0.003)	(0.003)
Number of children		–0.053***	–0.057***	–0.062***
		(0.007)	(0.007)	(0.007)
Number of grandchildren		–0.026***	–0.028***	–0.033***
		(0.009)	(0.009)	(0.009)
Paved road			–0.030***	–0.033***
			(0.011)	(0.013)
Has road passing through			–0.085***	–0.055**
			(0.023)	(0.023)
Village outmigration rate			0.215***	0.146***
			(0.023)	(0.025)
Has access to tap water			–0.033***	–0.029**
			(0.012)	(0.012)
Number of rainy days			0.000	0.000
			(0.000)	(0.000)
Number of snowy days			–0.001*	–0.002***
			(0.000)	(0.001)
Distance to train station			–0.000	–0.000
			(0.000)	(0.000)
Distance to bus stop			–0.000	–0.000
			(0.001)	(0.001)
Located in non-mountainous areas			–0.032**	–0.042***
			(0.013)	(0.014)
Province fixed effects	No	No	No	Yes
Individual and household controls	No	Yes	Yes	Yes
Village controls	No	No	Yes	Yes
Observations	14,142	14,142	14,142	14,142
Predicted probability	0.277	0.279	0.284	0.284

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013). All variables refer to year 2013 (wave II) except village-level characteristics which refer to year 2011 (wave I).

Note.—The dependent variable is a dummy variable indicating whether the child of an elderly parent migrates to the city. Migration-prone zodiac refers to any of the eight signs of the Chinese zodiac animal: Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

***Statistically significant at the 1 percent level.

Table 2.4: First Stage Regressions: Determinants of Having Migrant Daughters and Migrant Sons (CHARLS 2013).

	Dependent Variable	
	Has Migrant Daughter	**Has Migrant Son**
	(1)	(2)
Migration-prone zodiac daughter (%)	0.110***	–0.005
	(0.018)	(0.017)
Migration-prone zodiac son (%)	0.021	0.100***
	(0.018)	(0.017)
Province fixed effects	Yes	Yes
Other controls	Yes	Yes
Observations	7,946	7,946
R^2	0.160	0.171
F stat 1^{st} stage Equation1	19.95	
F stat 1^{st} stage Equation2		17.50
Kleibergen-Paap rk F stat	17.25	

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—All models include the control variables listed in Table 2.1. Migration-prone zodiac refers to any of the eight signs of the Chinese zodiac animal: Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 2.5: OLS and IV Estimates of Gender-Specific Migration Effects on Parental Health Outcomes (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
OLS						
Has migrant daughter (β_d)	0.003	0.389**	0.035***	–0.022	0.104*	0.022
	(0.012)	(0.161)	(0.009)	(0.016)	(0.056)	(0.016)
Has migrant son (β_s)	0.013	0.149	–0.001	–0.012	0.157***	0.023
	(0.012)	(0.145)	(0.009)	(0.014)	(0.048)	(0.015)
2SLS						
Has migrant daughter (β_d)	0.336***	3.645**	0.223**	–0.033	1.046**	0.490***
	(0.128)	(1.615)	(0.092)	(0.148)	(0.518)	(0.160)
Has migrant son (β_s)	0.093	0.539	0.010	0.200	0.268	0.058
	(0.145)	(1.806)	(0.103)	(0.162)	(0.580)	(0.181)
Outcome mean	0.21	31.2	0.88	0.45	2.8	0.46
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,946	7,946	7,946	7,946	7,946	7,946
Kleibergen-Paap rk F stat	17.25	17.25	17.25	17.25	17.25	17.25

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).

Note.—The dependent variables are (1) a dummy variable indicating self-reported health is excellent/very good/good/fair; (2) body mobility score ranges from 9 to 36; (3) a dummy variable equals to 1 when the functional score (0-12) derived from the 6-item KatzADLs and the 6-item LawtonIADLs is above 8; (4) a dummy variable equals to 1 when the CESD-10 depression scale (0-30) is above 8; (5) memory test score ranges from 0 to 10; (6) a dummy variable indicating an individual is happy or satisfied with life. All models include the control variables listed in Table 2.1. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

***Statistically significant at the 1 percent level.

Table 2.6: Robustness: IV Estimates of Gender-Specific Migration Effects on Placebo Parental Health Outcomes (CHARLS 2013).

	Dependent Variable	
	Childhood Health	**Chronic Disease**
	(1)	(2)
Has migrant daughter (β_d)	0.035	-0.175
	(0.131)	(0.127)
Has migrant son (β_s)	0.120	0.128
	(0.137)	(0.147)
Outcome mean	0.73	0.74
Province fixed effects	Yes	Yes
Other controls	Yes	Yes
Observations	7,855	7,946
Kleibergen-Paap rk F stat	15.87	17.25

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—The dependent variables are (1) a dummy variable indicating self-reported health before age 15 is excellent/very good/good/fair; (2) a dummy variable indicating presence of any chronic disease diagnosed by a doctor. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.

Table 2.7: Robustness: IV Estimates of Gender-Specific Migration Effects on Parental Health Outcomes, Controlling for Business Cycles (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
Has migrant daughter (β_d)	0.262**	2.812**	0.182**	–0.079	0.587	0.343**
	(0.111)	(1.257)	(0.079)	(0.131)	(0.431)	(0.135)
Has migrant son (β_s)	0.036	–0.610	–0.026	0.240	–0.291	–0.089
	(0.128)	(1.475)	(0.091)	(0.148)	(0.486)	(0.157)
Year of birth dummies	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,946	7,946	7,946	7,946	7,946	7,946
Kleibergen-Paap rk F stat	21.73	21.73	21.73	21.73	21.73	21.73

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—See notes for Table 2.5 for a detailed description of the dependent variables. All models include the control variables listed in Table 2.1 as well as a series of dummies for children's year of birth. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 2.8: Robustness: IV Estimates of Gender-Specific Migration Effects on Parental Health Outcomes, Excluding Elderly Parents of Dragon Children (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
Has migrant daughter (β_d)	0.324**	4.073**	0.226**	–0.039	0.932*	0.305*
	(0.138)	(1.739)	(0.095)	(0.160)	(0.548)	(0.160)
Has migrant son (β_s)	0.081	–2.469	–0.098	0.288	0.265	0.099
	(0.210)	(2.571)	(0.145)	(0.237)	(0.805)	(0.244)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,960	5,960	5,960	5,960	5,960	5,960
Kleibergen-Paap rk F stat	8.23	8.23	8.23	8.23	8.23	8.23

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—See notes for Table 2.5 for a detailed description of the dependent variables. All models include the control variables listed in Table 2.1. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 2.9: Robustness: IV Estimates of Gender-Specific Migration Effects on Parental Health Outcomes, Controlling for Children's Generosity to Elderly Parents (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Remittances are Exogenous					
Has migrant daughter (β_d)	0.345***	3.683**	0.227**	–0.025	1.050**	0.488***
	(0.130)	(1.664)	(0.094)	(0.151)	(0.530)	(0.162)
Has migrant son (β_s)	0.111	0.611	0.016	0.215	0.277	0.054
	(0.153)	(1.918)	(0.109)	(0.170)	(0.612)	(0.189)
Log (Remittances from children)	–0.008*	–0.032	–0.003	–0.007	–0.004	0.002
	(0.004)	(0.062)	(0.003)	(0.005)	(0.019)	(0.005)
Kleibergen-Paap rk F stat	15.27	15.27	15.27	15.27	15.27	15.27
	Panel B: Remittances are Endogenous (Second Stage)					
Has migrant daughter (β_d)	0.311**	3.154**	0.199**	0.014	0.935*	0.400**
	(0.127)	(1.563)	(0.090)	(0.150)	(0.516)	(0.172)
Has migrant son (β_s)	0.044	–0.415	–0.038	0.291*	0.053	–0.116
	(0.134)	(1.656)	(0.095)	(0.157)	(0.539)	(0.179)
Log (Remittances from children)	0.022	0.426**	0.021*	0.069***	0.096	0.078***
	(0.018)	(0.214)	(0.012)	(0.022)	(0.070)	(0.023)
	First Stage					
		Has Migrant Daughter	**Has Migrant Son**	**Children Remittances**		
Migration-prone zodiac daughter (%)		0.111***	–0.003	0.090		
		(0.018)	(0.017)	(0.121)		
Migration-prone zodiac son (%)		0.021	0.099***	0.259**		
		(0.018)	(0.017)	(0.125)		
Married child (%)		–0.063**	–0.099***	1.477***		
		(0.030)	(0.033)	(0.241)		
F stat 1^{st} stage Equation1		14.79				
F stat 1^{st} stage Equation2			14.71			
F stat 1^{st} stage Equation3				14.11		
Kleibergen-Paap rk F stat		10.66	10.66	10.66		
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,946	7,946	7,946	7,946	7,946	7,946

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—See notes for Table 2.5 for a detailed description of the dependent variables. In panel B, remittances from children are also considered as endogenous. In this case, instruments are the share of daughters with the migration-prone Chinese zodiacs, the share of sons with the migration-prone Chinese zodiacs, and the share of children who are married. All models include the control variables listed in Table 2.1. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 2.10: Robustness: IV Estimates of Gender-Specific Migration Effects on Parental Health Outcomes, Excluding Ethnic Minorities (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Excluding Minority-Concentrated Provinces					
Has migrant daughter (β_d)	0.333**	3.165*	0.217**	0.228	0.946*	0.429**
	(0.138)	(1.685)	(0.096)	(0.163)	(0.550)	(0.171)
Has migrant son (β_s)	0.042	–0.727	–0.022	0.116	0.412	0.077
	(0.154)	(1.808)	(0.107)	(0.176)	(0.589)	(0.190)
Observations	6,684	6,684	6,684	6,684	6,684	6,684
Kleibergen-Paap rk F stat	14.97	14.97	14.97	14.97	14.97	14.97
	Panel B: Excluding Minority Elderly Parents					
Has migrant daughter (β_d)	0.408**	3.724*	0.231**	0.169	1.175*	0.548***
	(0.158)	(1.937)	(0.111)	(0.175)	(0.604)	(0.195)
Has migrant son (β_s)	0.210	1.497	0.137	0.261	0.516	0.204
	(0.180)	(2.164)	(0.126)	(0.195)	(0.673)	(0.221)
Observations	6,811	6,811	6,811	6,811	6,811	6,811
Kleibergen-Paap rk F stat	11.97	11.97	11.97	11.97	11.97	11.97
	Panel C: Excluding Minority Provinces and Minority Parents					
Has migrant daughter (β_d)	0.407**	3.604*	0.227**	0.245	0.974	0.465**
	(0.168)	(2.018)	(0.115)	(0.189)	(0.641)	(0.204)
Has migrant son (β_s)	0.142	0.320	0.084	0.190	0.525	0.213
	(0.174)	(1.988)	(0.117)	(0.191)	(0.632)	(0.211)
Observations	6,054	6,054	6,054	6,054	6,054	6,054
Kleibergen-Paap rk F stat	13.17	13.17	13.17	13.17	13.17	13.17
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).

Note.—See notes for Table 2.5 for a detailed description of the dependent variables. All models include the control variables listed in Table 2.1. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

***Statistically significant at the 1 percent level.

Table 2.11: Heterogeneous Effects of Daughters' Migration on Parental Health Outcomes (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Gender					
Mother						
Has migrant daughter (β_d)	0.445**	6.606**	0.273*	–0.083	0.851	0.563**
	(0.199)	(2.788)	(0.148)	(0.221)	(0.755)	(0.241)
Observations	3,974	3,974	3,974	3,974	3,974	3,974
KP rk F stat	8.95	8.95	8.95	8.95	8.95	8.95
Father						
Has migrant daughter (β_d)	0.272*	2.118	0.215**	–0.065	1.124*	0.431**
	(0.149)	(1.716)	(0.104)	(0.178)	(0.607)	(0.181)
Observations	3,972	3,972	3,972	3,972	3,972	3,972
KP rk F stat	17.67	17.67	17.67	17.67	17.67	17.67
	Panel B: Age					
Aged≤65						
Has migrant daughter (β_d)	0.236	0.047	–0.013	–0.207	0.750	0.119
	(0.167)	(1.570)	(0.087)	(0.193)	(0.645)	(0.188)
Observations	4,589	4,589	4,589	4,589	4,589	4,589
KP rk F stat	11.51	11.51	11.51	11.51	11.51	11.51
Aged 65+						
Has migrant daughter (β_d)	0.651**	10.679**	0.627**	0.240	1.423	1.063**
	(0.297)	(4.520)	(0.271)	(0.348)	(1.132)	(0.420)
Observations	3,357	3,357	3,357	3,357	3,357	3,357
KP rk F stat	3.3	3.3	3.3	3.3	3.3	3.3
	Panel C: Household Income					
Low						
Has migrant daughter (β_d)	0.301*	3.313	0.239**	–0.044	1.071**	0.594***
	(0.161)	(2.074)	(0.122)	(0.189)	(0.650)	(0.211)
Observations	5,594	5,594	5,594	5,594	5,594	5,594
KP rk F stat	12.23	12.23	12.23	12.23	12.23	12.23
High						
Has migrant daughter (β_d)	0.239	3.576*	0.144	0.022	0.552	0.211
	(0.211)	(2.100)	(0.110)	(0.226)	(0.864)	(0.223)
Observations	2,352	2,352	2,352	2,352	2,352	2,352
KP rk F stat	3.2	3.2	3.2	3.2	3.2	3.2
	Panel D: Living Arrangements					
Live with Others						
Has migrant daughter (β_d)	0.297**	3.480*	0.219**	–0.059	0.946	0.458**
	(0.149)	(1.872)	(0.109)	(0.175)	(0.605)	(0.187)
Observations	5,049	5,049	5,049	5,049	5,049	5,049
KP rk F stat	6.8	6.8	6.8	6.8	6.8	6.8
Empty-Nest						
Has migrant daughter (β_d)	0.396	4.429	0.217	0.025	0.886	0.414
	(0.246)	(2.793)	(0.162)	(0.265)	(0.863)	(0.287)
Observations	2,897	2,897	2,897	2,897	2,897	2,897
KP rk F stat	5.77	5.77	5.77	5.77	5.77	5.77
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—See notes for Table 2.5 for a detailed description of the dependent variables. All models include the control variables listed in Table 2.1. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 2.12: Pathways: Monetary, Emotional and Time Inputs to Elderly Parents by Children's Migration Status and Gender (CHARLS 2013).

	Migrant Daughter Only	**Migrant Son Only**	**No Migrant Child**	**Diff. in Means**	**Std. Error**
Monetary Support: M_i					
Receive remittances	0.852	0.834	0.710	0.018	(0.014)
Remittances in total (RMB)	3552.146	4326.238	2081.094	-774.092**	(329.541)
Remittances in money (RMB)	2333.353	3282.267	1432.668	-948.914***	(251.660)
Remittances in in-kind (RMB)	1218.793	1043.971	648.426	174.823	(116.605)
Emotional Support: E_i					
Avg. # of meets	85.830	62.648	107.544	23.182***	(3.253)
Meet at least once a year	0.987	0.969	0.890	0.019***	(0.006)
Meet at least once a month	0.766	0.636	0.703	0.130***	(0.017)
Meet at least once a week	0.567	0.475	0.555	0.092***	(0.018)
Meet almost everyday	0.413	0.315	0.415	0.098***	(0.018)
Avg. # of contacts	63.009	47.566	31.927	15.443***	(2.887)
Contact at least once a year	0.824	0.874	0.591	-0.050***	(0.013)
Contact at least once a month	0.752	0.802	0.516	-0.050***	(0.015)
Contact at least once a week	0.496	0.464	0.274	0.032*	(0.019)
Contact almost everyday	0.105	0.058	0.037	0.047***	(0.010)
Observations	1,276	1,696	3,705		
Time Support: T_i ***(Subsample)***					
Receive any help	0.209	0.150	0.215	0.059**	(0.023)
Hours of help per day	17.656	11.873	17.918	5.783	(4.311)
Days of help in past month	3.842	2.281	3.972	1.561***	(0.584)
Help with ADLs	0.113	0.099	0.124	0.013	(0.024)
Help with IADLs	0.240	0.174	0.238	0.065**	(0.027)
Observations	487	638	1,598		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—*/**/*** indicate difference in means between the first two groups (parents who only see their daughters migrate and who only see their sons migrate) is statistically significant at the 0.1/0.05/0.01 level. Time support from children is reported by a subsample of parents who experienced any difficulty with one or more ADLs or IADLs (i.e. functionally limited parents).

Table 2.13: Causal Pathways: IV Estimates of Gender-Specific Migration Effects on "Channel Outcomes" (CHARLS 2013).

	Dependent Variable					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Lifestyle					
	Farming^{+}	**Social Activities**$^{+}$	**Social Activities**$^{\#}$	**Sleep**$^{\#}$	**Meals**$^{+}$	**Grandchild Care**$^{+}$
Has migrant daughter (β_d)	0.133	0.483***	0.864***	0.162	0.274**	–0.082
	(0.142)	(0.161)	(0.278)	(0.535)	(0.137)	(0.160)
Has migrant son (β_s)	0.043	0.073	0.051	–0.517	0.120	0.063
	(0.156)	(0.180)	(0.311)	(0.568)	(0.150)	(0.178)
Outcome mean	0.59	0.48	0.69	6.18	0.79	0.42
Kleibergen-Paap rk F stat	17.25	17.25	17.25	17.25	17.25	17.25
	Panel B: Health-Related Expenditure					
	Incurring Medical Exp.$^{+}$	**Log p.c. Medical Exp.**$^{\#}$	**Incurring Fitness Exp.**$^{+}$	**Log p.c. Fitness Exp.**$^{\#}$	**Log p.c. Food Exp.**$^{\#}$	**Food/Total Exp. (%)**
Has migrant daughter (β_d)	0.279*	1.428	0.212***	0.981**	1.155**	–0.002
	(0.153)	(1.043)	(0.080)	(0.393)	(0.522)	(0.119)
Has migrant son (β_s)	0.123	1.254	0.024	0.365	0.205	–0.304**
	(0.173)	(1.192)	(0.091)	(0.441)	(0.587)	(0.136)
Outcome mean	0.80	4.94	0.04	0.21	3.61	0.70
Kleibergen-Paap rk F stat	17.25	17.25	17.25	17.25	17.25	17.25
	Panel C: Healthcare Utilisation					
	Out-patient^{+}	**Out-patient**$^{\#}$	**In-patient**$^{+}$	**In-patient**$^{\#}$	**Forgone Healthcare**$^{+}$	**Treat Chronics**$^{+}$
Has migrant daughter (β_d)	0.012	–0.760	–0.048	–0.007	0.027	0.141
	(0.072)	(0.524)	(0.096)	(0.179)	(0.085)	(0.114)
Has migrant son (β_s)	0.018	0.080	0.028	–0.001	0.034	0.073
	(0.078)	(0.507)	(0.102)	(0.204)	(0.094)	(0.126)
Outcome mean	0.23	0.56	0.14	0.22	0.14	0.56
Kleibergen-Paap rk F stat	17.06	17.06	17.06	17.06	17.06	17.33
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,946	7,946	7,946	7,946	7,946	7,946

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—(+) refers to dichotomous variables. (#) refers to continuous variables. The dependent variables in panel B are at the household level. All models include the control variables listed in Table 2.1. Panel C includes an additional dummy for whether an individual had any illness (column 1-5) and a set of dummies for presence of any chronic disease diagnosed by a doctor (column 6). Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Chapter 3

Child Migration, Remittances and Household Expenditures in China

3.1 Introduction

The literature concerning the impact of migration and remittances on expenditure patterns of migrant-sending households is growing. An important strand of this literature has examined the different roles played by international and internal remittances (Castaldo and Reilly, 2007; Adams and Cuecuecha, 2010b; Clément, 2011; Randazzo and Piracha, 2014). Despite the fact that these studies provide mixed results, they all highlight the importance of taking into account different sources of remittances in the analysis of household expenditure patterns. In the same spirit, I believe that another fruitful perspective taken on this issue consists of distinguishing the effect according to the type and purpose of migration, for instance, whether migrate *temporarily* to earn more money for poverty alleviation at home, or migrate *permanently* to start a new and typically more promising life in another place. Still, there is very little economic evidence that the spending behaviour of a household is disproportionately affected by having temporary *versus* permanent migrants, and much remains to be unravelled in this regard. Clearly, temporary migration differs sub-

stantially from permanent migration in terms of their motivation, duration, obligations for the left-behinds, and so forth.

At the same time, research has tended to analyse the sole impact of remittances on household expenditure decisions. Yet, very little is known about whether migration exerts any *independent* effect on household expenditure over and above its effect on the remittances, for example, through a transfer of consumption norms or a transfer of advanced production technologies. As noted by Taylor and Mora (2006): "constraints on household expenditures include not only income but also information, uncertainty and risk aversion, and preferences".

The aim of this paper is to provide a more in-depth insight into the impact of migration and remittances on household expenditure behaviour by specifically disentangling the role of *temporary* and *permanent* migration in household expenditure, and by examining the *overall* impact of migration on household expenditure, which is composed of the direct effect from remittances and other more subtle spillover and general equilibrium effects. In particular, I address the following empirical questions. What is the overall impact of adult children's rural-urban migration on the expenditure decisions of the households left behind? Is the impact on household expenditure dependent on the type of the child's stay in the city (temporary or permanent)? To what extent does the impact on household expenditure come from remittances?

To answer the aforementioned questions, I use data from the China Health and Retirement Longitudinal Study (CHARLS), a nationally representative survey interviewing elderly people aged 45 and over along with their spouses of any age. Crucially for my analysis, the CHARLS contains questions about a child's place of residence and place of registration (i.e., *hukou*), permitting a rigorous comparison among three groups of households: those without migrant children, those with temporary (or non-*hukou*) migrant children and those with permanent (or *hukou*) migrant children. In addition, the CHARLS survey collects rich expenditure data on a broad range of consumption- and investment-type commodities. The household expenditure outcomes I explore cover both aggregate expenditure categories and individual expenditure measures.

There are several stumbling blocks to identification. First, many of the household choices (e.g., migration, food, education, etc.) are co-determined and, as a result, migration (or remittances) and household expenditure behaviour could be triggered by the same variable. Second, neither sending migrants nor receiving remittances are random. If such selectivity is based on unobservable characteristics, a simple comparison of migrant (or remittance-receiving) and non-migrant (or non-remittance-receiving) households will introduce biases in the estimated effects of migration and remittances on household expenditure outcomes. For example, it is likely that more ambitious or risk-loving households are more likely to produce migrants and receive remittances. If this is the case, there will be an overestimation of the productive role of migration and remittances, as these households are also more likely to devote their money to investment- rather than consumption-type goods. Third, there could be unobservable factors such as droughts, diseases, or sound local policies that simultaneously affect the expenditure patterns of the households and the migration or remittance decision of the children. Finally, reverse causation could arise if children choose whether to migrate and how much to remit according to the household expenditure status, just as the case in which a migrant child sends more money back home when the left-behind household is trapped in poverty.

To alleviate these concerns, I propose an instrumental variable (IV) strategy, relying on both macro-level variation in the village migration networks for three years preceding the 2013 survey and micro-level variation in the age composition of the children across households. Overall, I find strong evidence of a positive impact of adult children's temporary migration on the food budget share and a negative impact on the shares devoted to agriculture and land. On the contrary, the permanent migration of children does not have any significant effect on the expenditure shares for consumption goods, but, interestingly, enhances the budget shares allocated to health and agriculture. I therefore provide new empirical evidence that the impact of migration on expenditure patterns of households depends on the *type* of migration.

The paper unfolds as follows. In Section 3.2, I provide the background context by describing the migration and the *hukou* system in China. I also briefly review the main

findings in the literature. Section 3.3 describes the data used in the analysis and Section 3.4 presents the identification strategy. Empirical results on the relationship between migration, remittances and household expenditures are discussed in Section 3.5. The paper concludes in Section 3.6.

3.2 Background

3.2.1 Institutional Context

Internal migration in China is arguably the largest movement of the labour force in human history. The number of rural-to-urban migrants in China rose from 34 million in 1989 to 274 million in 2014 (Cai, 2002; National Bureau of Statistics of China, 2015). The mobility of the Chinese population has been strictly regulated by a household registration system, known as the *hukou* system. People were free to migrate between rural and urban areas until 1958, when the *hukou* system was formally set up. It registers each person with a specific location (e.g., a city, town, or village) at birth and follows this person for life, determining where s/he can live and work. The two most important things about *hukou* are location (place of registration) and type (rural/agricultural and urban/non-agricultural) (Goodkind and West, 2002). This system, in fact, serves as a "domestic passport system" that sharply divides Chinese society into two household types: rural and urban. Rural *hukou* means that household registration is in rural areas, and urban *hukou* refers to household registration in urban areas. Rural and urban residents have been treated differently in several important aspects. More specifically, rural *hukou* holders are tied to the land to support themselves and to provide agricultural products for the nation, whereby the government grants urban *hukou* holders access to a variety of social welfare. This has thus resulted in salient segregation and inequality between the rural and urban Chinese. Importantly, migrant workers without local *hukou* are restricted in employment opportunities and have poor access to social benefits and public services such as education, healthcare, unemployment insurance, housing subsidies, and pensions (see, for example, Cai, Park, and Zhao, 2008). These migration restrictions effectively discourage migrant

workers from staying in cities for long periods (permanent migration) and from bringing their entire families to cities (family migration).

As a consequence, rural-urban migration in China takes a unique form, characterised by a two-track system consisting of temporary (non-*hukou*) migration and permanent (*hukou*) migration (Chan and Zhang, 1999; Sun and Fan, 2011).[1] This migration dichotomy is rooted in the institution of the *hukou* system and depends on whether or not rural migrants in the city are able to transfer their *hukou* location. In fact, changing one's *hukou* type is very difficult, especially from "rural" to "urban". Hence, a large proportion of migrants work in urban areas for a few months to a few years and, finally, return to their home. Since people with better skills and education are more welcomed by the urban government and are more likely to obtain urban *hukou*, permanent migrants are predominantly represented by young, highly skilled, and well-educated individuals.

The economic reform launched in 1978 led to an excess labour force in rural areas and high demand for low-priced labour in urban areas. To meet this demand, as well as to tackle rural-urban inequality, the Chinese government has undertaken a series of reforms since the 1980s to gradually relax constraints on the *hukou* system. The initial *hukou* reform, which took place in 1985, issued a "temporary residence permit" (*zanzhuzheng*) that granted legal temporary residency to rural migrants in urban areas. In 1992, the grain rationing system, which had persisted for forty years, was fully abolished.[2] From the late 1980s to the mid-1990s, some local governments (e.g., Shanghai) offered the "blue-stamp" *hukou* to "desirable" migrants such as investors and professionals. The most profound reform of the *hukou* laws started with a pilot scheme in 1997, and further expanded in 1998. The major changes include: 1) granting urban *hukou* to migrants who hold a stable job and have resided in the city for more than two years; 2) making it easier for the immediate family of urban residents, investors, new business owners and real estate purchasers to obtain

[1] There are other terminologies commonly used to describe these two forms of migration. For example, temporary migration is also called short-term/circular/repeat/informal migration, and permanent migration is also called long-term/plan/formal migration.

[2] The grain rationing system started in the 1950s. Urban households received grain coupons with which they were able to buy a certain amount of grain at a cheaper price and the exceeding amount at market price. At the same time, rural households had to fulfil production quotas imposed by the government and were allowed to sell the excess amount at market price.

urban *hukou*; and 3) recognising inheritance of *hukou* from both mother and father.[3] In 2003, the law of "custody and repatriation" was repealed.[4] More recently, the rural-urban *hukou* distinction has been eliminated and a unified *"residency hukou"* system has been implemented in some parts of China, particularly in small cities and towns. It is important to note the fact that, albeit loosened, the *hukou* system remains in place and continues to affect the size and composition of the internal migration flows in China (Chan and Zhang, 1999; Meng, 2012). Meanwhile, migrant workers are still faced with discrimination in the labour market and in society.

3.2.2 Related Literature

In the economic literature, there are three competing views on the role of migration and remittances in household expenditure. Although there has been much debate over this issue, the consensus is that the ways in which migration and remittances affect household spending behaviour mostly depend on how migrants and remittances are perceived by the households left behind. If migrants are considered to be part of the extended household and their income as part of the pooled household income, then a dollar of remittance income will be spent by the households just like a dollar of any other source of income, say, wage income. This generally reflects the fungible nature of remittances and constitutes the first view in the debate: migrant remittances should not entail any change in household expenditure decisions. The empirical support for this view is provided by, for example, Castaldo and Reilly (2007) in the case of Albania, Adams, Cuecuecha, and Page (2008) in the case of Ghana, and Randazzo and Piracha (2014) in the case of Senegal.

The second, and more optimistic, view is rooted in the permanent income hypothesis (PIH) and lies at the heart of the New Economics of Labour Migration (NELM), which

[3]Before this reform, the *hukou* registration had been passed on from mother to child. After the reform, a newborn child was also allowed to inherit the father's *hukou*. In addition, a child under the age of 18 could change the *hukou* status from the mother's to father's.

[4]In 1982, China established the "custody and repatriation" (C&R) system, under which the police had the right to detain and expel people who did not possess a local residence permit (*hukou*) or a temporary residence permit (*zanzhuzheng*). In 2003, a migrant worker named Sun Zhigang died during his period of detention after being unable to show his temporary residence permit and identity card, leading directly to the end of this system.

emphasises the potential development impact of migration and remittances. Specifically, remittances are treated by households as a transitory component of income and are thus spent, at the margin, on human and physical capital investments. In such a case, migrant remittances are very likely to exert a beneficial influence on the local economies. More recently, a broad strand of literature has highlighted the productive role of migration and remittances in a wide range of investment-type outcomes at the household level, including education (Cox-Edwards and Ureta, 2003; Kifle, 2007; Adams and Cuecuecha, 2010b, 2013), health (Taylor and Mora, 2006; Valero-Gil, 2009; Amuedo-Dorantes and Pozo, 2011; Adams and Cuecuecha, 2013), housing (Osili, 2004; Taylor and Mora, 2006; Adams and Cuecuecha, 2010b, 2013), and entrepreneurial activities (Woodruff and Zenteno, 2007; Yang, 2008; Wahba and Zenou, 2012). For example, two papers by the same authors—Adams and Cuecuecha (2010b) in Guatemala and Adams and Cuecuecha (2013) in Ghana—present consistent evidence of a positive effect of remittances from both international and internal migrants on investment goods and a negative effect on food. In a study that focuses on the impact of migration (instead of remittances) on expenditure patterns, Taylor and Mora (2006) suggest that migration is associated with a substantially high marginal budget share spent on investment, based on household survey data from rural Mexico. This turns out to be the only economic paper I am aware of that disentangles the effect of different forms of migration on household expenditure, and the authors find stronger effects for households with international migrants relative to those with internal migrants.

The final, and more pessimistic, view argues that migrant households tend to spend most of their remittances on consumption rather than investment goods, and, as a result, remittances may play little part in the development process of the sending areas. For example, in a broad study using data collected from 113 countries, Chami, Fullenkamp, and Jahjah (2005) show that remittances are devoted to "status-oriented" consumption through compensating poor economic performance. Exploiting data from Tajikistan, Clément (2011) confirms that remittances are not spent productively. He reveals differential effects on household expenditure depending on where the remittances are generated. In particular, international remittances increase consumption expenses and decrease invest-

ment expenses, whereby internal remittances produce mixed results with more expenditure on health but less expenditure on housing and agriculture. In Indonesia, Adams and Cuecuecha (2010a) also find no evidence of any productive use of remittances, and claim that Indonesian households with international migrants are poor and hence spend remittances at the margin on food rather than housing. The Chinese literature on this issue, albeit small, is unanimous and supports the pessimistic view that migration and remittances are more linked to increased consumption expenditures in migrant-sending areas (De Brauw and Rozelle, 2008; Zhu et al., 2012, 2014; Démurger and Wang, 2016). The interpretation of the findings is in line with the facts in China: 1) remittances are treated as a permanent rather than transitory source of income by households (Zhu et al., 2014); 2) there is a lack of good investment opportunities in rural villages (De Brauw and Rozelle, 2008); 3) households are so poor that they mainly use remittances to meet basic and short-term consumption needs (De Brauw and Rozelle, 2008); and 4) the perceived skill premium or return to education is low (Démurger and Wang, 2016).

Yet, since most of the above papers have attempted to estimate the sole "remittance effect", it is still unclear whether we can draw a convincing conclusion regarding the relationship between migration and household expenditure. As noted in the introduction, migration can affect household expenditure in ways that remittances are not able to adequately capture (e.g., a transfer of consumption norms) and one needs to better understand the role of migration besides that of remittances. In the paper, I examine the impacts of both migration and remittances on the expenditure patterns of households left behind. By comparing the estimates on migration and remittance variables, I show that the effect of migration on household expenditures is underestimated, especially agricultural expenditure, by not accounting for the non-monetary effects related to the mobility. This is very important because it indicates that both pecuniary and non-pecuniary aspects of migration are key to understanding the household expenditure decisions of the left-behinds.

Moreover, few researchers have taken into account different sources of remittances (Castaldo and Reilly, 2007; Adams and Cuecuecha, 2010b, 2013; Clément, 2011; Randazzo and Piracha, 2014) and only one has considered different types of migration (Taylor

and Mora, 2006). Indeed, existing work has focused exclusively on the migration destination, i.e., whether the households have international or internal migrants, or whether they receive external or internal remittances. In the present paper, however, the primary interest lies in the migration duration, namely temporary migration and permanent migration, and thus the predictability of remittance flows. Because temporary and permanent migration serve different roles in shaping household expenditure behaviour, I believe that distinguishing between these two types of migration holds paramount importance.

3.3 DATA

3.3.1 DATA SOURCE AND SAMPLE

The data come from the China Health and Retirement Longitudinal Study (CHARLS), a collaborative research project developed by a group of researchers from the China Centre for Economic Research at Peking University, the University of Southern California, and the University of Oxford.[5] The survey design and data collection procedures are detailed in Zhao et al. (2013). The CHARLS aims to be nationally representative and covers 450 rural villages/urban communities in 150 counties randomly selected across 28 provinces of China.[6] Besides broad spatial coverage, the CHARLS asks respondents detailed questions about basic socio-demographics, household income, expenditure and assets, health status, employment, migration experiences, and remittances. In addition to the main survey, there is a supplementary village/community survey from which I can extract information on environmental characteristics. In each sampled household, one elderly person aged 45 and older, along with the spouse of any age, received a face-to-face, computer-aided personal interview (CAPI).

To date, there are three waves of national data available: the 2011-2012 baseline survey (wave I), the 2013-2014 follow-up survey (wave II), and the 2014 follow-up survey (wave

[5]The CHARLS is publicly available at the project website: http://charls.ccer.edu.cn/charls/.

[6]The sampling procedure was based on a stratified four-stage design: counties, village or urban neighbourhoods (primary sampling units), households, and respondents. The sampling frame covers 28 out of 31 provinces across mainland China. Tibet is beyond the interest of the CHARLS survey. Hainan and Ningxia are excluded due to very small populations.

III), which contains only life history data.[7] I focus on the second wave of the national survey for two reasons. First, there appear to be problems in the 2011 survey with the measurement of *current* migration.[8] Second, unlike Antman (2016), very few CHARLS households have experienced a change in the migration status of adult children over the short course of two years, which effectively precludes me from applying household fixed effects models to my study. There are 10,822 households and 18,605 individuals in the 2013 sample.

Since the primary interest of this research is to learn about the impact of migration and remittances on household expenditure behaviour, the unit of observation is at the level of the household.[9] I restrict the analysis to 1) rural households with adult children aged 18 years and above, as these children are economically active and are most likely to migrate for labour-related motives. I also exclude 2) households with international migrant children (only 136 cases), and 3) non-migrant households who report receiving remittances from children (1,521 cases).[10] The latter exclusion ensures that the comparison group for my empirical analysis is composed of only households that endure no physical absence of children and receive no monetary transfers from children. By subtracting this sub-sample, I am able to obtain better estimates of the migration effect on household spending. Figure 3.1 shows the different types of households according to children's migration and remittances status. After imposing all sample selection criteria, I am left with 3,742 observations of

[7] Before the national baseline survey, there were two pilot surveys conducted in two provinces: Gansu and Zhejiang.

[8] In the CHARLS, there are two questions that can be used to identify a child's migration status. The first question asks "How many months in the past year did the child live away from home", and the second asks "Where does the child normally live now". The latter question generally produces a more instructive measure since it captures *current* migrants rather than *return* migrants, some of whom may be mistakenly included in the analysis if the former question was used. Limiting attention to the current migrants here is important because the returnees are sharing the household budget at the time of the survey. Unfortunately, the preferred question on current migration status used in this paper is only available for *all* children in the 2013 survey. For this reason, I could not exploit the panel structure of the CHARLS dataset.

[9] Households are defined as "living together, sharing meals and at least some expenses" (Huang et al., 2013).

[10] As is often the case, migrant-sending households and remittance-receiving households are not identical because it may be that households have children in urban areas, but do not receive children's remittances; and it may also be that households receive remittances from children who are residing in rural areas. This is documented in Figure 3.1. I exclude the latter households, which account for 59 percent of the non-migrant households.

elderly households. I further restrict the sample to migrant households when analysing the impact of remittances, so as to separate the "remittance effect" from the "migration effect". The reason is that in the migrant sample the income effect of remittances is no longer biased by the non-monetary effect of migration, e.g., norms. This yields a sample of 2,224 observations.

The key independent variables of interest relate to children's migration and remittances, both distinguishing between temporary and permanent. With respect to migration, I utilise three questions in the family module of the CHARLS: 1) "Where does the child normally live now?"; 2) "What type of location does the child live?"; and 3) "Is the child's *hukou* location the same as his/her place of residence?" Based on the first two questions, I define migrant children as those who are living outside their own village and residing in urban areas at the time of the survey. The information from the third question enables me to describe the migration of children in a more detailed way. Namely, migrant children whose rural-urban mobility does not involve a change in *hukou* location are classified as *temporary migrants*. Alternatively, migrant children whose *hukou* has been formally transferred to the new location are classified as *permanent migrants*.[11] This definition yields 71.8 percent of the sample as households with migrant children. Of this group, 51.6 percent of households have temporary migrant children only, 31.1 percent of households have permanent migrant children only, and 17.2 percent of households have both temporary and permanent migrant children (see Panel A of Table 3.1). These figures confirm the floating patterns of internal migration in China.

With respect to remittances, I consider all private economic transfers (in the form of cash and in-kind) from children in the year prior to the administration of the survey.[12] Since data on remittances contains no information on the characteristics of the children who remit, it is hard to identify with certainty the households that receive temporary and/or permanent monetary transfers from children. Fortunately, the availability of de-

[11] These migrants are required to change their *hukou* records at the local public security office at both their previous and new residence location.

[12] This broad definition of remittances is similar to that used by Clément (2011), in which remittances are defined as "money and goods sent from one place or person to another".

tailed information on migration makes it possible to combine responses to migration and remittance questions to examine the impact of temporary and permanent remittances on household expenditure. To draw a distinction between children's *permanent transfers* and *temporary transfers*, I drop the 463 households with both temporary and permanent migrant children.[13] After dropping this overlapping group, households who report having temporary (permanent) migrant children *only* and report receiving remittances from children are assumed to be *temporary (permanent)-remittance-receiving households*. Households who report having migrant children but do not report receiving remittance from children are defined as *non-remittance-receiving households*. Of the remaining 2,224 migrant households, 24.9 percent receive no private transfers from children, 44.7 percent receive temporary private transfers from children, and 30.4 percent receive permanent private transfers from children (see Panel B of Table 3.1). This classification represents an important departure from previous literature concerning the relationship between remittance receipt and household expenditure, because the focus here is on the *predictability* rather than the *origin* of remittance income inflows.

The outcome variables of interest are the budget shares allocated to different types of household expenditure. In the CHARLS, detailed expenditure data are collected on a large array of commodities with different periodicity, i.e., weekly, monthly, and yearly. Monthly and weekly expenditures are aggregated to obtain annual values. I examine two broad consumption categories and two broad investment categories, each of which is further classified into specific expenditure items. The expenditure categories (and specific expenditure items) are: 1) food consumption (pure food, tobacco and alcohol); 2) non-food consumption (clothing, utilities and household services, other products); 3) consumptive investment (durables, housing); and 4) productive investment (health,[14] agriculture, land). Since ageing households are sampled here, education expenditure is omitted from this

[13] This data limitation warrants caution in the interpretation of the results. Since my analytical sample for remittances effectively excludes all households who have both temporary and permanent migrant children, which account for about 17 percent of the migrant households, my findings regarding the effect of remittances may not be generalised to the entire migrant households in rural areas.

[14] I treat health as a productive item because numerous studies have found that health expenditure can increase the productivity of labour.

study. Table 3.2 presents a description of the expenditure variables used in my analysis. It is worth explaining that the categorisation of the investment goods is inspired by the definition put forward by De Brauw and Rozelle (2008): consumptive investments "directly improve the quality of life for members of the household" and productive investments "improve the productive capacity of the household".

3.3.2 DESCRIPTIVE STATISTICS

Table 3.3 presents descriptive statistics on the average budget shares of the four aggregate expenditure categories and the ten individual expenditure outcomes for three groups of households, i.e., those without migrant children, those with temporary migrant children and those with permanent migrant children. The table also reports a t-test performed to check whether there are differences in means of the expenditure shares between temporary or permanent migrant households and non-migrant households.[15] Ageing households in rural villages spend a disproportionately large share of total expenditure on consumption (about 71 percent), especially on food (about 45 percent). Investment expenditures (about 29 percent) are yet limited and are mainly devoted to health (about 12 percent). Compared with non-migrant households, households with migrant children allocate a larger share of their spending to pure food, other products, and health; a smaller share to tobacco and alcohol, clothing, and agriculture; and a similar share to housing. Temporary migrant households appear to have a significantly smaller share on utilities and household services, whereby permanent migrant households have lower shares on durables and land.

A raw comparison of the unconditional means reveals mixed evidence concerning the effect of migration on expenditure patterns of the left-behind households: having migrants in the city seems to increase food consumption but decrease non-food consumption (except for other products) and investment (except for health). Of course, it is not clear whether these differences in expenditure shares are driven by demographic differences across households with and without migrant children. Indeed, we can see from Table 3.4 that migrant

[15] Table 3.3 in the Appendix reports similar summary statistics by separating the sample into households receiving no remittances, households receiving temporary remittances and households receiving permanent remittances.

and non-migrant households differ significantly along a number of important dimensions,[16] and thus it is important to control for these variables in the regression analysis below. More specifically, households with migrant children are smaller in size, have fewer adults, and have more elderly dependants. They are also more likely to have poorly educated members and have older children. At the same time, members in temporary migrant households are even less educated compared to those in permanent migrant households, supporting the fact that better-educated individuals are more able to move with *hukou* (assuming that the educational attainment is positively correlated within a household). It should not be surprising that migrant households are concentrated on interior and western provinces, which are the main migrant sending regions in China. More temporary migrant children are found in August and September while less are reported in July and November. Unsurprisingly, such seasonal pattern of the migration flows is less evident for permanent migrants who generally have more stable settlement in urban areas.

Most notably, the instrumental variables demonstrate strong differences by migration status of the children, showing that households who have children in the city tend to reside in villages where migration networks are larger and are more likely to have children who finished middle school upon the *hukou* reform in 1997. The t-statistics imply that the differences between the migrant and non-migrant groups are statistically significant at the 1 percent level.

3.4 Identification Strategy

I first investigate the impact of temporary migration and permanent migration on household expenditure outcomes. Thus, the following expenditure share equation is estimated:

$$ExpShare_{si} = \beta_0 + \beta_t TemMig_i + \beta_p PerMig_i + X_i\beta_1 + \varepsilon_i \tag{3.4.1}$$

[16] Corresponding statistics after cutting the sample by children's remittance status are presented in Table C.2 in the Appendix.

where the dependent variable $ExpShare_{si}$ represents the share of expenditure on one of the goods s in total household expenditure. In other words, it refers to the budget share allocated to commodity s. As outlined before, I explore both aggregate expenditure measures (food consumption, non-food consumption, productive investment, and consumptive investment) and specific expenditure measures (food, tobacco and alcohol, clothing, utilities and services, other products, health, agriculture, land, durables, and housing). $TemMig_i$ and $PerMig_i$ are dummy variables indicating respectively whether the household has an adult child who migrates temporarily or permanently to urban areas at the time of the survey. Hence, there are four groups of households: 1) households without migrant children; 2) households with temporary migrant children only; 3) households with permanent migrant children only; and 4) households with both temporary and permanent migrant children. Effectively, the first group (i.e., $TemMig_i = 0, PerMig_i = 0$) serves as the reference group in the analysis. X_i denotes a vector of household, regional, and time attributes that may affect the expenditure decision of the households left behind. This includes the following characteristics: size of household, dummies for age composition of the household (i.e., presence of household members aged 0-5 years, 6-15 years, 16-65 years, and 66 years or above), dummies for educational attainment of the household (i.e., presence of household members with no education, primary education, secondary education, and high school education or above), average age of children, a dummy indicating whether the household owns agricultural land, regional dummies controlling for macroeconomic conditions that differ by province, and time dummies indicating the month of the survey interview.

Next, I examine the relationship between household expenditure outcomes and the receipt of remittances from temporary and permanent migrants. As mentioned earlier, I am not only interested in studying the role of migration in expenditure behaviour but my further interest is in understanding whether the migration status of children affects household expenditure over and above its effect on the remittances. The remittance equation that uses only the migrant sample is specified as below:

$$ExpShare_{si} = \alpha_0 + \alpha_t TemRemit_i + \alpha_p PerRemit_i + X_i\alpha_1 + \epsilon_i \qquad (3.4.2)$$

where the children migration variables are replaced with the new treatment variables—dichotomous indicators for whether the household receives remittances from temporary migrant children ($TemRemit_i$) and whether the household receives remittances from permanent migrant children ($PerRemit_i$). I control for the same set of covariates as Equation 3.4.1. It is important to note that the question I ask here is how remittances affect the household expenditure shares at the extensive margin, where households receive remittances from children or not.[17]

The coefficients of central interest are β_t and β_p in the migration specification 3.4.1, which indicates how children's temporary and permanent migrations affect the expenditure decisions of the rural households left behind. Two further interesting coefficients are α_t and α_p in the remittance specification 3.4.2, indicating how the household expenditure patterns are affected by receiving different types of remittances from children. As discussed in the introduction, estimating the above equations by Ordinary Least Squares will yield inconsistent and biased estimates since both migration and remittances are endogenous. The potential sources of endogeneity could be in the form of: 1) simultaneity bias such as the case in which a household decides to send a child to the city and, at the same time, decides to start a small business; 2) selection bias such as the case in which migration and investment are risky activities and a household with a high risk tolerance is more likely to produce migrants and is also better able to obtain investment opportunities; 3) omitted variable bias arising from third variables that are correlated with both the migration or remittances choices of the children and the expenditure patterns of the households (e.g., a village weather shock); or 4) reverse causality in which case children make migration or remittance decisions according to the expenditure conditions of the households.

To address these concerns, I implement an instrumental variable (IV) procedure, relying

[17]Identifying the effects on household expenditure of receiving temporary/permanent remittances (the extensive margin), as opposed to the effects on household expenditure of having additional temporary/permanent remittances (the intensive margin), has proved very different. The reason is that due to data limitation I define households having *only* temporary (permanent) migrant children and receiving remittances from children as temporary (permanent)-remittance-receiving households, which is clearly an underestimate of actual cases. Capturing "the amount of permanent remittances" and "the amount of temporary remittances" turns out to be even more difficult. So I leave this question open to future researchers.

on both macro- and micro-level variations in environment and demographic characteristics that affect children's propensity to migrate and to remit but do not have a direct effect on household expenditure behaviour. Specifically, I propose two IVs for children's migration and remittances: 1) the village-level migration flows in the recent past, and 2) the presence of children in the household who were aged 15-18 when the *hukou* reform took place in 1997. The use of the first instrument follows the spirit of a number of studies that use historic state-level migration rates to instrument for current migration (Hanson and Woodruff, 2003; McKenzie and Hildebrandt, 2006; Woodruff and Zenteno, 2007; McKenzie and Rapoport, 2007). Indeed, a large body of literature has emphasised the influential role of social networks in the migration decision and the receipt of remittances (Munshi, 2003; McKenzie and Rapoport, 2007, 2010; Dolfin and Genicot, 2010; Giulietti, Wahba, and Zenou, 2014). The basic idea is that established migrants can provide job information and job referrals, help to finance the trip, and aid assimilation after arrival, thus alleviating the cost of migration for future migrants. It is important to be precise about the village-level instrument considered here. In particular, I use the percentage of same-village individuals who worked for more than three months at *other* provinces in 2010 (three lags behind the 2013 survey). So the variation I exploit lies in exogenous differences in the established inter-provincial migration networks. To the extent that long-distance migration generally involves more unfamiliarity and uncertainty, the role of migration networks becomes more crucial. Interestingly, in the case of China, Giulietti, Wahba, and Zenou (2014) discover that the impact of social networks (*guanxi*) on migration decisions depends on the strength of the ties, with help from migrant co-villagers in the city (weak ties) being solely job-related.[18] Given their findings, plus the fact that permanent migration is more associated with favourable consideration of privileged groups (e.g., professionals, investors) which does not necessarily have to depend on migration networks, I speculate that my instrument relying on differences in village migration rates will be more relevant to predict *temporary* migration rather than *permanent* migration. I will show later that this is indeed the case.

[18] They argue that strong ties (i.e., the closest contacts of the household) usually provide job information and different types of help to migrate or upon migration, while weak ties (i.e., the fraction of out-migrants from the village) usually provide information about jobs at the destination.

The second instrument takes advantage of a policy change and the age composition of children in the household that, working together, generate exogenous variation in migration and household remittance receipt. To be more precise, I adopt the presence of children aged 15 to 18 years old in the year of the 1997 *hukou* reform, arguing that this is the time window within which a child completes compulsory education and the unexpected removal of *hukou* restrictions acts as a pull factor attracting more potential migrant children to the city. In China, middle school completion is mandated by law. Yet, high school education is neither compulsory nor greatly subsidised in rural areas (De Brauw and Giles, 2016). Thus, the ages of 15-18 years[19] are a vital stage of a Chinese person's life cycle because this is the time when they, as a middle school graduates, face two important life decisions: pursue higher education or enter the labour market. If immediate job market opportunities are brighter, then they may opt for the latter. Given that the 1997 *hukou* reform (see more details of this reform in Section 3.2) greatly reduced barriers to migration, resulting in strong incentives to migrate for work, it is highly likely that the potential migrant individual would utilise this opportunity to find a job in the city.[20] This hypothesis is confirmed in Figure 3.2, in which I show the correlation between children's birth cohorts in 1997 and the predicted probability of permanent migration based on the estimations in Table 3.5.[21,22] One can observe that the point predicted probability for children aged 15-18 in 1997, and hence who were middle school graduates at that time, is evidently larger than that for other age groups, meaning that they are most likely to migrate permanently. To further bolster the case that the greatest impact for this birth cohort is due to the reform rather than simply the age profile of permanent migrants, I also check the predicted probabilities of permanent migration for children reaching 15-18 years old in each particular year

[19] I show below that the results are insensitive to different cut-off ages.

[20] In fact, it has been found in China that removing the mobility restriction affects post-compulsory schooling decisions of middle school graduates, sharply decreasing their high school enrollment (Pan, 2012; De Brauw and Giles, 2016).

[21] The predicted probabilities are calculated using linear probability model.

[22] I examine permanent migration here because it seems reasonable to assume that the *hukou* relaxation would effectively encourage permanent migration through easing the transfer of *hukou* status from rural to urban. Nevertheless, the pattern of results remains similar when looking at temporary migration. This is also confirmed by the first stage estimates (Table 3.5), where we can see that the estimated coefficient on the permanent migration variable is larger than that on the temporary migration variable.

from 1970-2013. Figure 3.3 shows the corresponding point estimates and 95% confidence intervals. Reassuringly, for individuals in the same 15-18 birth cohort the year of the *hukou* policy, 1997, "predicts" the strongest migration likelihood relative to the remaining years, increasing my confidence in the relevance of this instrument. Moreover, there appears to be some degree of variation in the predicted probabilities of migrating permanently over time (after controlling for covariates), which is perhaps driven by macroeconomic environment, especially the evolution of policies set by the Chinese government.

Crucially, the *hukou* reform in 1997 is not expected to exert any influence on current household expenditure, given the period of over 16 years. It is also worth noting that, unlike community-level IVs that are subject to potential concerns about exclusion restriction violation (as everyone at the origin will be affected), the instrument that combines *hukou* policy change and children's demographic characteristics by construction varies across both villages and households.

Exploiting the variation in both village migration networks and children's age composition across households, I estimate the following two first-stage regressions for the migration equation:

$$TemMig_i = \theta_0 + \theta_1 M_i + \theta_2 H_i + X_i\theta_3 + \mu_{1i} \tag{3·4·3}$$

$$PerMig_i = \delta_0 + \delta_1 M_i + \delta_2 H_i + X_i\delta_3 + \mu_{2i} \tag{3·4·4}$$

and the first stages for the remittance equation are given by:

$$TemRemit_i = \gamma_0 + \gamma_1 M_i + \gamma_2 H_i + X_i\gamma_3 + \upsilon_{1i} \tag{3·4·5}$$

$$PerRemit_i = \lambda_0 + \lambda_1 M_i + \lambda_2 H_i + X_i\lambda_3 + \upsilon_{2i} \tag{3·4·6}$$

In these equations, the instrumental variables are M_i, which indicates the lagged village

long-distance migration rate, and H_i, which indicates the presence of any child in the household who was at the age of 15-18 over the same period of the *hukou* policy reform. In the full sample, the average value of M_i is 0.136 and the average of H_i is 0.308, while the average values of M_i and H_i in the migrant sample are 0.152 and 0.328, respectively. I check that the instruments are sufficiently correlated with the migration of children and the receipt of children's remittances, with the first-stage results in Section 3.5. It is important to note that, in my regression model, I have controlled for the average age of the children of the household. The identification hinges on the assumption that, after controlling for all observable attributes, the size of village migration networks and the *hukou* policy change during the time of children's middle school graduation will influence the migration and remittance decisions of children but will not affect directly the expenditure patterns of households. As will be discussed later, there are some potential threats to the exclusion restriction, and I perform a number of robustness checks accordingly.

3.5 Results

3.5.1 First Stage Results

To demonstrate the strength of the instrumental variables proposed, I start with a description of the first stage results. Table 3.5 reports the results from the first stage regression for having temporary migrant children (Equation 3.4.3) and for having permanent migrant children (Equation 3.4.4). The two excluded instruments are the village inter-provincial migration rate (lagged three years behind the survey) and the *hukou* reform occurring when any child in the household was 15-18 years old.

The lagged village migration network has a positive and highly significant effect on the likelihood that a household has a temporary migrant child. A child's permanent migration, however, is not affected by the migration of co-villagers, reflecting that weak ties are more effective in providing job-related information in the city rather than spreading information about how to secure a city *hukou* (perhaps because most of the migrant co-villagers are temporary migrants themselves). We can see that the presence of children who experienced

the *hukou* reform at 15-18 years is a strong and highly significant predictor of a household's opportunity to have a migrant child, with the effects being greater for permanent migration. This pattern is not only expected but also policy relevant, implying that removing *hukou* restrictions can effectively facilitate the permanent settlement of the potential migrants. Reassuringly, in all statistically significant cases, my instruments are highly significant at the 1 percent level. The strength of the instruments is supported by the Kleibergen-Paap *rk* Wald F statistics and the standard first-stage F statistics. It can be observed that the Kleibergen-Paap *rk* Wald F statistics are comfortably above 7.03, a conservative critical value (corresponding to 10% maximal IV size) suggested by Stock and Yogo (2005). The standard F statistics cast additional light on the strength of the instruments, indicating that the coefficients on the temporary and permanent migration variables are also separately identified, according to the "larger than 10" rule of thumb (Staiger and Stock, 1997; Stock and Yogo, 2005). Therefore, I conclude that the instrumental variables are relevant and are strong predictors of the endogenous migration variables.

3.5.2 MAIN RESULTS AND SENSITIVITY ANALYSIS

Table 3.6 presents the estimation results obtained with OLS and IV. For the sake of brevity, the table reports only the parameter estimates of the temporary and permanent migration variables. Starting with preliminary OLS regressions, we see that both temporary migration (columns (1)) and permanent migration (columns (2)) are significantly associated with a higher share of total expenditure devoted to pure food, and a lower share devoted to tobacco and alcohol. Additionally, having temporary migrant children in the city leads to a decrease in the budget share for clothing but an increase in the budget share for other products. By contrast, the estimated coefficients are not statistically significant at conventional levels in any of the budget shares pertaining to investment activities, with the only exception being the estimate for the temporary migration effect on the agriculture budget share which is negative and statistically significant at the 5 percent level. Overall, the OLS estimates suggest a link between the migration of the children and the expenditure behaviour of the rural households left behind, although I do not intend to attribute any

causality here.

Looking next at the preferred IV estimates, shown in columns (3)-(4) of the table, a different picture emerges. Focusing first on the consumption expenditures in Panel A of Table 3.6, the IV estimates of the impact of having temporary migrant children (column (3)) remain virtually similar to those obtained with the OLS (column (1)), but they are much greater in magnitude. The point estimate indicates that having one or more children who temporarily move to urban areas results in a statistically significant 29.4 percentage point increase in the budget share allocated to food (significant at the 1 percent level). Of these, a 21.4 percentage point increase is associated with pure food and an 8 percentage point increase is associated with tobacco and alcohol drinking. The proportion of expenditure on other products (0.038) is also positively affected by children's temporary move to the city, despite being statistically weaker (significant at the 10 percent level). Conversely, having temporary migrant children impacts negatively the budget share for clothing. The relevant point estimate of –0.026 is statistically significant at the 5 percent level of confidence. However, when it comes to permanent move with *hukou* transfer, I find that in none of the IV regressions performed does the migration of children appear to influence household budget shares devoted to consumption-type goods. The coefficients on the permanent migration variable are small, and never statistically significantly different from zero. Strikingly, simply looking at the consumption patterns of the remaining households, my findings so far have revealed different impacts as a consequence of different forms of migration.

Panel B displays the IV results from using the expenditure share on each of the investment commodities as the dependent variable. For consumptive investment category, we see that having at least one child permanently settled in the city corresponds to a reduction in the budget share allocated to consumptive investment by statistically significant 10.3 percentage points, while having at least one child temporarily migrate to the city is associated with no statistically significant difference in consumptive investment (point estimate 0.021). Within productive investment category, there is a strong negative correlation between children's temporary absence and household productive investment. In particular,

the budget share devoted to agriculture (–0.107) and land (–0.019) is found to be reduced, with both estimated effects being statistically significant at the 1 percent level. Unlike the situation for temporary migration, there is a sizable increase in the fraction of total expenditure devoted to productive investment in response to the permanent migration of children. The estimated impact of having one or more children permanently in the city on the expenditure share on one important human capital—health—is strictly positive (point estimate 0.111) and statistically significant at the 5 percent level. Similarly, a positive and highly significant migration effect (8 percent increase, at the 5 percent significance level) is found on the budget share allocated to agricultural production for households with *hukou* migrant children.

It is important to note that the point estimates from the IV regressions are considerably and consistently higher than the corresponding OLS estimates. One possibility is that, due to the use of one of the instruments, my estimates partly measure the Local Average Treatment Effect (LATE) for the subgroup of households who would not have children in the city without the 1997 *hukou* reform but have at least one child migrate to the city when the new policy is implemented.

In order to explore the heterogeneous impact of migration, I split the data along two important dimensions: the economic status of the household (pre-transfer income below and above the median) and the socio-economic status of the village in which the household lives (less developed and more developed). The results are interesting and somewhat puzzling (see Table 3.7). Two findings are worth discussing. First, the positive impact of temporary migration on the budget share for food consumption appears to be larger for relatively poor households, suggesting that in the short run poor households may use migration as a means to relax the household budget and to meet basic consumption needs. Second, the fact that the increase in the fraction of expenditure on productive investment associated with permanent migration is larger for households in less developed regions implies the possibility that in poor areas with fewer formal financial institutions, migrant remittances, especially more "predictable" income transfers from permanent migrants, are a valuable source of credit.

Altogether, two points are suggested by the evidence presented above: 1) temporary migration of children may act as a short-term poverty reduction strategy that helps rural households to achieve a basic level of consumption, but results in less productive investment (in supportive of the pessimistic view described in Section 3.2); and 2) permanent migration of children does not seem to have a significant effect on the consumption decisions of rural households, but has great potential to enhance their productive capacity (in supportive of the optimistic view described in Section 3.2). I believe that these findings would be of immediate interest to researchers and policymakers as they put forward the importance of taking into account the type of migration in the analysis of household expenditure patterns and in the design of optimal policies to leverage the most out of internal migration flows in the developing world.

In the following, I carry out a number of checks to test the robustness of my estimates. First, one potential threat to the validity of any community-level instrument lies in the apparent fact that it affects every household and every individual at the origin, and is thus difficult to be distinguished from other unobserved village attributes that may be correlated with household expenditures, thereby invalidating the exogeneity assumption. For instance, the development level in a village influences both village migration networks and household expenditure outcome: if well-developed villages had particularly low rates of out-migration and if, at the same time, well-developed villages offered good investment opportunities, my IV estimates would be biased. I address this problem by, first, clustering the standard errors at the village level to allow for any arbitrary correlation in the error term of households within a given village and, second, controlling for a long list of village-level variables that are measured at the same time as the village IV. These results are reported in Table 3.8. Columns (1)-(2) show the benchmark IV results. In columns (3)-(4) I introduce an array of basic controls at the village level: the proportion of villagers holding non-agricultural *hukou*, whether the village has access to tap water, whether the village has drivable road, the distance to the nearest train station (km), whether the village is located in plain areas, the size of arable land (Mu), whether agricultural machines are used in agricultural production, and the years since national ID cards were issue (and its

quadratic form). In columns (5)-(6) I further incorporate a number of important controls: the per capita village income, whether the village has a national poverty status,[23] the average unit price for pork, eggs, rice, and flour in the village, the average price for a new house in the village, the number of enterprises, the proportion of households engaged in non-agricultural work, and whether households in the village have difficulty in getting loans from financial institutions. It is reassuring that, even after adding these powerful controls, the point estimates hardly change and lagged village migration rates remain a strong and highly significant predictor of children's current migration.

Second, a common worry regarding IV estimation that exploits a particular policy reform relates to the possibility that other simultaneous policy changes may contaminate the results. In the context of my instruments, one might be concerned that there were other national reforms in China that particularly affected the 15-18 children cohort in 1997, such as the college expansion and the tuition reform in the late 1990s, which in turn may influence the expenditure outcome as well. To take care of this problem, I re-estimate the first stage regressions on two sub-samples of rural households in which: 1) both parents hold rural *hukou*, and 2) one of the parents holds urban *hukou*. The latter category serves as a placebo group in the falsification exercise. The idea is that, due to the *hukou* inheritance law, children in such households should not be heavily affected by the *hukou* reform since they have had or will have urban *hukou*. If there were some other law changes, which were implemented at the same time and only affected the cohort of children aged 15-18 years, I would still expect to observe some effects on their post-middle school decisions in the placebo test. The corresponding results (see Table 3.9) illustrate that the 1997 *hukou* policy change produced a very precise effect on the probability that the major beneficiaries of this reform—children who finished middle school and had rural *hukou*—would migrate (Panel A), but had no impact on those children already holding city *hukou* (Panel B). This clearly indicates that the *hukou* IV is not correlated with other policy changes. Note that the village IV remains a powerful determinant of migration in

[23] To determine the poverty status of a village, I referred to China's official poverty line, which is 2,433 RMB per year in 2011.

the sample for facilitation test, where I have only 276 observations. Therefore, it confirms that the previous conclusion is not an artifact of the much smaller sample cells.

Finally, one might argue that the assumed 15-18 age window is somewhat arbitrary. As a matter of fact, in China, the normal school starting age is 6 or 7 years. The majority of Chinese students finish middle school aged between 15 and 17, or order than 17 if they had to repeat grades. To circumvent this issue, I re-estimate the first stage models adopting a new *hukou* instrument based on alternative age cut-off of 15-16 years and 16-17 years. The resulting estimates are presented in Table 3.10.[24] Again, the coefficients are remarkably similar to what I obtained using the original instrument (Panel A). This gives me greater confidence in the robustness of my findings.

3.5.3 Remittances and Household Expenditure

In order to gain further insights on the pecuniary and non-pecuniary effects associated with children's migration, I estimate the remittance specification 3.4.2 using only households that experience the migration of children—hence migrant households. By comparing the effects between remittance-receiving migrant households and non-remittance-receiving migrant households, I am able to provide some suggestive evidence on the relative importance of this monetary channel. The estimated results are reported in Table 3.11.[25]

A visual inspection of the regression results suggests that the significance level of the estimates are generally weaker compared to that in the migration specification (see Table 3.6). This is a clear indication that the effects on household expenditures I find can not be fully explained by more private transfers from migrant children to the left-behind households. Two notably exceptions are the budget share on food associated with temporary migration (0.293) and the budget share on health associated with permanent migration (0.161). A comparison of the magnitude of these point estimates in columns (3)-(4) of Ta-

[24] The corresponding second-stage estimates will be available upon request. The point estimates of interest are insensitive to these changes.

[25] Table C.3 in the Appendix reports the first stage results from estimating Equation 3.4.5 and 3.4.6, where the dependent variables are indicators for whether the household receives temporary and permanent remittances from children. The two excluded instruments have the expected signs and are highly significant at the 1 percent level. Moreover, the weak identification test is comfortably passed.

ble 3.6 and those in columns (3)-(4) of Table 3.6 seem to indicate that the observed positive effect of children's temporary migration on household food consumption and the positive effect of children's permanent migration on health expenditure share mostly come from the income effect of migrant remittances. However, the estimated effect of permanent migration on the agriculture share (0.075), which were highly significant in the migration case (0.08), loses statistical significance here. Then the remaining possibility may include more subtle non-monetary channels, such as a transfer of more advance production knowledge and technologies, which are rather difficult to test in survey data. Nevertheless, we can derive preliminary conclusions about the differential impact of remittance and migration—migration can influence household expenditure in some dimensions that remittances are not able to fully capture.

3.6 CONCLUSION

Migration, whether temporary or permanent, is a common subsistence strategy in developing countries. According to the literature, migration and remittances could have important consequences for the budget allocation and production decisions of the households left behind, as well as for the economic development in the source communities. What is less clear from the existing work, however, is whether different migration strategies affect the impact of migration and remittances on these outcomes differently. This paper provides, to the best of my knowledge, a first attempt at answering this important question.

My main findings based on the CHARLS data indicate that households could benefit from their children's ability to engage in permanent migration, which allows the left-behind household members to invest more in health and agriculture. In particular, having permanent migrant children in the city increases the budget share on health by 11.1 percentage points and the budget share on agriculture by 8 percentage points, improving the productive capacity of the rural households. Temporary migration of children, however, is excluded from this development process, since its positive impact is predominantly for food consumption. In line with the pessimistic view by De Brauw and Rozelle (2008) and

Démurger and Wang (2016), I find that children's temporary migration results in a 10.7 percent decline in the agriculture share and a 1.9 decline in the land share.

Overall, the empirical evidence in this paper highlights the importance of disentangling the role of different forms of migration in shaping household expenditure patterns and promoting local economies. Temporary migration and remittances are interpreted in terms of short-term poverty alleviation strategies that supplement household income and satisfy basic consumption needs, whereby permanent migration and remittances act more as long-term development strategies that boost capital accumulation and enhance households' earning potential.

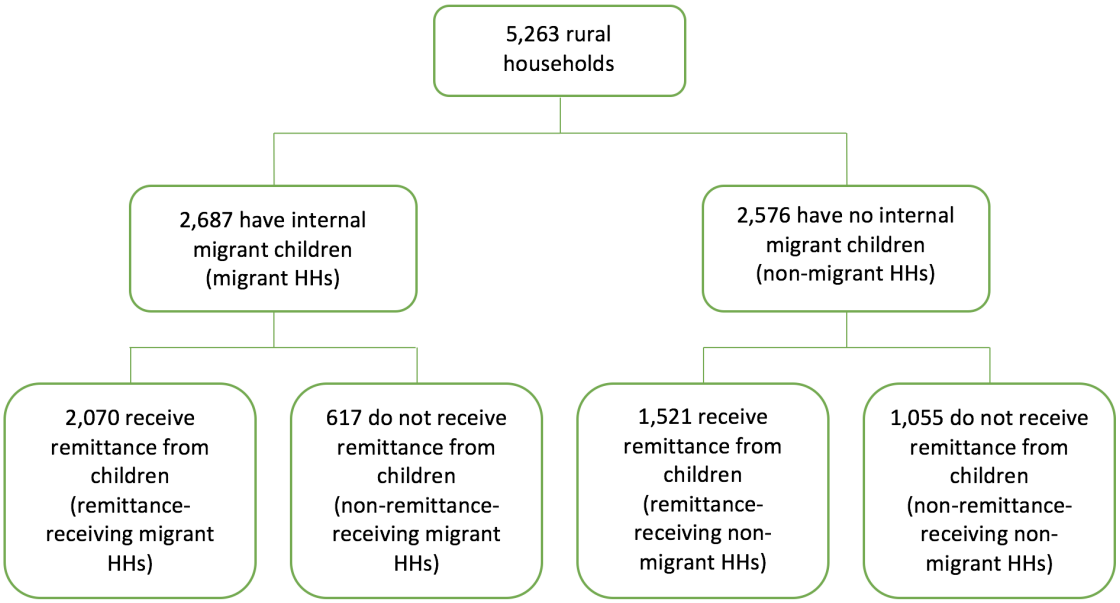
While it is beyond the scope of this paper to analyse in depth the channels through which different types of migration affect the household expenditure decisions differently, one potential explanation may be grandchildren's education. Since kids in temporary migrant households are more likely to be left behind by their parents and cared by their grandparents, as opposed to kids whose parents have managed to obtain a city *hukou* and can bring them to cities for a better life, it is possible that left-behind households with temporary migrants have a more constrained budget due to grandkids' educational needs whilst those with permanent migrants can spend (such a non-negligible amount of) money elsewhere instead, resulting in different expenditure patterns between these households. I test this hypothesis by re-estimating Equation 3.4.1 replacing the outcome variable with the expenditure share on education. The results reported in Table 3.12 confirm that permanent migration of children causes a decrease in the household budget share allocated to education, significant at the 1 percent level. Temporary migration of children is positively associated with household investment in education (despite being statistically insignificant). Clearly, more research should be done to better understand the mechanisms that underline the main findings.

A straightforward implication for policymakers is that policies directed to further weaken the *hukou* restriction can encourage migrants to settle permanently (according to the first stage results), which in turn will be a vital driver for household investment and local development in rural areas (according to the second stage results). Conversely,

a tightening of the *hukou* policy may deter potential permanent migrants, who can likely end up being temporary migrants or even stayers, possibly leading to more household consumption, and food consumption in particular.

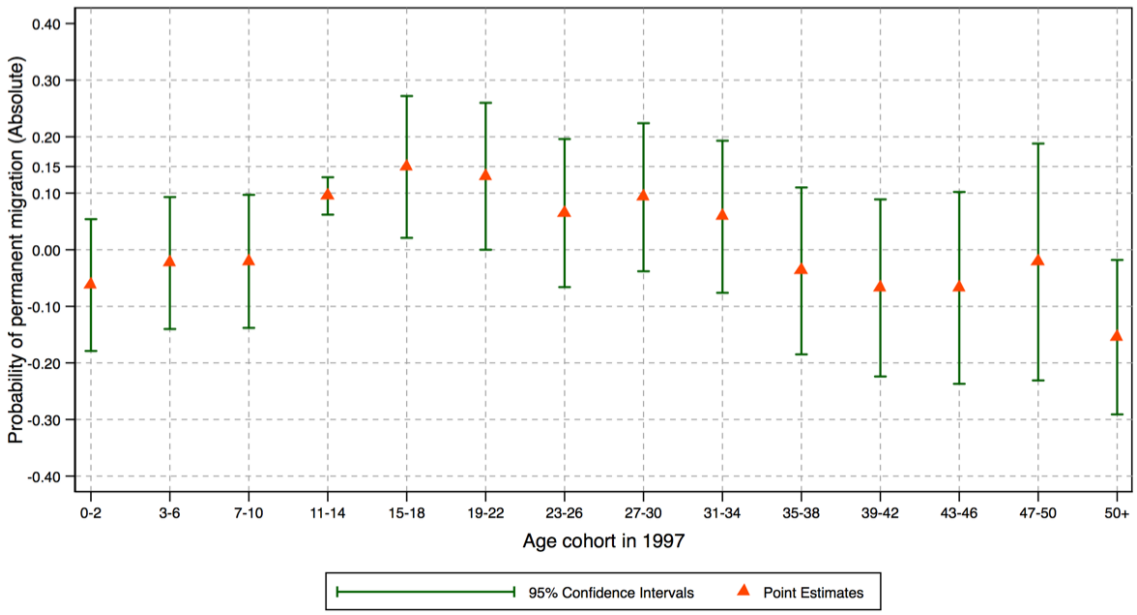
Figures and Tables

Figure 3.1: Migration and Remittances (CHARLS 2013).



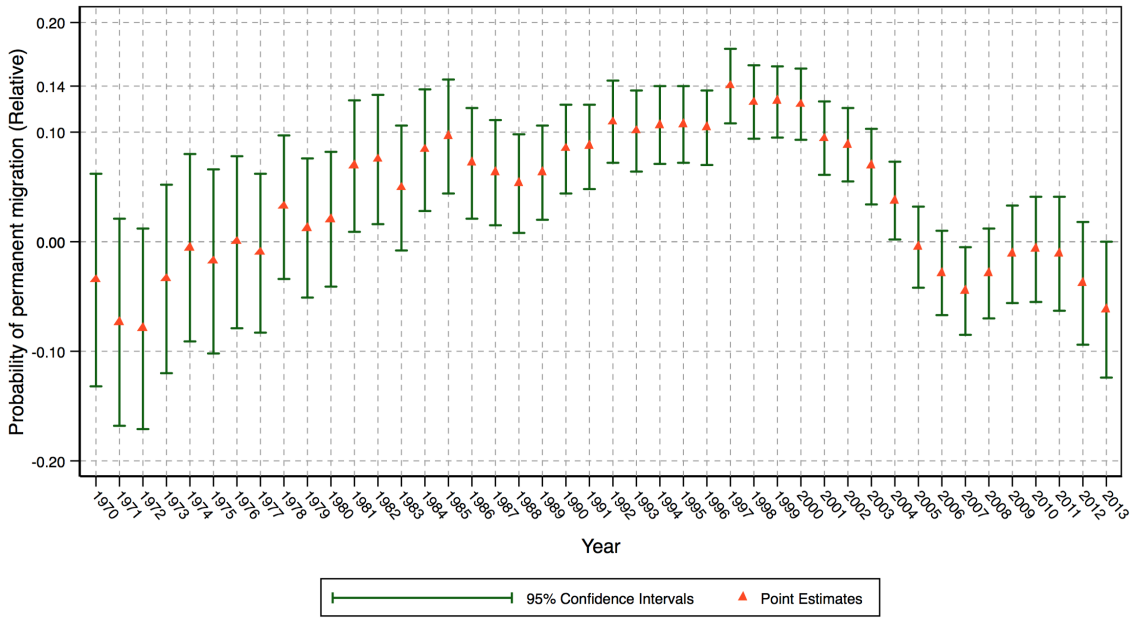
Source.—Author's own calculations from the CHARLS national survey 2013 (wave II).

Figure 3.2: Predicted Probabilities of Permanent Migration By Children Birth Cohort in 1997 (CHARLS 2013).



Source.—Author's own calculations from the CHARLS national survey 2013 (wave II). Each error-bar indicates the point estimate (*red dot*) and the 95% confidence interval (*green bar*) of the probabilities. According to the *hukou* reform in 1997, children who were between ages 15 and 18 in 1997 (i.e., those born between 1979 and 1982) are the most likely beneficiaries of the reform, because they had the chance to adjust their decisions for study and work according to the new policy.

Figure 3.3: Predicted Probabilities of Permanent Migration For Children Aged 15-18 By Year (CHARLS 2013).



Source.—Author's own calculations from the CHARLS national survey 2013 (wave II). Each error-bar indicates the point estimate (*red dot*) and the 95% confidence interval (*green bar*) of the probabilities, calculated for children who were aged 15-18 years old in that particular year.

Table 3.1: Analytical Sample (CHARLS 2013).

	Has No Migrant	**Has Temporary Migrant**	**Has Permanent Migrant**	**Has Temporary & Permanent Migrant**
A: Migration				
Remittance-receiving household (0/1)	0.000	0.717	0.806	0.864
Average amount of remittances (RMB)	0.000	3689.428	3554.839	5147.851
Observations= $3,742$	1,055	1,387	837	463
	Receive No Remittances	**Receive Temporary Remittances**	**Receive Permanent Remittances**	
B: Remittances				
Average amount of remittances (RMB)	0.000	5142.951	4408.000	
Observations= $2,224$	554	995	675	

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).

Table 3.2: Definition of Expenditure Outcomes (CHARLS 2013).

Variable	**Definition**
A: Consumption	
Food consumption	
Pure food	Purchased food (products purchased from supermarkets) Non-purchased food (own-produced agricultural products) Meals eaten outside home
Tobacco and alcohol	Cigarettes, cigars, alcohol
Non-food consumption	
Clothing	Clothing, bedding
Utilities and household services	Water, electricity, fuels, internet, housekeepers
Other products	Household items and personal toiletries (e.g., toothpaste), personal care (e.g., beauty goods), transport, entertainment (e.g., books, VCDs/DVDs, cinema)
B: Investment	
Consumptive investment	
Durables	Furniture, household appliances, transportation vehicles, electronics (e.g., computer, mobile phone)
Housing	Rent, mortgage loan, decoration, renovation
Productive investment	
Health	Medicine, doctor fees, hospitalisation, fitness
Agriculture	Farming equipment purchase or repair, cost of production (e.g., seeds, fertiliser, pesticide, labour)
Land	Rent

Table 3.3: Descriptive Statistics: Mean Comparisons of Average Budget Shares by Children's Migration Status (CHARLS 2013).

	Has No Migrant	**Has Temporary Migrant**	**Has Permanent Migrant**	***t*-test (2)-(1)**	***t*-test (3)-(1)**
	(1)	(2)	(3)	(4)	(5)
A: Consumption					
Food consumption	0.423	0.471	0.458	0.048***	0.035***
Pure food	0.347	0.407	0.397	0.061***	0.050***
Tobacco and alcohol	0.076	0.064	0.061	–0.012***	–0.015***
Non-food consumption	0.199	0.186	0.192	–0.013**	–0.008
Clothing	0.036	0.028	0.028	–0.008***	–0.008***
Utilities and household services	0.122	0.109	0.117	–0.013**	–0.005
Other products	0.041	0.049	0.047	0.008***	0.006*
B: Investment					
Consumptive investment	0.115	0.106	0.096	–0.008	–0.019**
Durables	0.057	0.051	0.042	–0.006	–0.015***
Housing	0.058	0.055	0.054	–0.002	–0.004
Productive investment	0.162	0.175	0.179	0.013	0.017*
Health	0.101	0.131	0.135	0.030***	0.034***
Agriculture	0.053	0.039	0.039	–0.014***	–0.014***
Land	0.008	0.005	0.005	–0.002	–0.003*
Observations	1,055	1,850	1,300		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—The four expenditure categories (food consumption, non-food consumption, consumptive investment, productive investment) do not add up to 100% because some expenditure items (education, taxes and fees, donations to the society) are not considered here.
*/**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table 3.4: Descriptive Statistics: Household, Regional and Time Characteristics by Children's Migration Status (CHARLS 2013).

	Has No Migrant	**Has Temporary Migrant**	**Has Permanent Migrant**	***t*-test (2)-(1)**	***t*-test (3)-(1)**
	(1)	(2)	(3)	(4)	(5)
Household Characteristics					
Household size (excl. migrants)	4.431	3.374	3.282	–1.057***	–1.149***
HH members age < 6 (0/1)	0.139	0.064	0.063	-0.075***	0.076***
HH members age 6-15 (0/1)	0.050	0.047	0.032	–0.003	–0.019**
HH members age 16-65 (0/1)	0.937	0.792	0.721	–0.146***	–0.217***
HH members age >65 (0/1)	0.272	0.403	0.521	0.131***	0.249***
HH members with no formal education (0/1)	0.440	0.481	0.479	0.041**	0.039*
HH members with primary education (0/1)	0.695	0.625	0.610	–0.070***	–0.085***
HH members with secondary education (0/1)	0.579	0.364	0.415	–0.215***	–0.164***
HH members with high school education or above (0/1)	0.323	0.173	0.216	–0.150***	–0.107***
Average age of children (years)	30.753	34.710	37.448	3.957***	6.695***
Own a land (0/1)	0.849	0.865	0.836	0.016	–0.013
Regional Characteristics					
Eastern provinces (0/1)	0.403	0.262	0.312	–0.141***	–0.091***
Interior provinces (0/1)	0.251	0.388	0.353	0.137***	0.102***
Western provinces (0/1)	0.346	0.350	0.335	0.004	–0.011
Survey Month Dummies					
July	0.497	0.448	0.451	–0.049**	–0.046**
August	0.403	0.458	0.457	0.056***	0.054***
September	0.031	0.049	0.039	0.017**	0.008
October	0.037	0.034	0.032	–0.003	–0.005
November	0.032	0.011	0.022	–0.021***	–0.011
Instruments					
Village migration rate t-3 (%)	0.083	0.171	0.143	0.088***	0.060***
Hukou reform at child age 15-18 (0/1)	0.224	0.338	0.371	0.114***	0.147***
Observations	1,055	1,850	1,300		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).

Note.—The eastern region includes the following ten provinces and municipalities: Beijing, Shanghai, Fujian, Guangdong, Hebei, Jiangsu, Liaoning, Shandong, Tianjin and Zhejiang. The interior region includes the following eight provinces: Anhui, Heilongjiang, Henan, Hubei, Hunan, Jiangxi, Jilin and Shanxi. The western region includes the following ten provinces and municipalities: Chongqing, Gansu, Guangxi, Guizhou, Inner Mongolia, Qinghai, Shanxi, Sichuan, Xinjiang and Yunnan.

*/**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table 3.5: Full Set of Estimates: First Stage Regressions of Migration Equation (CHARLS 2013).

	Dependent Variable	
	Has Temporary Migrant	**Has Permanent Migrant**
	(1)	(2)
IV: Village migration rate t-3	0.331***	–0.020
	(0.041)	(0.039)
IV: *Hukou* reform at child age 15-18	0.076***	0.142***
	(0.018)	(0.017)
Household size (excl. migrants)	–0.026***	–0.033***
	(0.006)	(0.005)
HH members age $<$ 6	–0.039	0.021
	(0.030)	(0.026)
HH members age 6-15	0.083**	–0.078**
	(0.037)	(0.034)
HH members age 16-65	–0.015	–0.034
	(0.029)	(0.029)
HH members age $>$65	–0.001	0.071***
	(0.023)	(0.022)
HH members with no formal education	–0.032*	–0.037**
	(0.017)	(0.017)
HH members with primary education	–0.062***	–0.029*
	(0.018)	(0.017)
HH members with secondary education	–0.126***	0.060***
	(0.018)	(0.017)
HH members with high school education or above	–0.112***	0.061***
	(0.020)	(0.019)
Average age of children	–0.002*	0.012***
	(0.001)	(0.001)
Own a land	0.052**	0.009
	(0.022)	(0.022)
Interior provinces	0.103***	0.023
	(0.021)	(0.020)
Western provinces	0.055***	0.014
	(0.020)	(0.019)
July	0.170***	–0.063
	(0.049)	(0.056)
August	0.213***	–0.031
	(0.050)	(0.056)
September	0.266***	–0.062
	(0.063)	(0.066)
October	0.150**	–0.059
	(0.065)	(0.068)
Observations	3,742	3,742
R^2	0.097	0.110
F stat 1^{st} stage Equation1	41.40	
F stat 1^{st} stage Equation2		33.91
Kleibergen-Paap rk F stat	16.94	

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 3.6: Estimated Effects of Temporary and Permanent Migration on Household Expenditure (CHARLS 2013).

Dependent Variable: Budget Shares	OLS		IV	
	Has Temporary Migrant (β_t)	**Has Permanent Migrant (β_p)**	**Has Temporary Migrant (β_t)**	**Has Permanent Migrant (β_p)**
	(1)	(2)	(3)	(4)
A: Consumption				
Food consumption	0.037***	0.022**	0.294***	0.066
	(0.010)	(0.010)	(0.077)	(0.083)
Pure food	0.045***	0.031***	0.214***	0.087
	(0.009)	(0.010)	(0.069)	(0.076)
Tobacco and alcohol	–0.009**	–0.008*	0.080**	–0.021
	(0.004)	(0.004)	(0.034)	(0.036)
Non-food consumption	–0.004	0.005	–0.025	0.022
	(0.006)	(0.007)	(0.041)	(0.049)
Clothing	–0.004***	–0.001	–0.026**	–0.014
	(0.002)	(0.002)	(0.011)	(0.014)
Utilities and household services	–0.006	0.003	–0.038	0.045
	(0.005)	(0.005)	(0.031)	(0.037)
Other products	0.006**	0.003	0.038*	–0.009
	(0.003)	(0.003)	(0.020)	(0.023)
B: Investment				
Consumptive investment	0.008	–0.001	0.021	–0.103*
	(0.007)	(0.007)	(0.053)	(0.057)
Durables	0.005	–0.006	–0.028	–0.014
	(0.004)	(0.004)	(0.023)	(0.029)
Housing	0.004	0.004	0.049	–0.088*
	(0.006)	(0.006)	(0.048)	(0.051)
Productive investment	–0.001	–0.001	–0.196***	0.190***
	(0.007)	(0.008)	(0.064)	(0.072)
Health	0.010	0.007	–0.070	0.111**
	(0.006)	(0.007)	(0.048)	(0.054)
Agriculture	–0.009**	–0.007	–0.107***	0.080**
	(0.004)	(0.005)	(0.033)	(0.038)
Land	–0.001	–0.001	–0.019***	–0.001
	(0.001)	(0.001)	(0.007)	(0.011)
Time fixed effects	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	3,742	3,742	3,742	3,742
Kleibergen-Paap rk F stat			16.94	

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—Columns (1)-(2) report the estimated effects obtained with OLS regression and columns (3)-(4) report the estimated effects obtained with IV regression. All models include the control variables listed in Table 3.4. Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 3.7: Heterogeneity in the Estimated Migration Effects on Household Expenditure.

Dependent Variable: Budget Shares								
	Low Income		High Income		Less Developed		More Developed	
	Temporary Migrant (β_t)	Permanent Migrant (β_p)	Temporary Migrant (β_t)	Permanent Migrant (β_p)	Temporary Migrant (β_t)	Permanent Migrant (β_p)	Temporary Migrant (β_t)	Permanent Migrant (β_p)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: Consumption								
Food consumption	0.302***	0.061	0.270*	0.035	0.278**	0.040	0.302**	0.083
	(0.091)	(0.121)	(0.160)	(0.118)	(0.113)	(0.119)	(0.123)	(0.122)
Pure food	0.231***	0.105	0.164	0.044	0.216**	0.069	0.185*	0.122
	(0.083)	(0.112)	(0.138)	(0.103)	(0.102)	(0.109)	(0.109)	(0.109)
Tobacco and alcohol	0.071*	–0.045	0.106*	–0.010	0.062	–0.029	0.117**	–0.039
	(0.042)	(0.053)	(0.063)	(0.051)	(0.052)	(0.050)	(0.054)	(0.055)
Non-food consumption	–0.043	0.058	0.021	–0.022	–0.075	0.086	0.022	–0.044
	(0.050)	(0.074)	(0.091)	(0.069)	(0.059)	(0.073)	(0.071)	(0.077)
Clothing	–0.021*	–0.001	–0.030	–0.025	–0.023	–0.001	–0.029	–0.028
	(0.011)	(0.020)	(0.028)	(0.022)	(0.014)	(0.018)	(0.018)	(0.023)
Utilities and household services	–0.040	0.066	–0.047	–0.047	–0.100**	0.100*	0.022	–0.005
	(0.039)	(0.057)	(0.055)	(0.045)	(0.049)	(0.059)	(0.052)	(0.053)
Other products	0.018	–0.007	0.098*	–0.006	0.048*	–0.013	0.029	–0.011
	(0.022)	(0.029)	(0.057)	(0.044)	(0.025)	(0.030)	(0.038)	(0.038)
B: Investment								
Consumptive investment	0.030	–0.066	0.010	–0.156	0.009	–0.125	0.080	–0.089
	(0.057)	(0.075)	(0.132)	(0.097)	(0.077)	(0.083)	(0.086)	(0.086)
Durables	–0.012	–0.010	–0.081	–0.021	–0.021	–0.013	–0.006	–0.036
	(0.026)	(0.040)	(0.059)	(0.050)	(0.034)	(0.044)	(0.036)	(0.039)
Housing	0.042	–0.056	0.092	–0.135	0.030	–0.112	0.086	–0.052
	(0.052)	(0.066)	(0.124)	(0.091)	(0.070)	(0.072)	(0.079)	(0.078)
Productive investment	–0.110*	0.132	–0.410**	0.257*	–0.121	0.237**	–0.305***	0.170
	(0.066)	(0.091)	(0.186)	(0.143)	(0.098)	(0.106)	(0.102)	(0.110)
Health	–0.094	0.135	–0.038	0.070	–0.028	0.150*	–0.144**	0.088
	(0.059)	(0.083)	(0.100)	(0.073)	(0.075)	(0.082)	(0.073)	(0.079)
Agriculture	–0.001	0.004	–0.339**	0.184*	–0.082*	0.092*	–0.144***	0.084
	(0.027)	(0.035)	(0.139)	(0.107)	(0.050)	(0.053)	(0.055)	(0.060)
Land	–0.014**	–0.007	–0.033	0.003	–0.011	–0.005	–0.018	–0.002
	(0.006)	(0.012)	(0.022)	(0.024)	(0.007)	(0.014)	(0.011)	(0.017)
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,135	2,135	1,607	1,607	1,785	1,785	1,957	1,957
Kleibergen-Paap rk F stat	9.11	9.11	5.45	5.45	7.44	7.44	7.39	7.39

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—All models include the control variables listed in Table 3.4. Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 3.8: Robustness Check: Estimated Effects of Temporary and Permanent Migration on Household Expenditure, Additional Village Controls (CHARLS 2013).

Dependent Variable: Budget Shares						
	Baseline		**Village Control I**		**Village Control II**	
	Temporary Migrant (β_t)	**Permanent Migrant (β_p)**	**Temporary Migrant (β_t)**	**Permanent Migrant (β_p)**	**Temporary Migrant (β_t)**	**Permanent Migrant (β_p)**
	(1)	(2)	(3)	(4)	(5)	(6)
A: Consumption						
Food consumption	0.294***	0.066	0.279***	0.087	0.308***	0.072
	(0.077)	(0.083)	(0.082)	(0.091)	(0.084)	(0.094)
Pure food	0.214***	0.087	0.205***	0.103	0.233***	0.086
	(0.069)	(0.076)	(0.072)	(0.081)	(0.080)	(0.085)
Tobacco and alcohol	0.080**	–0.021	0.073*	–0.016	0.074*	–0.015
	(0.034)	(0.036)	(0.041)	(0.042)	(0.045)	(0.045)
Non-food consumption	–0.025	0.022	–0.032	0.031	–0.055	0.044
	(0.041)	(0.049)	(0.038)	(0.052)	(0.043)	(0.055)
Clothing	–0.026**	–0.014	–0.026**	–0.014	–0.021*	–0.016
	(0.011)	(0.014)	(0.011)	(0.014)	(0.012)	(0.015)
Utilities and household services	–0.038	0.045	–0.042	0.053	–0.055*	0.059
	(0.031)	(0.037)	(0.030)	(0.040)	(0.033)	(0.041)
Other products	0.038*	–0.009	0.036**	–0.008	0.021	0.001
	(0.020)	(0.023)	(0.018)	(0.023)	(0.021)	(0.023)
B: Investment						
Consumptive investment	0.021	–0.103*	0.027	–0.111*	0.032	–0.113*
	(0.053)	(0.057)	(0.058)	(0.061)	(0.060)	(0.065)
Durables	–0.028	–0.014	–0.029	–0.021	–0.031	–0.020
	(0.023)	(0.029)	(0.029)	(0.032)	(0.031)	(0.032)
Housing	0.049	–0.088*	0.056	–0.090	0.063	–0.093
	(0.048)	(0.051)	(0.048)	(0.056)	(0.051)	(0.060)
Productive investment	–0.196***	0.190***	–0.199***	0.175**	–0.208***	0.179**
	(0.064)	(0.072)	(0.070)	(0.079)	(0.074)	(0.082)
Health	–0.070	0.111**	–0.084*	0.108*	–0.109**	0.125**
	(0.048)	(0.054)	(0.043)	(0.056)	(0.045)	(0.058)
Agriculture	–0.107***	0.080**	–0.104**	0.072*	–0.088*	0.060
	(0.033)	(0.038)	(0.047)	(0.043)	(0.050)	(0.045)
Land	–0.019***	–0.001	–0.012	–0.005	–0.011	–0.006
	(0.007)	(0.011)	(0.008)	(0.010)	(0.009)	(0.011)
Exogenous village controls	No	No	Yes	Yes	Yes	Yes
Extended set of village controls	No	No	No	No	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,742	3,742	3,742	3,742	3,742	3,742
Kleibergen-Paap rk F stat	16.94	16.94	13.83	13.83	10.47	10.47

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).

Note.—Columns (1)-(2) report the IV results from Table 3.6. Columns (3)-(4) include exogenous controls for village characteristics. Columns (5)-(6) include an extended set of controls for village characteristics. All models include the control variables listed in Table 3.4. Robust standard errors clustered at village level are reported in parentheses.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

***Statistically significant at the 1 percent level.

Table 3.9: Robustness Check: First Stage Regressions with Parents Holding Urban *Hukou* (CHARLS 2013).

	Dependent Variable	
	Has Temporary Migrant	**Has Permanent Migrant**
	(1)	(2)
	Panel A: Rural Hukou Parents	
Village migration rate t-3	0.349***	–0.015
	(0.043)	(0.041)
Hukou reform at child age 15-18	0.084***	0.143***
	(0.018)	(0.018)
Observations	3,742	3,742
R^2	0.099	0.103
F stat 1^{st} stage Equation1	43.62	
F stat 1^{st} stage Equation2		32.20
Kleibergen-Paap rk F stat	15.60	
	B: Urban Hukou Parents (Placebo)	
Village migration rate t-3	0.333**	–0.119
	(0.165)	(0.157)
Hukou reform at child age 15-18	0.001	0.084
	(0.069)	(0.071)
Observations	276	276
R^2	0.191	0.152
F stat 1^{st} stage Equation1	2.03	
F stat 1^{st} stage Equation2		1.03
Kleibergen-Paap rk F stat	0.747	
Time fixed effects	Yes	Yes
Other controls	Yes	Yes

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 3.10: Robustness Check: First Stage Regressions with Different Age Cut-Offs (CHARLS 2013).

	Dependent Variable	
	Has Temporary Migrant	**Has Permanent Migrant**
	(1)	(2)
	Panel A: 15-18 Years (Baseline)	
Village migration rate t-3	0.331***	–0.020
	(0.041)	(0.039)
Hukou reform at child age 15-18	0.076***	0.142***
	(0.018)	(0.017)
R^2	0.097	0.110
F stat 1^{st} stage Equation1	41.40	
F stat 1^{st} stage Equation2		33.91
Kleibergen-Paap rk F stat	16.94	
	Panel B: 15-16 Years	
Village migration rate t-3	0.329***	–0.022
	(0.041)	(0.039)
Hukou reform at child age 15-16	0.083***	0.135***
	(0.020)	(0.020)
R^2	0.096	0.105
F stat 1^{st} stage Equation1	40.35	
F stat 1^{st} stage Equation2		22.49
Kleibergen-Paap rk F stat	14.08	
	Panel C: 16-17 Years	
Village migration rate t-3	0.328***	–0.025
	(0.041)	(0.040)
Hukou reform at child age 16-17	0.084***	0.112***
	(0.021)	(0.021)
R^2	0.096	0.100
F stat 1^{st} stage Equation1	40.14	
F stat 1^{st} stage Equation2		14.10
Kleibergen-Paap rk F stat	10.31	
Observations	3,742	3,742
Time fixed effects	Yes	Yes
Other controls	Yes	Yes

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 3.11: Estimated Effects of Temporary and Permanent Remittances on Household Expenditure (CHARLS 2013).

Dependent Variable: Budget Shares	OLS		IV	
	Receive Temporary Remittances (α_t)	**Receive Permanent Remittances (α_p)**	**Receive Temporary Remittances (α_t)**	**Receive Permanent Remittances (α_p)**
	(1)	(2)	(3)	(4)
A: Consumption				
Food consumption	0.042***	0.023	0.293**	0.006
	(0.015)	(0.017)	(0.120)	(0.122)
Pure food	0.036**	0.023	0.228**	0.053
	(0.015)	(0.017)	(0.109)	(0.111)
Tobacco and alcohol	0.006	0.000	0.065	–0.047
	(0.006)	(0.007)	(0.047)	(0.051)
Non-food consumption	0.001	0.015	–0.013	0.031
	(0.009)	(0.011)	(0.066)	(0.072)
Clothing	–0.007**	–0.003	–0.028	0.007
	(0.003)	(0.004)	(0.019)	(0.022)
Utilities and household services	0.004	0.014*	–0.015	0.043
	(0.006)	(0.008)	(0.049)	(0.050)
Other products	0.004	0.004	0.031	–0.019
	(0.004)	(0.005)	(0.031)	(0.036)
B: Investment				
Consumptive investment	0.004	0.002	0.015	–0.144
	(0.011)	(0.012)	(0.081)	(0.088)
Durables	–0.003	–0.009	–0.020	–0.011
	(0.007)	(0.007)	(0.039)	(0.045)
Housing	0.007	0.011	0.035	–0.133*
	(0.009)	(0.010)	(0.073)	(0.079)
Productive investment	0.006	0.003	–0.094	0.243**
	(0.012)	(0.013)	(0.100)	(0.102)
Health	0.013	0.004	–0.002	0.161**
	(0.010)	(0.011)	(0.076)	(0.079)
Agriculture	–0.005	–0.001	–0.064	0.078
	(0.007)	(0.008)	(0.052)	(0.052)
Land	–0.002	–0.001	–0.029**	0.004
	(0.002)	(0.002)	(0.014)	(0.013)
Time fixed effects	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	2,224	2,224	2,224	2,224
Kleibergen-Paap rk F stat				11.80

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—Columns (1)-(2) report the estimated effects obtained with OLS regression and columns (3)-(4) report the estimated effects obtained with IV regression. All models include the control variables listed in Table 3.4. Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Table 3.12: Estimated Effects of Temporary and Permanent Migration on Education Expenditure (CHARLS 2013).

Dependent Variable: Budget Share on Education		
	Has Temporary Migrant	**Has Permanent Migrant**
	(1)	(2)
Education	0.008	–0.141***
	(0.029)	(0.033)
Time fixed effects	Yes	Yes
Other controls	Yes	Yes
Observations	3,742	3,742
Kleibergen-Paap rk F stat	16.94	

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—This table reports the estimated effects obtained with IV regression. All models include the control variables listed in Table 3.4. Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Conclusion

The present thesis contributes to the health economics literature and the migration literature by providing new evidence on several interesting aspects: 1) the impact of the UK Equality Act 2010 on the labour market outcomes of disabled people; 2) the impact of adult children's internal migration on the health and well-being outcomes of elderly parents left behind in Chinese rural villages, distinguishing between the gender of migrant children; and 3) the impact of adult children's internal migration on the expenditure decisions of households left behind in rural China, distinguishing between the type of migration and remittances.

In a distinct chapter, I shed some light on a previously unexploited Act that consolidates existing anti-discrimination legislation in Great Britain—the Equality Act (EA) 2010. As the first unified equality law, the EA was designed to protect and promote the interests of certain vulnerable groups in order to make society fairer, with the nine "protected characteristics" covered by the Act being: age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation. Nearly seven years have passed since the enactment of the Act, economists have made, however, almost no attempt to explore the law's effectiveness. This stands in sharp contrast to the voluminous work triggered by the Americans with Disabilities Act (ADA) in the US and the Disability Discrimination Act (DDA) in the UK. Focusing on disability, I find robust evidence that, after the implementation of the EA, disabled individuals are better-off in the labour market relative to the non-disabled, as reflected in their increased employment opportunities and increased hourly wages. Therefore, the first

chapter of the thesis provides a first attempt at answering a very important question in relation to both policy evaluation and policy development.

In the two chapters devoted to studying the Great Migration in China, the main results confirm that migration can have an important bearing on families and family members left behind. In the second chapter, we reveal a defining gendered pattern in children's migration effect on the welfare of their elderly parents remaining in the rural villages. In particular, we find that parents of migrant children could benefit from their ability to send their daughters to the city, which in turn improves their health and subjective well-being. Surprisingly, and contrary to traditional expectations of "Rear sons for help in old age" in rural China, the migration of sons does not bring similar benefits to parents. In the third chapter, I study a similar issue concerning the impact of adult children's rural-urban migration but focusing on an array of household expenditure outcomes instead. Explicitly distinguishing between temporary migrant households and permanent migrant households, I detect a differential impact of migration on household expenditure patterns depending on the type of children's stay in the city. The temporary migration of children enhances the expenditure share on one key consumption good (i.e., food), while children's permanent migration stimulates productive investment (i.e., health and agriculture). Moreover, the results show that the effect of migration goes beyond the income effect of remittances, operating also through non-pecuniary channels, possibly the transmission of consumption norms, or production knowledge transfer.

Overall, these findings contribute directly to a growing body of literature about migration and its impact on sending areas. Remarkably, the analysis presented in this thesis deepens current understanding of this relationship by accounting for the fundamental heterogeneity of migration and, more specifically, by differentiating the migration effects according to daughter-son and temporary-permanent. Migration, as a complex social phenomenon, is inherently heterogeneous. Despite this, previous studies have focused on estimating the overall effect of migration. The empirical evidence here highlights the importance of disentangling the effects of different components of migration activity in future research. Essentially, these two papers can be regarded as complementary in the sense

that one explores the migration effect on individual-level outcomes and the other looks at household-level outcomes. Interestingly, the findings of a positive migration effect of daughters on elderly health (Chapter 2) and a positive migration effect of permanent migrants on the budget share for health (Chapter 3) seem to be mutually supportive and consistent with a story in which females are more involved in permanent migration (perhaps because they are more likely to move to cites for marriage reasons).

Technically speaking, the present thesis innovates the economic literature in two aspects. First, the econometric estimation strategies proposed in the first chapter correspond to a unique contribution towards the UK literature on policy evaluation. Previous work on the DDA has tended to adopt a difference-in-difference method due to a lack of regional variation that this legislation had properly generated. The triple difference analysis undertaken, using variation from group, time and place, helps reduce the bias in the estimate of the average treatment effect of the policy change. Second, the novel instrumental variables for migration proposed in the second chapter are arguably more exogenous than the "traditional" instruments predominantly used in the migration literature such as current or historic migration networks. Interesting scope for further research may include explorations on whether parallel effects exist in Western horoscopes for Western people, as well as for other microeconomic behaviours that are correlated with risk and/or personality, e.g., entrepreneurial decisions.

In the future, I wish to study whether there is a relationship between the Equality Act 2010 and subjective outcomes (e.g., job satisfaction) of the disabled. Undoubtedly, objective measures of welfare such as employment and wages cannot fully capture the overall utility of individuals. In addition, I want to further explore the mechanism through which different forms of migration differently influence the outcome measures.

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A Appendix to Chapter 1

A.1 Rationale for the Choice of the Comparisons Group

A.1.1 Before-After Estimator: Pre v.s. Post

Here I formulate the first idea for choosing the comparison group mentioned in §1.3.2. Suppose that pre-treatment data on the EA disabled are available, the causal effect of the EA can be evaluated by considering a single difference:

$$E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Pre) \tag{A.1.1}$$

The equation A.1.1 can be expressed as:

$$\begin{aligned}&[E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Post)]\\&+[E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Pre)]\end{aligned}$$

or:

$$ATT + [E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Pre)]$$

with an underlying identifying assumption:

$$E(Y_{it}^{(0)}|i = Disable, t = Pre) = E(Y_{it}^{(0)}|i = Disable, t = Post) \tag{A.1.2}$$

It can be immediately seen that if the condition is respected, this "before-after" estimator will unbiasedly identify the true causal impact of the 2010 reform on the outcome of the EA disabled, i.e., ATT in Equation 1.3.1. However, this can be easily violated as discussed in the main text of §1.3.2.

A.1.2 Cross-Section Estimator: Disabled v.s. Non-disabled

Given that the EA does not affect everyone and only people with EA disabilities are exposed to the treatment, the sample of non-disabled units naturally serves as a comparison group that is not influenced by the legislation but is presumably subject to other similar trends that affect the EA disabled. If I have access to data describing the post-Act responses of both the EA disabled and the non-disabled, I can simply compare the average outcome of these two groups in the post-intervention period and do the simple difference:

$$E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post) \tag{A.1.3}$$

Again, this can be rewritten as:

$$\begin{aligned}
& E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post) \\
= \; & [E(Y_{it}^{(1)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Disable, t = Post)] \\
& + [E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post)] \\
= \; & ATT + \underbrace{[E(Y_{it}^{(0)}|i = Disable, t = Post) - E(Y_{it}^{(0)}|i = Nondisable, t = Post)]}_{\text{selection bias (SB)}} \\
= \; & ATT + SB
\end{aligned} \tag{A.1.4}$$

where the term in the square bracket represents the bias due to the nonrandom selection process. Obviously, the key of identifying the ATT is to assume the biased term is zero (i.e. $SB = 0$ in the above question). This signifies that the mean outcome for the EA disabled and the non-disabled must be the same in the absence of the EA. If this condition holds, the "cross-section" estimator in Equation A.1.3 will correctly identify the average

treatment effect on the treated (ATT). Indeed, this identifying hypothesis can be regarded as a randomisation condition, under which the composition of the treated and comparison groups is supposed to be identical. Since only data subsequent to the date of the EA implementation are used, this estimator is not subject to the same criticism as the previous one.[1]

A.2 Additional Empirical Evidence

Table A.1: The Estimated Impact of Equality Act 2010 on Log Hourly Wage (Heckman Selection Model, QLSF 2005-1013)

	I	II	III	IV	V	VI
Disable (β_1)	–0.076***	–0.046***	–0.067***	–0.030***	–0.086***	–0.054***
	(0.005)	(0.003)	(0.007)	(0.006)	(0.011)	(0.008)
Post (β_2)	–0.074***	–0.075***	–0.074***	–0.075***		
	(0.003)	(0.002)	(0.003)	(0.002)		
Disable×Post (β_{DD})	0.026***	0.022***	0.040***	0.047***		
	(0.008)	(0.006)	(0.013)	(0.010)		
Disable×2006 (β_{2006})					–0.004	0.005
					(0.015)	(0.011)
Disable×2007 (β_{2007})					0.019	0.017
					(0.016)	(0.011)
Disable×2008 (β_{2008})					0.007	0.005
					(0.016)	(0.011)
Disable×2009 (β_{2009})					0.021	0.009
					(0.016)	(0.012)
Disable×2010 (β_{2010})					0.027*	0.018
					(0.015)	(0.012)
Disable×2011 (β_{2011})					0.034**	0.030***
					(0.015)	(0.012)
Disable×2012 (β_{2012})					0.041***	0.033***
					(0.016)	(0.012)
Disable×2013 (β_{2013})					0.015	0.006
					(0.026)	(0.019)
Demographic characteristics	No	Yes	No	Yes	No	Yes
Disable×linear time trend	No	No	Yes	Yes	No	No
Disable×year dummies	No	No	No	No	Yes	Yes
Rho	–0.864	0.147	–0.864	0.147	–0.864	0.156
Log-likelihood×10^6	–136	–110	–136	–111	–136	–111
N						246,099
N (censored)						83,764
N (uncensored)						162,335

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).
Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variable is log hourly wage. LFS survey weights are employed in all regressions to ensure the sample representativeness. The instrument for selection is number of dependent children in family.

[1] As a matter of fact, when we lack an ideal social experiment and have only observational (or non-experimental) data, the randomization condition has little chance of being satisfied.

Table A.2: Full Coefficients for Employment Regressions in Table 1.3

	I	II	III	IV	V	VI
Disable (β_1)	−0.398***	−0.352***	−0.400***	−0.350***	−0.401***	−0.356***
	(0.003)	(0.003)	(0.005)	(0.004)	(0.007)	(0.007)
Post (β_2)	−0.014***	−0.022***	−0.014***	−0.022***		
	(0.002)	(0.002)	(0.002)	(0.002)		
Disable×*Post* (β_{DD})	0.040***	0.036***	0.035***	0.038***		
	(0.005)	(0.005)	(0.009)	(0.008)		
Year 2006					−0.005	−0.004
					(0.003)	(0.003)
Year 2007					−0.002	−0.003
					(0.003)	(0.003)
Year 2008					−0.001	−0.002
					(0.003)	(0.003)
Year 2009					−0.020***	−0.024***
					(0.003)	(0.003)
Year 2010					−0.023***	−0.027***
					(0.003)	(0.003)
Year 2011					−0.023***	−0.032***
					(0.004)	(0.003)
Year 2012					−0.020***	−0.030***
					(0.004)	(0.003)
Year 2013					−0.022***	−0.034***
					(0.006)	(0.006)
Disable×2006 (β_{2006})					−0.013	−0.010
					(0.010)	(0.009)
Disable×2007 (β_{2007})					−0.003	0.000
					(0.010)	(0.009)
Disable×2008 (β_{2008})					0.007	0.007
					(0.010)	(0.009)
Disable×2009 (β_{2009})					0.011	0.012
					(0.010)	(0.009)
Disable×2010 (β_{2010})					0.029***	0.023**
					(0.010)	(0.009)
Disable×2011 (β_{2011})					0.040***	0.037***
					(0.010)	(0.009)
Disable×2012 (β_{2012})					0.046***	0.043***
					(0.010)	(0.010)
Disable×2013 (β_{2013})					0.043**	0.038**
					(0.017)	(0.016)

Continued.

Continued.

	I	II	III	IV	V	VI
Age group-30		0.084***		0.084***		0.083***
		(0.002)		(0.002)		(0.002)
Age group-40		0.123***		0.123***		0.122***
		(0.002)		(0.002)		(0.002)
Age group-50		0.046***		0.046***		0.046***
		(0.002)		(0.002)		(0.002)
Male		0.089***		0.089***		0.089***
		(0.002)		(0.002)		(0.002)
Married		0.110***		0.110***		0.110***
		(0.002)		(0.002)		(0.002)
White		0.121***		0.121***		0.121***
		(0.003)		(0.003)		(0.003)
Number of dependent children		–0.059***		–0.059***		–0.059***
		(0.001)		(0.001)		(0.001)
Degree or equivalent		0.269***		0.269***		0.270***
		(0.003)		(0.003)		(0.003)
Other higher education		0.262***		0.262***		0.263***
		(0.003)		(0.003)		(0.003)
GCE A-level or equivalent		0.215***		0.215***		0.216***
		(0.003)		(0.003)		(0.003)
GCSE A*-C or equivalent		0.201***		0.201***		0.202***
		(0.003)		(0.003)		(0.003)
Other qualification		0.141***		0.141***		0.142***
		(0.003)		(0.003)		(0.003)
North East		–0.011***		–0.011***		–0.011***
		(0.004)		(0.004)		(0.004)
North West		0.003		0.003		0.003
		(0.003)		(0.003)		(0.003)
Yorkshire and Humber		0.005*		0.005*		0.005*
		(0.003)		(0.003)		(0.003)
East Midlands		0.023***		0.023***		0.023***
		(0.003)		(0.003)		(0.003)
West Midlands		0.009***		0.009***		0.009***
		(0.003)		(0.003)		(0.003)
East England		0.018***		0.018***		0.018***
		(0.003)		(0.003)		(0.003)
South West		0.011***		0.011***		0.011***
		(0.003)		(0.003)		(0.003)
Wales		–0.005		–0.005		–0.005
		(0.004)		(0.004)		(0.004)
Scotland		0.006**		0.006**		0.006**
		(0.003)		(0.003)		(0.003)
Disable$\times t$			0.001	–0.001		
			(0.002)	(0.001)		
Demographic characteristics	No	Yes	No	Yes	No	Yes
Disable$\times$linear time trend	No	No	Yes	Yes	No	No
Disable$\times$year dummies	No	No	No	No	Yes	Yes
R^2	0.107	0.212	0.107	0.212	0.107	0.212
N	288633	288633	288633	288633	288633	288633

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).
Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variable is probability of employment. LFS survey weights are employed in all regressions to ensure the sample representativeness.

Table A.3: Full Coefficients for Log Hourly Wage Regressions in Table 1.3

	I	II	III	IV	V	VI
Disable (β_1)	–0.100***	–0.047***	–0.095***	–0.031***	–0.110***	–0.055***
	(0.005)	(0.003)	(0.008)	(0.006)	(0.012)	(0.008)
Post (β_2)	–0.059***	–0.074***	–0.059***	–0.074***		
	(0.003)	(0.002)	(0.003)	(0.002)		
Disable×Post (β_{DD})	0.028***	0.022***	0.037***	0.047***		
	(0.009)	(0.006)	(0.014)	(0.010)		
Year 2006 (D)					–0.002	–0.005
					(0.005)	(0.004)
Year 2007 (D)					–0.006	–0.013***
					(0.005)	(0.004)
Year 2008 (D)					–0.024***	–0.028***
					(0.005)	(0.004)
Year 2009 (D)					0.002	–0.006
					(0.005)	(0.004)
Year 2010 (D)					–0.031***	–0.038***
					(0.005)	(0.004)
Year 2011 (D)					–0.067***	–0.080***
					(0.006)	(0.004)
Year 2012 (D)					–0.077***	–0.103***
					(0.006)	(0.004)
Year 2013 (D)					–0.087***	–0.113***
					(0.009)	(0.006)
Disable×2006 (β_{2006})					–0.003	0.005
					(0.016)	(0.011)
Disable×2007 (β_{2007})					0.013	0.018
					(0.016)	(0.011)
Disable×2008 (β_{2008})					0.003	0.005
					(0.016)	(0.011)
Disable×2009 (β_{2009})					0.023	0.009
					(0.017)	(0.012)
Disable×2010 (β_{2010})					0.035**	0.018
					(0.017)	(0.012)
Disable×2011 (β_{2011})					0.038**	0.030***
					(0.016)	(0.012)
Disable×2012 (β_{2012})					0.037**	0.033***
					(0.017)	(0.012)
Disable×2013 (β_{2013})					0.013	0.007
					(0.027)	(0.019)
Age group-50 (D)		0.184***		0.184***		0.185***
		(0.008)		(0.008)		(0.008)
Age group-30 (D)		0.084***		0.084***		0.083***
		(0.004)		(0.004)		(0.004)
Age group-40 (D)		0.112***		0.112***		0.112***
		(0.006)		(0.006)		(0.006)
Male (D)		0.100***		0.100***		0.100***
		(0.002)		(0.002)		(0.002)
Married (D)		0.049***		0.049***		0.049***
		(0.002)		(0.002)		(0.002)
White (D)		0.060***		0.060***		0.060***
		(0.003)		(0.003)		(0.003)
Degree or equivalent (D)		0.328***		0.328***		0.329***
		(0.004)		(0.004)		(0.004)
Other higher education (D)		0.212***		0.212***		0.213***
		(0.004)		(0.004)		(0.004)
GCE A-level or equivalent (D)		0.147***		0.147***		0.148***
		(0.004)		(0.004)		(0.004)
GCSE A*-C or equivalent (D)		0.083***		0.083***		0.084***
		(0.003)		(0.003)		(0.003)

Continued.

Continued.

	I	II	III	IV	V	VI
Other qualification (D)		0.049***		0.049***		0.050***
		(0.004)		(0.004)		(0.004)
Potential work experience (years)		0.021***		0.021***		0.021***
		(0.001)		(0.001)		(0.001)
Experience square (years)		–0.000***		–0.000***		–0.000***
		(0.000)		(0.000)		(0.000)
North East (D)		–0.142***		–0.142***		–0.142***
		(0.004)		(0.004)		(0.004)
North West (D)		–0.128***		–0.128***		–0.129***
		(0.003)		(0.003)		(0.003)
Yorkshire and Humber (D)		–0.135***		–0.135***		–0.135***
		(0.003)		(0.003)		(0.003)
East Midlands (D)		–0.120***		–0.120***		–0.120***
		(0.003)		(0.003)		(0.003)
West Midlands (D)		–0.118***		–0.118***		–0.118***
		(0.003)		(0.003)		(0.003)
East England (D)		–0.054***		–0.054***		–0.054***
		(0.004)		(0.004)		(0.004)
South West(D)		–0.134***		–0.134***		–0.134***
		(0.004)		(0.004)		(0.004)
Wales (D)		–0.147***		–0.147***		–0.147***
		(0.004)		(0.004)		(0.004)
Scotland (D)		–0.109***		–0.109***		–0.109***
		(0.003)		(0.003)		(0.003)
Hours worked per week		–0.001***		–0.001***		–0.001***
		(0.000)		(0.000)		(0.000)
Electricity and water (D)		0.254***		0.254***		0.254***
		(0.008)		(0.008)		(0.008)
Manufacturing (D)		0.117***		0.117***		0.117***
		(0.005)		(0.005)		(0.005)
Construction (D)		0.148***		0.148***		0.148***
		(0.006)		(0.006)		(0.006)
Hotel and restaurants (D)		–0.048***		–0.048***		–0.047***
		(0.005)		(0.005)		(0.005)
Transport and communication(D)		0.148***		0.148***		0.148***
		(0.005)		(0.005)		(0.005)
Banking and finance (D)		0.147***		0.147***		0.147***
		(0.005)		(0.005)		(0.005)
Public administration (D)		0.079***		0.079***		0.078***
		(0.004)		(0.004)		(0.004)
Professional occupations (D)		0.018***		0.018***		0.019***
		(0.004)		(0.004)		(0.004)
Technical occupations (D)		–0.130***		–0.130***		–0.129***
		(0.004)		(0.004)		(0.004)
Administrative and secretarial (D)		–0.337***		–0.337***		–0.337***
		(0.004)		(0.004)		(0.004)
Skilled trades (D)		–0.351***		–0.351***		–0.350***
		(0.004)		(0.004)		(0.004)
Personal service (D)		–0.508***		–0.508***		–0.506***
		(0.004)		(0.004)		(0.004)
Sales and customer service (D)		–0.445***		–0.445***		–0.444***
		(0.005)		(0.005)		(0.005)
Process, plant and machine operatives (D)		–0.448***		–0.448***		–0.447***
		(0.004)		(0.004)		(0.004)
Elementary occupations (D)		–0.545***		–0.545***		–0.544***
		(0.004)		(0.004)		(0.004)
Part time (D)		–0.116***		–0.116***		–0.116***
		(0.004)		(0.004)		(0.004)
Disable×t			–0.002	–0.006***		
			(0.003)	(0.002)		
Demographic characteristics	No	Yes	No	Yes	No	Yes
Disable×linear time trend	No	No	Yes	Yes	No	No
Disable×year dummies	No	No	No	No	Yes	Yes
R^2	0.006	0.528	0.006	0.528	0.007	0.529
N	162335	162335	162335	162335	162335	162335

Source.—UK Quarterly Lablour Force Survey (UK QLFS, 2005Q1-2013Q4).
Note.—Robust standard errors are reported in parentheses. */**/*** indicate significance at the 0.1/0.05/0.01 level. The dependent variable is log hourly wage. LFS survey weights are employed in all regressions to ensure the sample representativeness.

B Appendix to Chapter 2

This appendix contains additional evidence and robustness checks to supplement the findings in the main text of the paper. In Appendix B.1, we provide more details about how we construct our elderly health outcomes. In Appendix B.2, we provide evidence that the Chinese zodiac sign predicts individual risk attitudes for Chinese people, based on the Rural-Urban Migration in China (RUMiC) data. Finally, in addition to the appendix tables referred to in Appendix B.2, this online appendix also contains some other figures and tables referred to in the main text.

B.1 Construction of Health Variables

a. Self-Reported Health (SRH)

The CHARLS follows the Health and Retirement Survey (HRS) frame and contains a basic question on general health status, which asks the respondent to assess his/her general health using two different scales: 1) "excellent", "very good", "good, fair", "poor"; and 2) "very good", "good", "fair", "poor", "very poor".[1] Following the standard approach, we transform this five-point categorical variable into a dichotomous outcome indicating good general health, which is equal to one if the respondent on the first scale reports "excellent", "very good", or "good" or if the respondent on the second scale reports "very good" or "good", and zero otherwise.

b. Physical Health

[1] Respondents were randomly assigned to the two scales.

In this dimension, we provide two specific measures to capture the physical health condition of the elderly: body mobility index and overall functional score. We construct a mobility score based on a set of mobility questions asked in the survey: running or jogging about 1km, walking 1km, walking 100km, getting up from a chair after sitting for a long period, climbing several flights of stairs, stooping, kneeling or crouching, reaching or extending arms above shoulder level, lifting or carrying weights over 10 jin, picking up a small coin from a table. Each question is given four options: "No, I don't have any difficulty" (4 points), "I have difficulty but can still do it" (3 points), "Yes, I have difficulty and need help" (2 points), and "I can not do it" (1 point). The mobility score aggregates answers in these nine questions and ranges from 9 (very poor body mobility) to 36 (very good body mobility).

In addition, we construct an overall functional indicator based on the Katz Index of Independence in Activities of Daily Living (KatzADLs) and the Lawton Instrumental Activities of Daily Living Scale (LawtonIADLs). The KatzADLs is the most appropriate instrument commonly used to assess the functional status of an individual as measured by the individual's ability to independently perform the six basic activities of daily living: bathing, dressing, eating alone, toileting, continence and transferring/moving about (walking across a room). The LawtonIADLs measures the ability to perform the activities necessary to live independently: housekeeping, food preparation, shopping, managing finance, taking medication, laundry, using the telephone and transportation (driving or using public transport). One point is given for each activity in case of independence. Therefore, the aggregate score ranges from 0 (complete dependence) to 12 (complete independence). We adopt the cut-off score of 9 and create a dichotomous indicator to capture the functioning of the elderly parents. An elderly parent is defined as having good functional health if the reported score is 9 or above.

c. Mental Health

We utilise two measures to gauge the psychological well-being of elderly parents. The first is based on one of the most widely used depression scales originally developed by Radloff

(1977), called the Center for Epidemiological Studies Depression Scale (CES-D). Similarly, CHARLS encompasses a 10-item Chinese version of a screening test in the survey, the CES-D-10, consisting of ten questions on a variety of depressive symptoms. Respondents are asked whether they had experienced the following feelings during the last week: 1) "I was bothered by things that don't usually bother me"; 2) "I had trouble keeping my mind on what I was doing"; 3) "I felt depressed"; 4) "I felt everything was an effort"; 5) "I felt hopeful about the future"; 6) "I felt fearful"; 7) "My sleep was restless"; 8) "I was happy"; 9) "I felt lonely"; 10) "I could not get "going"." Possible options are: "Rarely or none of the time", "Some or a little of the time", "Occasionally or a moderate amount of the time" and "Most or all of the time." Each of the items evaluates the severity of a particular symptom of psychological distress using a 4-point Likert-type scale from 0 (rarely or none of the time) to 3 (most or all of the time). Two positive items were recoded such that "rarely or none of the time" scored 3 points and "most or all of the time" scored 0 points. The total score is derived by summing the responses. This final score delivers an aggregate depression index ranging from 0 to 30, with a higher point indicating a more frequent occurrence of depressive symptoms and thus worse mental health. We create a dichotomous indicator using the threshold score of 8, which was set according to the 16 threshold suggested by Radloff (1977) for a 20-item case. Cognition is an important measure of mental health. Although the CHARLS questionnaire contains a five-point question on self-rated memory, just as the SRH described above, this subjective measure of cognition may suffer from similar concerns. To quantify the cognitive capacity of the elderly in a more reliable way, we instead construct an objective measure based on the score from a short memory test. In the interview, elderly participants are asked to memorise a list of ten common words[2] and recall as many words as possible in any order, both immediately after hearing them and later (after finishing depression and numeracy questions as well as drawing tasks). The immediate and delayed recall tasks gauge the elderly respondents' short-term memory and

[2]The ten words used for the respondent were randomly selected from one of the four wordlists: A. rice, river, doctor, clothes, egg, bowl, child, hand, book; B. stool, foot, sky, money, pillow, dog, house, wood, school, tea; C. mountain, stone, blood, mother, shoes, eye, girl, house, road, sun; D. water, hospital, tree, father, fire, tooth, moon, village, boy, table.

episodic memory respectively. We average the number of correct recalls at the immediate recall phase and delayed recall phase as our dependent variable in terms of cognitive ability, which ranges from 0 (very poor cognitive ability) to 10 (very good cognitive ability). On average, respondents remember 2.8 simple words over the immediate and delayed recall phases.

d. Subjective Well-being

We focus on two dimensions of subjective well-being (SWB), "life satisfaction" and "happiness", which have been proved to be good proxies of SWB. The life satisfaction question asks individuals "Please think about your life as a whole. How satisfied are you with it?" and possible answers take a scale representation from "Completely satisfied" to "Not at all satisfied." The happiness question is embedded in the aforementioned CES-D-10 test as one positive item. We create a dichotomous indicator that is equal to one if the respondent claims that s/he is satisfied with his/her current life or has felt happy during the survey's reference week, and zero otherwise.

B.2 Chinese Zodiac Signs and Risk Attitudes: RUMiC Data

To investigate the extent to which the Chinese zodiac sign can influence individual risk attitudes, we obtain data from the second wave of the RUMiC-Urban Migration in China (RUMiC RHS, 2009). In the questionnaire, there is a general risk question which directly asks interview respondents aged 16 and over about their willingness to take risks:

> *"Generally, some people prefer to take risk, while others try to avoid any risk. If it is to rank the risk from low to high as 0 to 10 (as shown by the following chart), 0 is "never take risk", 10 is "most likely to take risk", which level do you belong to (choose a number from 0 to 10)."*

Based on this question we create two measures to capture an individual's underlying attitude towards risk. Above all, we use a binary measure indicating that an individual is willing to bear *at least some* amount of risk (i.e., the reported value on the general risk

scale is greater than 0). We then probe the above question further by exploiting its ordinal structure and construct a second risk measure: the self-reported level of risk that ranges from 0 (very risk-averse) to 10 (very risk-taking). We call the former *risk indicator* and the latter *risk index* following Jaeger et al. (2010). The 2009 RHS sample covers 32,171 individuals from 7,992 rural households in nine provinces of China.[3] For comparison purposes, we limit our attention to respondents aged between 18 and 79, which perfectly replicates the age window of the adult children in the CHARLS. There are a total of 11,965 observations (7,570 households) in our final sample. Table B.1 summarises the main variables used in the empirical analysis, distinguished broadly by nature of a zodiac sign (Chinese animal sign or Western sun sign) and specifically by the sign's migration type (migration-prone or migration-averse).[4] In our representative sample, roughly 67% of individuals were born under migration-loving Chinese zodiac signs, while a smaller fraction of respondents (about 52%) were born under migration-loving Western zodiac signs. This is not surprising as the migration-prone group defined using Chinese animals incorporates two more zodiac signs than the same group characterised by horoscopes.

Let us now focus on the two variables related to risk attitudes. Looking first at the Chinese zodiac domain, we can see that individuals who were born under migration-seeking animal signs, relative to those born under migration-averse animal signs, have on average a greater propensity to take risks (0.710 vs. 0.674), with the t-test on difference in means strongly rejecting their similarity at the 1 percent level. With regard to risk tolerance level, the animal of birth seems to play a role as well, with individuals born under migration-loving animal signs being willing to take a significantly higher level of risk relative to their migration-averse counterparts (2.504 vs. 2.365). The difference in the subjective risk

[3]The RHS sampled provinces are: Anhui, Chongqing, Guangdong, Hebei, Henan, Hubei, Jiangsu, Sichuan, and Zhejiang.

[4]Referring to our previous argument, the twelve Chinese zodiac signs are treated as migration-loving or migration-averse according to the migration-related traits associated with each animal. Likewise, there are interesting findings in Western astrology that individuals born within a *positive* or *odd-numbered* sun sign (Aries, Gemini, Leo, Libra, Sagittarius, Aquarius) are more extrovert, adventurous, active and aggressive than those born within a *negative* or *even-numbered* sun sign (Taurus, Cancer, Virgo, Scorpio, Capricorn, Pisces) who are more introvert, gentle, conservative and risk-averse (see, for example, Mayo, White, and Eysenck, 1978; Van Rooij, 1994). We thus postulate that persons born under odd numbered star signs are more *prone* to migration and persons born under the even numbered star signs are more *averse* to migration.

level between the two groups, albeit not great in magnitude, is highly significant at the 1 percent level. Interestingly though, we find no statistically significant correlation between the zodiac signs and risk attitudes when it comes to the Western sun signs. Therefore, simply a raw comparison of unconditional means reveals that the Chinese zodiac signs are relevant determinants of Chinese people's risk attitudes, whilst the Western zodiac signs do not appear to reflect the risk preferences of the Chinese.

Next, we move to regression analysis in order to check whether the unconditional results outlined above are robust once we control for a number of primary determinants of general risk attitudes. We initially add into regressions only attributes that are purely exogenous (gender, age, height, weight, birth sign, and birth order), and then control additionally for characteristics that are potentially endogenous (marital status, years of education, monthly income, number of children, household size, and province of residence)[5]. The dependent variable is an individual's willingness to take risks—we examine both the probability of taking risks (*risk indicator*, estimated by a probit model) and the self-assessed risk level (*risk index*, estimated by the OLS). The main independent variable refers to a dichotomous indicator for whether a person's Chinese zodiac sign belongs to the migration-prone animal signs. In the placebo exercise, as suggested before, we repeat the same analysis replacing the zodiac variable with a dummy for whether a person's Western sun sign falls within the migration-prone category (i.e., the odd-numbered sun signs).

The estimation results obtained with probit and OLS are presented in Table B.2. As expected, females are less likely to take risks and exhibit a lower level of risk tolerance than males. Taller individuals are more willing to take risks and select a higher value on the general risk scale. Willingness to take risks increases with income, suggesting that wealthier individuals can better buffer "negative shocks." All of these effects are statistically significantly different from zero at the 1 percent significance level (with the exception of the estimates on height in column (3) and (7), yet they are still significant at the 5 percent level). Age and weight also appear to make a difference, but only when the measure of risk

[5]The results hold pretty well if we replace the province dummies with a bunch of county dummies provided by the RUMiC, which takes into account any geographical patterns in risk preferences at a more local level. Results with county controls will be available upon request.

attitudes is the risk tolerance level.

Most importantly, in addition to conventional determinants of risk attitudes (e.g., gender, height, and income), a person's birth sign is also found to significantly affect willingness to take risks. Indeed, in column (1) where only exogenous controls are added the coefficient estimate implies that having a migration-prone Chinese zodiac sign results in a greater probability of taking risks in general (3.4 percent effect, significant at the 1 percent level). It is reassuring to see that this point estimate remains similar in size and equally statistically significant (3.2 percent effect, significant at the 1 percent level) once we include additional controls (column (2)). Surprisingly, the astrological effects are also quantitatively significant—corresponding to about 63 percent of the gender effects on risk attitudes. In terms of risk level, column (3) suggests that being born under one of the migration-loving Chinese zodiac signs is associated with a significantly higher level of risk tolerance (point estimate 0.120). Introducing other control variables hardly changes the results, despite being statistically weaker at the 5 percent significance level (column (4)). In column (5)-(8) of Table B.2 we perform a placebo test, where we estimate the impact of the Western zodiac signs on a Chinese person's risk attitudes. In neither of the regressions performed does the Western horoscope appear to exert any influence on the person's willingness to take risks. In fact, the estimated coefficients on zodiac variable have unexpected negative signs and are never significantly different from zero.

Taken together, there are two important findings. Firstly, a comparison of the estimates in columns (1)-(4) and those in columns (5)-(8) indicates the importance of cultural beliefs in the formation and cultivation of personal attributes. We focus on the risk attitudes here due to data availability, but this conclusion can easily be generalised to other traits associated with migration (e.g., introversion/extroversion, openness, etc.). Secondly, we not only find that the Chinese zodiac sign is a good reflection of risk attitudes but we are also able to attribute causality to the regression results, as a person's birth sign (determined by year of birth) is exogenous with respect to his/her attitude towards risk. Establishing the causal impact of the zodiac sign on risk attitudes is the key to understanding the predictive power of astrology for migration: astrological variation in risk attitudes could

be part of the explanation as to how beliefs in zodiac signs can lead to differences in observable migration behaviour.

Table B.1: Descriptive Statistics (RUMiC 2009).

	Chinese Zodiac Sign		Western Zodiac Sign	
	Migration Prone	**Migration Averse**	**Migration Prone**	**Migration Averse**
Dependent Variables: Risk Attitudes				
Risk indicator (0/1)	0.710	0.674***	0.696	0.701
Risk index (0-10)	2.504	2.365***	2.430	2.490
Demographic and Household Characteristics				
Female (0/1)	0.407	0.414	0.414	0.405
Age (years)	48.639	49.046*	48.652	48.905
Height (cm)	164.538	164.409	164.476	164.518
Weight (kg)	60.759	60.658	60.737	60.714
Eldest child	0.377	0.350***	0.362	0.375
Married (0/1)	0.913	0.920	0.913	0.917
Years of education	7.311	7.296	7.292	7.322
Monthly earnings (/100 RMB)	5.618	5.593	5.493	5.739
Number of children	1.928	1.975**	1.945	1.941
Household size	3.315	3.323	3.329	3.305
Province Dummies				
Hebei	0.052	0.052	0.048	0.057**
Jiangsu	0.108	0.099	0.105	0.105
Zhejiang	0.148	0.155	0.141	0.160***
Anhui	0.096	0.094	0.100	0.091*
Henan	0.103	0.101	0.106	0.097
Hubei	0.127	0.133	0.134	0.124*
Guangdong	0.113	0.127**	0.121	0.115
Chongqing	0.056	0.058	0.056	0.058
Sichuan	0.196	0.181*	0.189	0.194
Observations	8,043	3,922	6,250	5,715

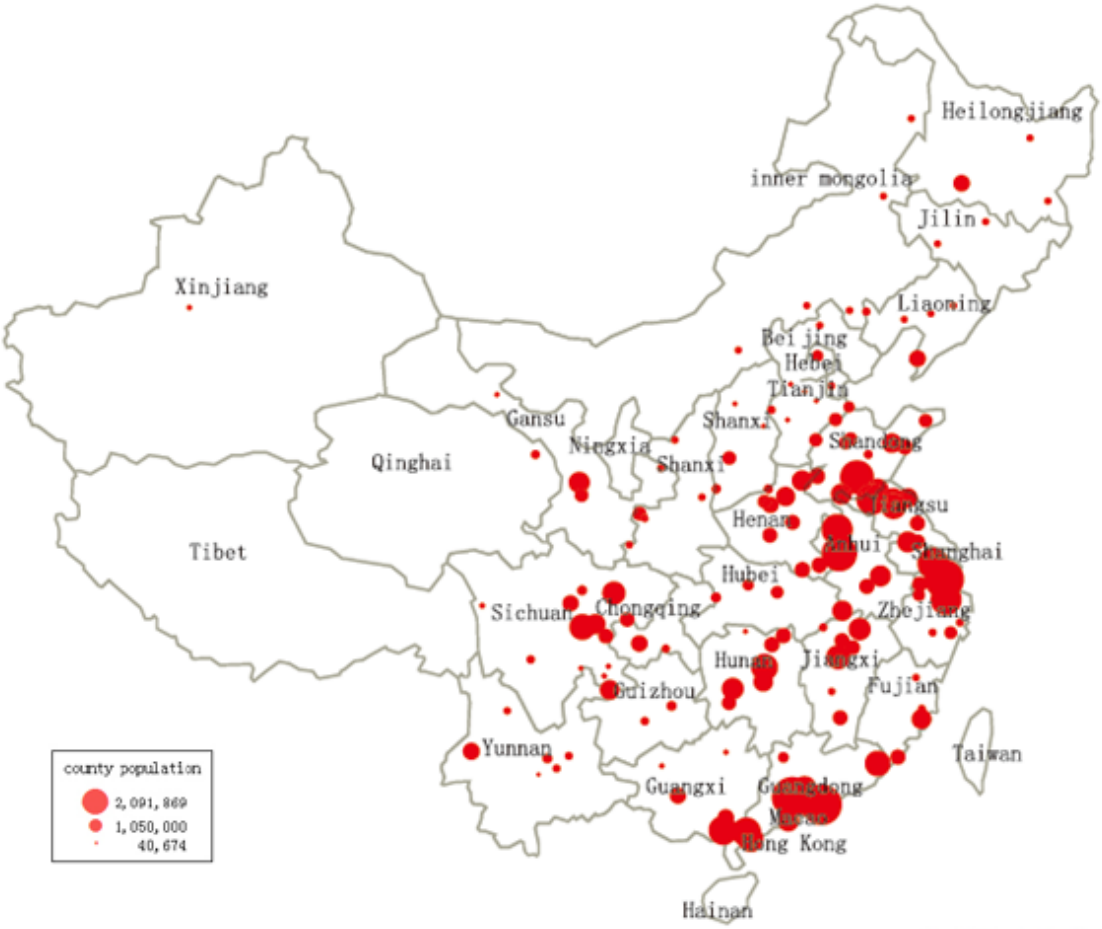
Source.—Rural-Urban Migration in China (RUMiC, RHS 2009).
Note.—In Chinese astrology, migration-prone zodiac refers to any of the eight signs of the Chinese zodiac animal: Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog; Migration-averse zodiac refers to any of the four signs of the Chinese zodiac animal: Snake, Goat, Rooster and Pig. In Western astrology, migration-prone zodiac refers to any of the odd-numbered Western horoscope: Aries, Gemini, Leo, Libra, Sagittarius and Aquarius; Migration-averse zodiac refers to any of the even-numbered Western horoscope: Taurus, Cancer, Virgo, Scorpio, Capricorn and Pisces. */**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table B.2: Probit and OLS Estimates of the Effects of Zodiac Signs on Risk Attitudes: Chinese Animal *v.s.* Western Horoscope (RUMiC 2009).

	Dependent Variable							
	Chinese Zodiac Sign				**Western Zodiac Sign *(Placebo Test)***			
	Risk Indicator		**Risk Index**		**Risk Indicator**		**Risk Index**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Migration-prone zodiac	0.034***	0.032***	0.120***	0.108**	–0.005	–0.002	–0.063	–0.049
	(0.009)	(0.009)	(0.044)	(0.043)	(0.008)	(0.008)	(0.041)	(0.041)
Female	–0.055***	–0.051***	–0.529***	–0.447***	–0.055***	–0.051***	–0.529***	–0.447***
	(0.011)	(0.011)	(0.051)	(0.052)	(0.011)	(0.011)	(0.051)	(0.052)
Age	0.002	0.002	–0.030**	–0.025*	0.002	0.002	–0.031**	–0.025*
	(0.002)	(0.003)	(0.012)	(0.013)	(0.002)	(0.003)	(0.012)	(0.013)
Age^2	–0.000**	–0.000**	–0.000	–0.000	–0.000**	–0.000**	–0.000	–0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Height	0.002***	0.004***	0.009**	0.018***	0.002***	0.004***	0.009**	0.018***
	(0.001)	(0.001)	(0.004)	(0.004)	(0.001)	(0.001)	(0.004)	(0.004)
Weight	–0.000	–0.001	0.008**	0.007**	–0.000	–0.001	0.008**	0.008**
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Eldest child	0.011	0.008	0.016	–0.003	0.012	0.009	0.018	–0.002
	(0.009)	(0.009)	(0.043)	(0.043)	(0.009)	(0.009)	(0.043)	(0.043)
Married		0.042**		0.111		0.042**		0.110
		(0.018)		(0.087)		(0.018)		(0.087)
Years of education		0.002		–0.001		0.002		–0.002
		(0.002)		(0.009)		(0.002)		(0.009)
Monthly earnings		0.001***		0.014***		0.001***		0.014***
		(0.000)		(0.002)		(0.000)		(0.002)
Number of children		0.003		0.022		0.003		0.022
		(0.005)		(0.024)		(0.005)		(0.024)
Household size		–0.010***		–0.022		–0.010***		–0.022
		(0.004)		(0.018)		(0.004)		(0.018)
Province fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	11,965	11,965	11,965	11,965	11,965	11,965	11,965	11,965

Source.—Rural-Urban Migration in China (RUMiC, RHS 2009)
Note.—The dependent variable risk index is the risk tolerance level reported by respondents on a scale from 0 (never take risk) to 10 (most likely to take risk). Risk indicator is a dummy variable that equals to 1 when the risk index is above 0. Migration-prone zodiac refers to any of the eight signs of the Chinese zodiac animal: Rat, Ox, Tiger, Rabbit, Dragon, Horse, Monkey and Dog, or any of the six signs of the Western horoscope: Aries, Gemini, Leo, Libra, Sagittarius and Aquarius. Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.

Figure B.1: CHARLS Sampled Counties and Districts.



Source.—A report by the CHARLS Research Team—"Challenges of Population Aging in China: Evidence from the National Baseline Survey of the China Health and Retirement Longitudinal Study (CHARLS)" (May 2013).

Table B.3: Principle Components of the Asset Index (CHARLS 2013).

	Scoring Factor	**Mean**	**SD**
Ownership of automobile	0.165	0.063	0.243
Ownership of electric bicycle	0.165	0.311	0.463
Ownership of motorcycle	0.180	0.361	0.480
Ownership of refrigerator	0.262	0.637	0.481
Ownership of washing machine	0.241	0.609	0.488
Ownership of television	0.137	0.934	0.249
Ownership of computer	0.279	0.147	0.354
Ownership of air conditioner	0.268	0.193	0.395
Number of durable goods	0.378	4.286	2.246
Flush toilet	0.225	0.327	0.469
Pit toilet/latrine	-0.151	0.885	0.319
No toilet	-0.150	0.288	0.453
Tap water	0.139	0.635	0.481
Bath facility	0.277	0.386	0.487
Main heating energy gas/electricity	0.192	0.390	0.488
Main cooking energy biomass (coal/crop residue/wood)	-0.195	0.593	0.491
Telephone connection	0.134	0.395	0.489
Broad-band internet	0.250	0.115	0.319
Number of rooms	0.216	6.471	3.589
Housing area (m^2)	0.165	124.860	79.386
Building high-quality material	0.185	0.265	0.441
Building low-quality material	-0.142	0.134	0.340
First eigenvalue	5.22		
% of covariance explained	23.7%		

Source.—Authors' calculation from the China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—The 22 asset variables used to construct the asset index are binary indicators with two exceptions: number of durable good owned by the household and number of rooms in the dwelling. This makes interpretation of the results easier: a change from 0 to 1 alters the asset index by scoring factor/standard deviation. For instance, asset index goes up by 0.262 units for households that own a refrigerator.

Table B.4: Full Set of IV Estimates of Gender-Specific Migration Effects on Parental Health Outcomes (CHARLS 2013).

	Dependent Variable					
	Self-Reported Health	**Body Mobility**	**ADLs/ IADLs**	**Depressive Symptoms**	**Cognitive Ability**	**Subjective Well-Being**
	(1)	(2)	(3)	(4)	(5)	(6)
Has migrant daughter (β_d)	0.336***	3.645**	0.223**	0.163	1.046**	0.490***
	(0.128)	(1.615)	(0.092)	(0.148)	(0.518)	(0.160)
Has migrant son (β_s)	0.093	0.539	0.010	0.107	0.268	0.058
	(0.145)	(1.806)	(0.103)	(0.165)	(0.580)	(0.181)
Female	–0.061***	–1.818***	–0.034***	–0.127***	0.054	–0.033**
	(0.012)	(0.159)	(0.010)	(0.014)	(0.050)	(0.015)
Age	–0.017	0.426**	0.048***	0.009	0.096**	0.052***
	(0.011)	(0.172)	(0.010)	(0.012)	(0.038)	(0.012)
Age^2	0.000	–0.005***	–0.000***	–0.000	–0.001***	–0.000***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Han ethnicity	–0.027	–0.270	–0.035*	–0.086**	–0.277**	–0.070**
	(0.026)	(0.309)	(0.020)	(0.034)	(0.113)	(0.034)
Good Mandarin level	0.002	–0.188	–0.010	–0.032	0.061	–0.052**
	(0.022)	(0.254)	(0.014)	(0.024)	(0.084)	(0.026)
Married	–0.038	–0.454	–0.020	0.055*	0.025	–0.026
	(0.025)	(0.316)	(0.019)	(0.029)	(0.094)	(0.032)
Has health insurance	–0.087**	0.010	–0.024	0.046	0.235*	0.030
	(0.036)	(0.529)	(0.025)	(0.040)	(0.123)	(0.040)
Can read or write	–0.025*	0.185	0.018	–0.018	0.600***	–0.032*
	(0.015)	(0.195)	(0.011)	(0.017)	(0.060)	(0.018)
Elementary school	–0.019	0.449*	0.009	0.016	0.856***	–0.090***
	(0.018)	(0.243)	(0.014)	(0.021)	(0.073)	(0.021)
Middle school and above	–0.042*	0.786*	0.025	–0.020	1.106***	–0.140***
	(0.024)	(0.458)	(0.022)	(0.032)	(0.134)	(0.030)
Household assets	0.010***	0.223***	0.004	0.032***	0.073***	0.022***
	(0.004)	(0.044)	(0.003)	(0.004)	(0.014)	(0.005)
Household size	0.010	–0.106	–0.006	–0.002	–0.005	0.017
	(0.012)	(0.164)	(0.009)	(0.014)	(0.051)	(0.015)
Number of daughters	–0.040**	–0.554***	–0.033***	–0.016	–0.110*	–0.038*
	(0.017)	(0.209)	(0.013)	(0.019)	(0.066)	(0.021)
Number of sons	0.002	0.062	0.004	0.000	0.065	0.043**
	(0.016)	(0.189)	(0.012)	(0.019)	(0.061)	(0.021)
Number of grandchildren	–0.005	0.282	0.019*	–0.004	–0.017	–0.024
	(0.013)	(0.175)	(0.010)	(0.015)	(0.051)	(0.016)
Mean age of children	0.005***	0.041*	0.001	0.003*	0.005	0.004*
	(0.002)	(0.024)	(0.001)	(0.002)	(0.007)	(0.002)
Has only one child	0.116***	0.573	0.013	0.041	0.179	0.133***
	(0.035)	(0.464)	(0.025)	(0.040)	(0.149)	(0.043)
Presence of medical facility	0.006	0.535**	0.002	–0.008	–0.096	–0.016
	(0.016)	(0.208)	(0.012)	(0.019)	(0.063)	(0.020)
Has access to tap water	0.026*	0.314	0.008	0.020	–0.019	0.019
	(0.016)	(0.202)	(0.012)	(0.018)	(0.063)	(0.020)
Number of rainy days	–0.001***	–0.003	–0.000*	–0.000	0.000	–0.001**
	(0.000)	(0.003)	(0.000)	(0.000)	(0.001)	(0.000)
Number of snowy days	0.000	–0.020***	0.000	–0.000	0.004	0.000
	(0.000)	(0.007)	(0.000)	(0.001)	(0.002)	(0.001)
Distance to closest pollution site	–0.000	0.001	0.000	–0.000**	–0.000	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,946	7,946	7,946	7,946	7,946	7,946
Kleibergen-Paap rk F stat	17.25	17.25	17.25	17.25	17.25	17.25

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013). All variables refer to year 2013 (wave II) except village-level characteristics which refer to year 2011 (wave I).

Note.—See notes for Table 2.5 for a detailed description of the dependent variables. All models include the control variables listed in Table 2.1. Instruments are the share of daughters with the migration-prone Chinese zodiacs and the share of sons with the migration-prone Chinese zodiacs. Robust standard errors clustered at household level are reported in parentheses accounting for survey weights.

*Statistically significant at the 10 percent level.

**Statistically significant at the 5 percent level.

***Statistically significant at the 1 percent level.

C Appendix to Chapter 3

Table C.1: Descriptive Statistics: Mean Comparisons of Average Budget Shares by Children's Remittance Status (CHARLS 2013).

	Receive No Remittances	**Receive Temporary Remittances**	**Receive Permanent Remittances**	***t*-test (2)-(1)**	***t*-test (3)-(1)**
	(1)	(2)	(3)	(4)	(5)
A: Consumption					
Food consumption	0.432	0.479	0.448	0.047***	0.015
Pure food	0.369	0.412	0.388	0.043***	0.019
Tobacco and alcohol	0.063	0.067	0.060	0.004	–0.003
Non-food consumption	0.191	0.183	0.195	–0.008	0.004
Clothing	0.038	0.026	0.028	–0.012***	–0.010***
Utilities and household services	0.107	0.107	0.119	0.000	0.012
Other products	0.046	0.049	0.048	0.003	0.002
B: Investment					
Consumptive investment	0.115	0.102	0.094	–0.013	–0.020*
Durables	0.063	0.050	0.042	–0.013**	–0.021***
Housing	0.051	0.052	0.052	0.001	0.001
Productive investment	0.162	0.181	0.181	0.019*	0.020
Health	0.107	0.136	0.133	0.029***	0.026**
Agriculture	0.047	0.040	0.044	–0.007	–0.003
Land	0.007	0.005	0.005	–0.002	–0.003
Observations	554	995	675		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—The four expenditure categories (food consumption, non-food consumption, consumptive investment, productive investment) do not add up to 100% because some expenditure items (education, taxes and fees, donations to the society) are not considered here.
*/**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table C.2: Descriptive Statistics: Household, Regional and Time Characteristics by Children's Remittance Status (CHARLS 2013).

	Receive No Remittances	**Receive Temporary Remittances**	**Receive Permanent Remittances**	***t*-test (2)-(1)**	***t*-test (3)-(1)**
	(1)	(2)	(3)	(4)	(5)
Household Characteristics					
Household size (excl. migrants)	3.879	3.262	3.360	–0.617***	–0.519***
HH members age < 6 (0/1)	0.081	0.067	0.073	–0.014	–0.009
HH members age 6-15 (0/1)	0.027	0.062	0.037	0.035***	0.010
HH members age 16-65 (0/1)	0.928	0.779	0.704	–0.149***	–0.224***
HH members age >65 (0/1)	0.218	0.425	0.569	0.207***	0.350***
HH members with no formal education (0/1)	0.361	0.520	0.483	0.159***	0.122***
HH members with primary education (0/1)	0.626	0.635	0.643	0.009	0.017
HH members with secondary education (0/1)	0.478	0.328	0.433	–0.151***	–0.046
HH members with high school education or above (0/1)	0.222	0.162	0.236	–0.060***	0.014
Average age of children (years)	30.191	35.673	38.799	5.482***	8.607***
Own a land (0/1)	0.852	0.871	0.827	0.019	–0.025
Regional Characteristics					
Eastern provinces (0/1)	0.352	0.242	0.320	–0.110***	–0.032
Interior provinces (0/1)	0.314	0.400	0.366	0.086***	0.052*
Western provinces (0/1)	0.334	0.358	0.314	0.024	–0.020
Survey Month Dummies					
July	0.513	0.451	0.456	–0.061**	–0.056**
August	0.394	0.454	0.456	0.061**	0.063**
September	0.052	0.047	0.034	–0.005	–0.018
October	0.029	0.038	0.034	0.009	0.005
November	0.013	0.009	0.019	–0.004	0.007
Instruments					
Village migration rate t-3 (%)	0.122	0.185	0.128	0.064***	0.006
Hukou reform at child age 15-18 (0/1)	0.236	0.357	0.360	0.120***	0.124***
Observations	554	995	675		

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—The eastern region includes the following ten provinces and municipalities: Beijing, Shanghai, Fujian, Guangdong, Hebei, Jiangsu, Liaoning, Shandong, Tianjin and Zhejiang. The interior region includes the following eight provinces: Anhui, Heilongjiang, Henan, Hubei, Hunan, Jiangxi, Jilin and Shanxi. The western region includes the following ten provinces and municipalities: Chongqing, Gansu, Guangxi, Guizhou, Inner Mongolia, Qinghai, Shanxi, Sichuan, Xinjiang and Yunnan.
*/**/*** indicate difference in means is statistically significant at the 0.1/0.05/0.01 level.

Table C.3: Full Set of Estimates: First Stage Regressions of Remittance Equation (CHARLS 2013).

	Dependent Variable	
	Has Temporary Migrant	**Has Permanent Migrant**
	(1)	(2)
IV: Village migration rate t-3	0.243***	–0.180***
	(0.052)	(0.044)
IV: *Hukou* reform at child age 15-18	0.062***	0.082***
	(0.023)	(0.021)
Household size (excl. migrants)	–0.029***	–0.016**
	(0.007)	(0.007)
HH members age <6	0.024	0.030
	(0.043)	(0.039)
HH members age 6-15	0.192***	–0.070*
	(0.048)	(0.042)
HH members age 16-65	0.006	0.008
	(0.036)	(0.035)
HH members age >65	–0.016	0.053*
	(0.031)	(0.028)
HH members with no formal education	0.057**	–0.006
	(0.023)	(0.021)
HH members with primary education	0.005	0.034
	(0.023)	(0.021)
HH members with secondary education	–0.081***	0.122***
	(0.024)	(0.021)
HH members with high school education or above	–0.047*	0.125***
	(0.028)	(0.026)
Average age of children	–0.000	0.016***
	(0.002)	(0.002)
Own a land	0.075**	–0.009
	(0.029)	(0.028)
Interior provinces	0.016	0.014
	(0.025)	(0.022)
Western provinces	0.000	0.000
	(.)	(.)
July	0.115	–0.173*
	(0.084)	(0.089)
August	0.146*	–0.163*
	(0.084)	(0.089)
September	0.154	–0.233**
	(0.097)	(0.096)
October	0.168*	–0.154
	(0.100)	(0.102)
Observations	2,224	2,224
R^2	0.063	0.121
F stat 1^{st} stage Equation1	14.39	
F stat 1^{st} stage Equation2		16.89
Kleibergen-Paap rk F stat	11.80	

Source.—China Health and Retirement Longitudinal Study (CHARLS 2013).
Note.—Robust standard errors are reported in parentheses.
*Statistically significant at the 10 percent level.
**Statistically significant at the 5 percent level.
***Statistically significant at the 1 percent level.