



# MONASH University

## **THREE ESSAYS ON SUBJECTIVE WELLBEING**

**KUSHNEEL AVNEET PRAKASH**

*B.Com, PG.Dip[Econs], M.Com[Econs]*

*The University of the South Pacific*

A thesis submitted for the degree of *Doctor of Philosophy* at  
Monash University in 2020  
Department of Economics

## **Copyright Notice**

© The author (2020).

I certify that I have made all reasonable efforts to secure copyright permissions for third-party content included in this thesis and have not knowingly added copyright content to my work without the owner's permission.

## Abstract

This dissertation is a collection of three distinct, but related, papers on subjective wellbeing (SWB). Economists are increasingly turning their attention to shining a light on what determines how satisfied people are with their lives and why some people are more satisfied with their lives than others. Chapter 1 presents a brief introduction on the concept of SWB in general and outlines a brief summary of the three related studies on SWB.

The first paper, *'The Quintessential Chinese Dream'? Homeownership and the Subjective Wellbeing of China's Next Generation* examines how homeownership influences the SWB of children. Specifically, this chapter utilises nationally representative panel data from China Family Panel Studies to examine how parental homeownership status influences the subjective wellbeing of their children in China. The results show that children aged 10-15 years of homeowners have 2.79 percentage points higher subjective wellbeing than children of non-homeowners. This finding continues to hold after using a series of alternative approaches to address the endogeneity of homeownership status and a number of other robustness checks. The results also suggest that parental inputs into their children's education, investment in home maintenance, the quality of the neighbourhood and parents' emotional support for their children are channels through which homeownership influences children's subjective wellbeing.

The second paper, *Housing Wealth and Happiness in Urban China* contributes to the discourse regarding rapid growth in inequality in housing wealth in China. This chapter examines how housing wealth and housing wealth inequality are associated with happiness, drawing on panel data from China Household Finance Survey. I find that housing wealth and housing wealth inequality matter for happiness and that more housing wealth increases happiness with diminishing returns to owning a second and third house. The results also show that the relationship between housing wealth inequality and happiness depends on one's reference group and the level of housing wealth inequality. I also employ the concentration index to examine the effect of housing wealth inequality on happiness inequality. The wealth-related concentration

index for happiness are all positive, suggesting that higher happiness is more concentrated among people with higher housing wealth.

Finally, in the third paper, *Petrol Prices and Subjective Wellbeing* I examine the effect of petrol prices on SWB using household panel data. To do so, I use 17 waves of the Household, Income and Labour Dynamics in Australia (HILDA) survey. Based on our preferred instrumental variable estimates, we find that a standard deviation increase in petrol prices leads to a decline of 0.0157–0.0245 standard deviations in SWB. The finding that increases in petrol prices significantly lower SWB is robust to alternative measures of wellbeing and alternative ways of addressing endogeneity, as well as employing different sources of fuel price data measured at a range of frequencies. We also examine the channels through which petrol prices influence SWB and find that maintaining social networks is an important way through which petrol prices influence SWB.

## **Declaration**

This thesis is an original work of my research and contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Print Name: Kushneel Avneet Prakash

Date: 29/09/2020

## Publications during enrolment

1. Locus of control and the gender gap in mental health. *Journal of Economic Behavior & Organization*, 2020, 178, 740-758 (with R. Smyth, S. Awaworyi Churchill, M. Munyanyi). [*Not part of thesis*]
2. Petrol prices and subjective wellbeing. *Energy Economics*, 90 [104867] (with R. Smyth, S. Awaworyi Churchill). [*Part of thesis*]
3. Housing wealth and happiness in urban China. *Cities*, 2020, 96 [102470] (with R. Smyth, Z. Cheng, H. Wang). [*Part of thesis*]
4. ‘The quintessential Chinese dream’? Homeownership and the subjective wellbeing of China’s next generation. *China Economic Review*, 2019, 58 [101350] (with R. Smyth). [*Part of thesis*]

## Thesis including published works declaration

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes three original papers published in peer reviewed journals. The core theme of the thesis is subjective wellbeing. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the student, working within the Department of Economics under the supervision of Prof. Russell Smyth.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research. In the case of each respective chapters containing published works, my contribution to the work involved the following:

<b>Thesis Chapter</b>	<b>Publication Title</b>	<b>Status</b>	<b>Nature and % of student contribution</b>	<b>Co-author name(s) Nature and % of Co-author's contribution*</b>	<b>Co-author(s), Monash student</b>
Two	'The quintessential Chinese dream'? Homeownership and the subjective wellbeing of China's next generation	Published	Concept, collecting data, data analysis and writing first draft [80%]	1. Russell Smyth - input into manuscript [20%]	No
Three	Housing wealth and happiness in urban China	Published	Concept, collecting data, data analysis and writing first draft [50%]	1. Russell Smyth - input into manuscript [10%] 2. Zhiming Cheng - input into manuscript [20%] 3. Haning Wang - input into manuscript [20%]	No  No  No

Four	Petrol prices and subjective wellbeing	Published	Concept, collecting data, data analysis and writing first draft [70%]	1. Russell Smyth - input into manuscript [10%] 2. Sefa Awaworyi Churchill - input into manuscript [20%]	No  No
------	--	-----------	---	--	--------------

I have renumbered sections of published papers in order to generate a consistent presentation within the thesis.

**Student name:** Kushneel Avneet Prakash

**Date:** 29/09/2020

I hereby certify that the above declaration correctly reflects the nature and extent of the student's and co-authors' contributions to this work. In instances where I am not the responsible author I have consulted with the responsible author to agree on the respective contributions of the authors.

**Main Supervisor name:** Prof. Russell Smyth

**Date:** 29/09/2020



## **Dedication**

This thesis is dedicated to my mummy and papa (my beloved parents):

Mr. Satendra Prakash and Mrs. Arun Lata Prakash

&

to my be-all and end-all lovely wife, Reema.

## Acknowledgements

My first and foremost heartfelt appreciation goes out to my awesome main supervisor, Prof. Russell Smyth. Russell, my mentor, deserves the most credit for taking me under his wings. He didn't have to, and for that I am for ever thankful. Russell has not only helped me frame my research ideas, but he has been super inspirational and supportive at every step in my PhD journey. He allowed me to come out of my comfort zone to learn new software and explore research questions using survey data on things which matter for wellbeing. Most important of all, he gave me enough space and support to make me an independent researcher. From the time I was exploring my PhD options at Monash University, I have always adored his intellect, work ethics, professionalism and his amiable personality. While he would have new publications coming in almost every month with many more in revise and resubmit form with his co-authors and other students, his detailed feedback with very quick turn around on my work would make me feel that I am probably his only student. *He is just amazing.*

I fondly recollect all the stimulating discussions I had with Russell in his office at Clayton and Caulfield campus and at times over lunch, which he would graciously pay for. He would encourage me to make the most of my time as a PhD student by attending and/or presenting at relevant local and international PhD conferences and workshops. He made me realise that this PhD is a journey rather than a destination in itself. On a much brighter personal note, while some of my PhD mates would go paranoid seeing their supervisor, bumping into Russell either in Menzies corridor or in the tea room would always lead to pleasant conversations ranging from studies, weekend sports, recommendations for travelling on business class on my next trip abroad to suggestions for having expensive coffee with scenic view during afternoon twilight on the hills of Florence in Italy (which I did but with a glass of wine). I could not have imagined having a better mentor for my PhD who gave me the same level of respect he would give to any of his co-authors and his colleagues. I hope to continue with the collegial bond we have created and continue working together on new research ideas and publications for many more years to come.

I am also indebted to all those who have commented on my three PhD papers. The comments and suggestion from my PhD panel committee members, Prof. Lata

Gangadharan, Dr. Vinod Mishra and Dr. Liang Choon Wang had allowed me to better frame my research questions and improve on the analysis for the robustness of the results. I truly appreciate their time in reading my work and their honest feedback and their desire for me to do well. I would also like to extend my sincere gratitude to those with whom I have had discussions with or have commented on my work. I found renowned economists at academic conferences incredibly supportive where people were genuinely willing to give valuable feedback to PhD students. With apologies in advance for inevitably forgetting someone, I express my sincere gratitude to Dr. Haining Wang from Sun Yat-sen University, Dr. Zhiming Cheng from University of New South Wales, Dr. Sefa Awaworyi Churchill from RMIT University, Dr. Habibur Rahman from Monash University Malaysia campus, Prof. Kenneth Clements from University of Western Australia, Prof. Mark Wooden from University of Melbourne, and the anonymous reviewers from the China Economic Review, Cities and Energy Economics journal plus the many people who have sat through my presentations and commented on my work either orally or via emails. Their comments and advice have guided and challenged my thinking to improve the analysis and arguments in my papers to a publishable quality. In particular, I would like to convey my sincere gratitude to Dr. Sefa who taught me a lot on the art of publishing and included me as part of a number collaborations that we are currently working on. Special thanks also to my two thesis examiners who have provided useful insights and suggestions for future work.

I was also blessed to have a great cohort of like-thinking minds doing PhD with whom I have often discussed my research ideas, shared casual drinks or played futsal. In no particular order, I thank Justin, Ratul, Veasna, Chau, Leo, Lizzy, Main, Ola, Abby, Hasib, Lina, Ben and Abebe for the company and collegial support throughout my journey. At this point I would also like to acknowledge the financial support of our department and Monash Graduate Association (MGA) to our PhD society which I was coordinating with Ratul to organise team bonding activities for our group. I would also like to thank all the academic and professional staff at the Department of Economics of Monash University who all made me feel part of the department and provided me with a decent workstation for working on campus and to work from home during the COVID-19 pandemic situation.

I would also like to extend my sincere appreciation to the Monash University for awarding me with scholarships to cover for my tuition fees via Monash International Postgraduate Research Scholarship (MIPRS) and Monash Graduate Scholarship (MGS) to cover for my stipend. Special mention also goes out to the Department of Economics for awarding me with departmental top-up scholarship, which provided additional stipend during my study years.

Most importantly, I thank my mum and dad for their unconditional support and motivation during the course of my program. It is fair to say that attaining PhD and having academic title Dr. in front of my name was my parents' dream which overtime became my drive to do well at school and universities I attended. The passion to excel and make my parents proud has defined me and my career choices, for which I am forever grateful.

Special acknowledgment also goes out to my friends and brother back at home. To Ronil, my little brother, thank you so much for late night chats which would refresh my mind from the constant thoughts on my work. Thank you for taking the burden of managing the construction our family home back in Fiji when I came over to Melbourne for studies. This was a huge relief that allowed me to focus fully on my studies knowing that you took the responsibilities on your shoulders as a strong and responsible man you have grown to be. Thanks to also my friends who have become more like my family, namely Krishneel, Jaynesh, Ashneel, Sanjesh, Preetika, Ashna, Ashley, Kelvin, Edwin, Namita and young Neytik for constantly being in contact and making me feel closer to home always.

And finally, to my better-half, my lovely wife, Reema. I am lucky and blessed to have her beside me in this journey of ours. Her moral support, love, warmth, laughter and adventures made this a fun and exciting journey. I thank her for all the understanding and patience in moving to a new city right after our wedding and making our small rental apartment, a home. She is the one where I would find comfort at the end of tiring day, weeks, months and years. I couldn't have imagined a better person to share this success and achievements besides her. For that, I am eternally grateful. You are, and forever will be, my be-all and end-all.

## TABLE OF CONTENTS

<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	<b>1-8</b>
<b>CHAPTER 2</b>	<b>‘THE QUINTESSENTIAL CHINESE DREAM’? HOMEOWNERSHIP AND THE SUBJECTIVE WELLBEING OF CHINA’S NEXT GENERATION</b>	<b>9-58</b>
	Abstract	10
Section 2.1	Introduction	11
Section 2.2	Conceptual framework and channels	14
Section 2.3	China’s context	16
Section 2.4	Data	18
Section 2.5	The Empirical Model	24
Section 2.6	Empirical Results	28
Section 2.7	Extensions and robustness checks	35
Section 2.8	Conclusion	41
	References	44
	Appendices	51
<b>CHAPTER 3</b>	<b>HOUSING WEALTH AND HAPPINESS IN URBAN CHINA</b>	<b>59-93</b>
	Abstract	60
Section 3.1	Introduction	61
Section 3.2	Literature Review	63
Section 3.3	How does housing wealth of others affect happiness in Chinese cities?	65
Section 3.4	Data and methods	67
Section 3.5	Main results	73
Section 3.6	Robustness checks	78
Section 3.7	Conclusion	82
	References	84
	Appendices	90
<b>CHAPTER 4</b>	<b>PETROL PRICES AND SUBJECTIVE WELLBEING</b>	<b>94-161</b>
	Abstract	95
Section 4.1	Introduction	96

Section 4.2	Why should petrol prices influence subjective wellbeing?	101
Section 4.3	Data and Variables	103-108
Section 4.3.1	Main outcome variable	104
Section 4.3.2	Petrol prices	107
Section 4.3.3	Covariates	108
Section 4.3.4	Channels	108
Section 4.4	Empirical Method	109
Section 4.5	Results	115-136
Section 4.5.1	Baseline results	115
Section 4.5.2	Addressing endogeneity	117
Section 4.5.3	Potential channels through which petrol prices influence SWB	117
Section 4.5.4	Extension and robustness checks	121-137
Section 4.5.4.1	Heterogenous effects across sub-groups	121
Section 4.5.4.2	Role of volatility and lagged effects of petrol price on SWB	124
Section 4.5.4.3	Economic significance of petrol price effects	128
Section 4.5.4.4	Employing alternative IVs	130
Section 4.5.4.5	Alternative measures of wellbeing	131
Section 4.5.4.6	Robustness to alternative fuel data and other sensitivity checks	134
Section 4.6	Conclusion	137
	References	140
	Appendices	150
<b>CHAPTER 5</b>	<b>CONCLUSION</b>	<b>162-165</b>
<b>APPENDICES</b>	Chapter 2 published paper	
	Chapter 3 published paper	

## List of Tables

2.1	Descriptive Statistics	23
2.2	Determinants of subjective wellbeing for children, CFPS (OLS results)	29
2.3	Determinants of subjective wellbeing in sub-samples, CFPS (OLS results)	31
2.4	Structural equation model of the relationship between homeownership and subjective wellbeing	33
2.5	Robustness checks (instrumenting endogenous variables)	36
2.6	Propensity score matching estimates of the average treatment effects of homeownership on subjective wellbeing of children, CFPS	38
2.7	Robustness checks, CFPS (4 waves – 2010-2012-2014-2016)	39
2.8	Robustness checks, CFPS (same children surveyed over 2010-2012-2014 waves)	40
3.1	Summary statistics of key variables, China Household Finance Survey 2011-2015	71
3.2	Fixed effects estimates of housing wealth and housing wealth inequality on happiness	74
3.3	Fixed effects estimates	76
3.4	Decomposition of the concentration index of happiness	78
3.5	Robustness check: coefficient stability	79
3.6	Robustness check: fixed effects estimates with different specifications	80
4.1	Subjective wellbeing by various categories	106
4.2	Petrol prices and subjective wellbeing, using city-level monthly ULP price data (baseline results)	118
4.3	Petrol prices and subjective wellbeing, using city-level monthly ULP price data (IV results)	119
4.4	Estimated indirect and direct effects of petrol prices on subjective wellbeing	120
4.5	Lagged petrol prices, petrol price volatility and subjective wellbeing	126
4.6	The income equivalence of rising petrol prices	129
4.7	Robustness checks: employing alternative IVs	131
4.8	Robustness checks: alternative measures of wellbeing	133
4.9	Robustness check: Petrol prices and subjective wellbeing using city-level monthly diesel price data (IV results)	135

## List of Figures

2.1	Diagrammatic representation of home tenure status in the total sample	21
2.2	Subjective wellbeing by categories of homeownership	22
3.1	Housing wealth inequality by province in 2015	62
3.2	Concentration curve for housing wealth-related happiness	72
4.1	Trends in life satisfaction in sample over time: HILDA waves 1-17	105
4.2	Heterogeneous effects of petrol price on life satisfaction by sub-groups	122



## List of Appendices

A2.1	Factor analysis for the subjective wellbeing items	51
A2.2	Definition of variables	52
A2.3	Determinants of subjective wellbeing for children, CFPS (ordered logit & ordered probit model results)	56
A2.4	Determinants of subjective wellbeing in sub-samples, CFPS (IV results)	57
A2.5	Factor analysis for the subjective wellbeing items (as used in robustness tests)	58
A3.1	Summary statistics, China Household Finance Survey 2011, 2013 and 2015	90
A3.2	Decomposition of Gini coefficient by source of housing wealth (full sample)	91
A3.3	Fixed effects estimates of housing wealth inequality within different reference groups on happiness	92
A3.4	Housing wealth, non-housing wealth and happiness	93
A4.1	Description and Summary Statistics of variables	150
A4.2	Test on the validity of IV	152
A4.3	Petrol prices and Life satisfaction, full baseline and 2SLS results	153
A4.4	Petrol prices and subjective wellbeing, alternating years	155
A4.5	Petrol prices and subjective wellbeing, using state-level yearly petrol prices	156
A4.6	Petrol prices and subjective wellbeing, heterogeneous effects by geographical location and vehicle ownership using state-level yearly petrol prices	157
A4.7	Petrol prices and subjective wellbeing using alternative yearly fuel prices (IV results)	158
A4.8	Petrol prices and subjective wellbeing, clustering at city-level	159
A4.9	Petrol prices and subjective wellbeing, using equivalized income	160
A4.10	Baseline and 2SLS results, using average monthly temperature as an additional control variable	161

# **CHAPTER 1**

## **INTRODUCTION**

There has been a remarkable surge in interest in studying life satisfaction, happiness, or the more precise term in the economics literature, “subjective wellbeing” (SWB) over the past two decades. Surveys based on answers to the question “how satisfied are you with your life?” have provided scholars and policy makers alike increased understanding of the factors influencing perceived happiness. The notion that formulation of public policy by policy makers should aim for something beyond the traditional measures of GDP is far from new, but it has gained prominence in recent times. The Stiglitz Commission (Stiglitz, Sen & Fitoussi, 2009), for instance, recommended the use of subjective measures, such as SWB, to measure, and monitor, social progress. There is now growing interest among policymakers in using measures of SWB to evaluate the impact of policy (see eg. DiMaria, Peroni & Sarrccino, 2019; Sachs, Becchetti & Annet, 2016). Improving SWB has, thus, become an important policy objective in many countries. The focus on Gross National Happiness as the goal of the government in Bhutan since 2008 and the recent 2019 Wellbeing Budget in New Zealand are a few examples of its growing importance. Economists are, thus, increasingly turning their attention to understanding what determines how satisfied people are with their lives and why some people are more satisfied with their lives than others. There are some correlates with SWB that are well-known (see Coates, Anand & Norris (2013) and Dolan, Peasgood & White (2008) for recent reviews), but much is still to be learnt. This dissertation contributes to our understanding of the factors correlated with SWB through the presentation of three independent essays.

The first paper of this dissertation focusses on the effect of one of the important objectives for many people in their life, owning one’s own home. Numerous studies have shown that owning one’s own home is linked to many economic and social benefits for family members and the society at large.<sup>1</sup> The role of homeownership has not only received attention in the economics discipline, but it has been examined from a multi-disciplinary approach. Scholars have discussed, and analysed, the consequences of homeownership from various perspective including demography, economics, geography, political science, psychology and sociology.<sup>2</sup> While there are studies on the economic and social implications of homeownership on homeowners

---

<sup>1</sup> See Dietz and Haurin (2003) and Rohe, Zandt and McCarthy (2002) for discussion on various social and economic effects of homeownership.

<sup>2</sup> See Zavisca and Theodore (2016) for a recent review.

and their children, the effect of homeownership on children's SWB has received very little attention in the literature. There is only one study that includes homeownership status as one of the variables in a general study of the SWB of children in the UK. The novel contribution of my first paper is that I present the first study to examine in depth the relationship between homeownership and SWB of children. I also use panel data rather than cross-sectional data and address endogeneity of homeownership together with examining the channels via which homeownership may affect SWB of children. To do so, I focus on China and employ nationally representative longitudinal data for that country from the China Family Panel Studies (CFPS) survey.

China represents a noteworthy case in which to situate a study on the relationship between homeownership and SWB of children. Homeownership for years was regarded as the quintessential American dream, but it is now the quintessential Chinese dream (Sito & Liu, 2018). China is becoming a nation of homeowners, with around 90% of households owning their own homes (Trading Economics, 2018). The Chinese case allows us to focus on a country outside of the United States or Western Europe in which much of the literature on the implications of homeownership is concentrated. This is particularly important because much of the literature on the effects of home ownership post the Global Financial Crisis in United States or Western European settings has focused on implications of declining home ownership, while China has experienced increasing rates of home ownership and now has one of the highest rates of home ownership in the world.

The findings suggest that parental homeownership status has a positive and significant effect on the SWB of their children. The channels through which homeownership influences children's SWB are found to be parental inputs into their children's education, investment in home maintenance, the quality of the neighbourhood and parents' emotional support for their children. These findings have considerable policy relevance given the significant increase in homeownership in China in recent years.

In the second paper of this dissertation, I continue to explore further aspects of housing and wellbeing in China. China presents an excellent example of a society in which housing markets were traditionally not important, but the commodification of housing and the consequential rapid growth in homeownership rates has resulted in

unprecedented levels of housing assets in China. Total housing wealth accounts for nearly 80% per cent of total household wealth which is much higher than in most other countries (Xie & Jin, 2015). As a result, over the last three decades increasing housing wealth as a component of total household wealth in China has created massive housing wealth inequality. The recent work by Piketty (2014) has put an academic spotlight on the role that inequality in housing wealth has played in contributing to steadily rising wealth inequality in many economies since the 1970s. While there is growing international interest in housing wealth inequality as a contributor to overall wealth inequality there are no existing studies for China, or other countries, that examine how housing wealth inequality affect happiness using longitudinal data.

In my second paper, I examine how housing wealth and inequality in housing wealth affects people's happiness in China using the China Household Finance Survey (CHFS) data. More specifically, in this paper I am interested in investigating whether housing wealth inequality contributes to differences in individual happiness in societies. I also further investigate whether there is increasing returns to happiness for owning more than one home. The findings show that housing wealth and housing wealth inequality matter for SWB. The relationship between housing wealth inequality and SWB depends on the reference group and the level of housing wealth inequality. I find that more housing wealth increases SWB but with diminishing returns to owning a second and third house and that higher happiness in China is more concentrated among people with more housing wealth. At a time when China has experienced rapid growth in inequality in housing wealth, this study has considerable policy relevance and calls for increased efforts to reduce general inequality in housing wealth.

In the third paper, I examine the effect of movements in petrol prices on SWB. Since the first oil price shock of the 1970s, economists have spent a lot of time better understanding the implications and dynamics of movements in petrol prices (see eg. Bachmeier & Griffin, 2003; Honarvar, 2009 and Valadkhani, 2013). An implicit motivation for such studies is that petrol price increases, as well as volatility in petrol prices, have adverse welfare effects on consumers and that through improving our understanding of petrol price movements we can reduce harmful welfare effects. Therefore, a natural extension of such studies, particularly given economists' parallel

keen interest in the antecedents of SWB at the individual level, is to directly examine how petrol price movements affect SWB.

In examining the relationship between petrol prices and SWB, I employ longitudinal data from the Household, Income and Labour Dynamics in Australia (HILDA) survey. Australia is representative of many developed countries that are heavily reliant on imported petroleum because of rising and highly volatile nature of petrol prices. Boyd-Swan and Herbst (2012) and Graham and Chattopadhyay (2010) are at least two studies which have investigated the relationship between fuel prices and wellbeing at household level. I differ from these studies in several important ways. The first is that I provide some firm evidence on the relationship between petrol prices and SWB for a country other than the United States that has experienced rising petrol prices that one would expect to effect SWB. Second, I differ methodologically from existing studies and use panel data to address the endogeneity of petrol prices. I also extend my analysis to examine several channels through which petrol prices potentially influences a person's SWB. The empirical findings suggest that increase in petrol prices are associated with a decline in SWB which remains robust to alternative ways of addressing endogeneity and to using different fuel prices from different sources and at different frequencies. Further results show that maintaining social networks is an important channel through which petrol prices have an adverse effect on SWB. I further carry out analysis on income equivalence for a change in SWB due to a change in petrol prices to quantify additional income compensatory effects to maintain the same level of SWB. Given that there are adverse effects of both diesel and petrol prices, as well as their volatility, on the wellbeing of individuals, an important policy implication of this study is to subsidise alternatives to fuel cars and renews calls for greater investment in public transport services, cycling and walking infrastructure in Australia. These policy interventions would provide alternatives to travel by car and reduce the sensitivity of individual SWB to petrol prices.

This dissertation is organised in five chapters. Following this introductory chapter, the relationship between homeownership and SWB of children in China is explored in Chapter 2. Chapter 3 extends our understanding on the dynamics of SWB in respect to housing. In this chapter, the relationship of housing wealth and housing wealth

inequality to individual SWB is investigated. Chapter 4 presents the analysis on the association of the dynamics of petrol prices on SWB. The final Chapter 5, concludes.

## References

- Bachmeier, L., & Griffin, J. (2003). New evidence on asymmetric gasoline price responses. *The Review of Economics and Statistics*, 85(3), 772-776.
- Boyd-Swan, C., & Herbst, C. (2012). Pain at the pump: Gasoline prices and subjective well-being. *Journal of Urban Economics*, 72, 160-175.
- Coates, D., Anand, P., & Norris, M. (2013). Housing, happiness and capabilities: A summary of the international evidence and models. *International Journal of Energy, Environment, and Economics*, 21(3), 181-214.
- Dietz, R., & Haurin, D. (2003). The social and private micro-level consequences of homeownership. *Journal of Urban Economics*, 54, 401-450.
- DiMaria, C., Peroni, C., & Sarracino, F. (2019). Happiness matters: Productivity gains from subjective well-being. *Journal of Happiness Studies*, 1-22.
- Dolan, P., Peasgood, T., & White, M. (2008). Do we really know what makes us happy? A review of economic literature on the factors associated with subjective wellbeing. *Journal of Economic Psychology*, 29, 94-122.
- Graham, C., & Chattopadhyay, S. (2010). (Un?) Happiness and gasoline prices in the United States. Retrieved May 5, 2019, from <https://www.brookings.edu/research/unhappiness-and-gasoline-prices-in-the-united-states/>.
- Honarvar, A. (2009). Asymmetry in retail gasoline and crude oil price movements in the United States: an application of hidden cointegration technique. *Energy Economics*, 31(3), 395-402.
- Piketty, T. (2014). *Capital in the Twenty-First Century*. Cambridge: Belknap Press.
- Rohe, W., Zandt, S., & McCarthy, G. (2002). Home ownership and access to Opportunity. *Housing Studies*, 17(1), 51-61.
- Sachs, J., Becchetti, L., & Annett, A. (2016). World Happiness Report 2016 (Vol.2). New York: UN Sustainable Development Solutions Network.
- Sito, P. & Liu, P. (2018). China property: How the world's biggest housing market emerged. *South China Morning Post*, November 26. Retrieved March 28 2019 from: <https://www.scmp.com/business/article/2174886/american-dream-home-ownership-quickly-swept-through-china-was-it-too-much>
- Stiglitz, J., Sen, A., & Fitoussi, J. (2009). *Report by the commission on the measurement of economic performance and social progress*. Paris: Commission on the measurement of economic performance and social progress. Retrieved



May 2, 2019, from [http://www.stiglitz-sen-fitoussi.fr/documents/rapport\\_anglais.pdf](http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf).

Trading Economics. (2018). *China Home Ownership Rate*. Retrieved July 20, 2018, from tradingeconomics.com: <https://tradingeconomics.com/china/home-ownership-rate>

Valadkhani, A. (2013). Do petrol prices rise faster than they fall when the market shows significant disequilibria? *Energy Economics*, 39, 66-80.

Xie, Y., & Jin, Y. (2015). Household wealth in China. *Chinese Sociological Review*, 47(3), 203-229

Zavisca, J., & Theodore, G. (2016). The socioeconomic, demographic, and political effects of housing in comparative perspective. *Annual Review of Sociology*, 42, 347-367.

## **CHAPTER 2**

### **‘THE QUINTESSENTIAL CHINESE DREAM’? HOMEOWNERSHIP AND THE SUBJECTIVE WELLBEING OF CHINA’S NEXT GENERATION**

This chapter presents co-authored work with Russell Smyth. The chapter uses data from China Family Panel Studies (CFPS), funded by 985 Program of Peking University and carried out by the Institute of Social Science Survey of Peking University. The authors would like to thank Choon Wang, Lata Gangadharan, Haining Wang, Vinod Mishra, Zhiming Cheng and two anonymous referees of *China Economic Review* for insightful comments on an earlier version that greatly improved the paper.

## **Abstract**

China has pursued housing policy reform that has successfully transformed a centrally planned public housing system into a market-oriented one, focused on promoting private ownership. As a consequence, China has become a nation of homeowners, with many Chinese aspiring to own their own home. Has this development made the lives of people better? We examine how homeownership influences the subjective wellbeing of children, who will be China's next generation. Utilising national representative panel data from China Family Panel Studies, we find that children aged 10-15 years of homeowners have 2.79 percentage points higher subjective wellbeing than children of non-homeowners. This finding continues to hold after we use alternative approaches to address the endogeneity of homeownership status and implement a number of other robustness checks. Our results also suggest that parental inputs into their children's education, investment in home maintenance, the quality of the neighbourhood and parents' emotional support for their children are channels through which homeownership influences children's subjective wellbeing.

**Keywords:** subjective wellbeing; happiness; homeownership; children; China

## 2.1 Introduction

Owning one's own home is an important objective for many people and homeownership potentially has important economic and social implications for both the homeowner and their children. Yet, while the effects of homeownership on various aspects of children's objective wellbeing are well documented,<sup>3</sup> the effect of homeownership on children's subjective wellbeing (SWB)<sup>4</sup> has received very little attention in the literature. Some studies have considered the SWB of children (see e.g. Casas & Rees, 2015; Migliorini, Tassara & Rania, 2018; Rees & Bradshaw, 2018; Tomyn & Cummins, 2011; Tomyn, Fuller-Tyszkiewicz, Cummins & Norrish, 2017). There is only one study that considers the relationship between homeownership and SWB of children. In a cross-sectional study of the determinants of SWB of 11 years old children in the UK, Rees and Bradshaw (2018) find that children living in rental houses had lower SWB than those living in houses owned by their parents.

We test whether homeownership status has a causal effect on the SWB of children in China and examine the channels or mediators via which it may affect the child's SWB. To do so, we use nationally representative longitudinal data from China Family Panel Studies (CFPS). Compared with other national datasets that contain information on children, such as the China Health and Nutrition Survey (CHNS), CFPS has the advantage that it contains data on both the SWB of children and whether their parents own their home, along with a rich set of controls that are potentially correlated with the child's SWB.

There is by now a considerable amount of literature on the determinants of SWB in China (see e.g. Asadullah, Xiao & Yeoh, 2018; Cai & Wang, 2018; Chen & Davey, 2008; Cheng et al., 2017; Hu & Coulter, 2017; Li & Liu, 2018; Mishra, Nielsen, Smyth & Newman, 2014; Smyth, Nielsen & Zhai, 2010) of which, a subset has examined the effect of homeownership (see e.g. Cheng, King, Smyth & Wang, 2016; Hu, 2013) on the SWB of the adult population. There is also a growing literature on the determinants of different aspects of SWB of children in China. For example, Wu (2014) studies the effect of China's one-child policy and finds that being an only child significantly

---

<sup>3</sup> For a review on some of the recent literature, see Zavisca and Theodore (2016).

<sup>4</sup> The term 'subjective wellbeing' is used interchangeably in the literature with 'life satisfaction' and 'happiness'. We use the term 'subjective wellbeing' throughout this paper.

lowers the SWB of children. Other studies include Chen and Liu (2012) and Lau and Li (2011), who find that perceived parental warmth, the level of engagement of one's family and level of social capital at school are determinants of various aspects of SWB of children in China. There are, however, no studies that examine the relationship between homeownership and SWB of children in China.

Our contribution is related to two strands of literature. One strand of literature are studies focused on the relationship between homeownership and objective outcomes. Studies have shown that children of homeowners receive better grades (see e.g. Barker & Miller, 2009; Haurin, Parcel & Haurin, 2002; Whelan, 2017); have higher rates of high school graduation (see e.g. Aaronson, 2000; Green & White, 1997); are better behaved (see e.g. Boyle, 2002; Grinstein et al., 2012; Haurin et al., 2002); have better health (Clair, 2019); experience lower rates of teen pregnancy (see e.g. Blau, Haskell & Haurin, 2019; Green & White, 1997), have lower rates of criminal conviction (Blau et al., 2019), are less likely to end up on welfare (Blau et al., 2019) and have better lifetime prospects in general (see e.g. Dockery et al., 2014) than children of renters.

A related literature to which we contribute are studies on housing status more generally, including housing insecurity, housing quality, overcrowding and residential mobility, and subjective child outcomes, such as cognitive development, emotional and social well-being and mental health. One set of studies finds that children living in homes owned by their parents have fewer emotional and behavioral difficulties (Rees, 2018). A second set of studies finds an association between housing insecurity, including housing affordability, and cognitive impairment in children (see review in Leventhal & Newman, 2010). A third set of studies has found a negative association between excessive moving and children's cognitive and emotional outcomes (see e.g. Gambaro & Joshi, 2016; Jellyman & Spencer, 2008). A fourth set of studies find that children who live in poorer quality housing experience lower emotional wellbeing and poorer mental health (see review in Clair, 2019). Other studies have found that overcrowding contributes to children's emotional problems (Park, Fertig & Allison, 2011).

Our novel contribution is that we present the first study to examine in depth the relationship between homeownership and the SWB of children. We differ from Rees

and Bradshaw (2018) in important respects. The first is in terms of focus. While our focus is on homeownership and SWB of children, homeownership was just one of many variables that Rees and Bradshaw (2018) considered in a more general study of the SWB of children. The second is that while Rees and Bradshaw (2018) used cross-sectional data and do not address endogeneity, we use panel data and employ a range of approaches to address endogeneity.

In presenting the first comprehensive study of the relationship between homeownership and SWB of children, we contribute to the existing literature on housing status and child outcomes in several important ways. First, existing research on homeownership and child wellbeing has focused on factors likely to affect children's future wellbeing or becoming. However, Clair (2019) suggests that just focusing on future wellbeing gives only a partial picture of the child's overall wellbeing. To get a holistic overview of the effects of homeownership on the child's wellbeing, it is essential to also consider the effect on their present wellbeing, reflected in their SWB. Second, there is increasing interest in what determines children's SWB, including housing status, that has not been explored in the literature (Clair, 2019). This interest reflects greater attention among economists to indicators of social progress other than GDP more generally (see e.g. Organisation for Economic Co-operation and Development [OECD], 2009; 2015; Stiglitz et al., 2009). Third, while studies have considered the relationship between housing status and emotional outcomes more generally, these studies have focused on emotional problems in children. The positive psychology movement (Seligman & Csikszentmihalyi, 2000) has shifted the focus from factors associated with problematic outcomes to consider those factors that improve our wellbeing or make us happier. The existing literature on housing status and child outcomes does not address the role that housing status can play in contributing positively to children's happiness.

Our preferred results suggest that children of homeowners have 2.79 percentage points higher SWB than children of non-homeowners. Moreover, we find heterogeneity in the SWB of children across genders, residential location and migration status of the household. Our results remain robust to a range of checks, including alternative ways to address potential endogeneity of homeownership, parental income and the SWB of the child's father.

This result contributes to the literature on the welfare implications of long-term social policy – in this case housing policy – change. Over the last decade, the Chinese government has expanded its affordable housing programs - such as the Economical and Comfortable Housing Program and the Housing Provident Fund Program – as vehicles to promote homeownership (see e.g. Chen & Deng, 2014; Deng, Shen & Wang, 2011). Our results suggest that programs, such as this, designed to increase housing affordability, can increase the welfare of Chinese children. In an era in which Chinese parents are going to increasing lengths to ensure the happiness, and secure the future of the “little emperor” generation (Mo & Burton-Bradley, 2018), our results also have important practical implications for parents. They suggest a further avenue through which parents can contribute to their child’s happiness.

## **2.2 Conceptual framework and channels**

The conceptual framework we employ is a variation of the home production model (Ben-Porath, 1967). This framework has been used to model child objective outcomes in terms of a good produced in the home, which is treated as a function of the child’s characteristics, the parents’ characteristics, parental inputs, homeownership status and other features of the child’s environment, including housing, neighbourhood and schooling characteristics (see e.g. Bernal & Keane, 2011; Blau, 1999; Blau et al., 2019; Cunha & Heckman, 2008). While this framework is typically used to model the child’s objective outcomes, if one sees these in terms of the child’s future wellbeing or becoming, as it is described in the psychology literature, it is a natural extension to model the child’s present wellbeing, captured by SWB, in the same way. Adopting such an approach where we model subjective responses on SWB is also consistent with studies, such as Cunha and Heckman (2008), that model the child’s subjective responses about noncognitive attributes within a home production framework.

Our primary interest is in the role that homeownership status plays in influencing the child’s SWB, controlling for the child’s and parents’ characteristics, parental inputs and environmental characteristics. The existing literature has identified five main channels through which homeownership may influence the child’s objective outcomes (future wellbeing) that are also likely to be true for the child’s SWB. We outline each of these in turn. Later in the paper, we test whether these channels act as mediators.

*Parental inputs into monitoring and nurturing their children*

Green and White (1997) posited that parents acquire new management skills associated with property ownership, such as budgeting, planning and problem solving, that transfer to successful parenting practices via learning by doing. As such, parents who are homeowners can be expected to take better care of their children. Children who are better cared for will be happier. It is likely that in transferring these skills to their children, parents who are homeowners will be more engaged with their children and this is expected to reinforce the positive effect on their child's SWB, independent of the acquisition of new skill sets.

*More parental involvement in the neighbourhood, including nurturing others' children*

Green and White (1997) noted that another difference between homeowners and renters is that the former has a larger financial stake in their neighbourhood because most of their wealth is tied up in their residence. Moreover, homeowners face a higher moving cost so they tend to remain in the same location longer than renters. Hence, homeowners have a greater incentive than renters to improve the neighbourhood environment which may contribute not only to the happiness of their own children, but the children of others, who will often also be the children of other homeowners, given that homeownership tends to be concentrated.

*Home owners invest more in home maintenance and repairs*

Rational choice theory suggests that homeowners have greater incentive to protect their investment in their properties than renters. As such, homeowners will invest more in home maintenance and repairs in order to realize the capital gains of their investment. Hence, owner-occupied housing has fewer health hazards, fewer structural impediments and is likely to be better-quality housing than renter-occupied housing (Haurin et al., 2002). This creates a cleaner and safer home environment for children, which is likely to contribute to higher SWB.

*Home owners live in better neighbourhoods*

Communities occupied mostly by homeowners tend to have more stable neighbourhoods, better schools and better public facilities (Mohanty and Raut, 2009). Living in better neighbourhoods has been shown to have a positive causal effect on a



range of objective outcomes for children, such as better performance at school and income later in life (see e.g. Chetty, Hendren & Katz, 2016). We expect children living in better neighbourhoods to be happier because they provide safer environments in which to live and play and better access to community facilities. Homeownership may also promote higher levels of parental engagement with their children as owners live in communities with greater opportunities for school participation and involvement in neighbourhood activities with their children (Grinstein-Weiss et al., 2012).

#### *Parents' self-esteem and emotional support for their children*

Owning one's own home increases satisfaction and self-esteem and this may translate into a more supportive psychological home environment for their children, potentially contributing to higher SWB (Blau et al., 2019). The opposite side of the coin, however, is that homeowners who have large mortgages can experience financial stress when paying off their home loan, which can translate into increased emotional stress (Cheng et al., 2016). This may manifest in conflict at home over money and/or one or more parents working longer hours to make ends meet with adverse effects on emotional support for, and the SWB of, their children.

Overall, these competing channels suggest competing hypotheses about the effect of homeownership on the SWB of children. The first four channels suggest that the relationship should be positive. The fifth channel suggests that the relationship may be negative, at least in certain circumstances, when parents have large mortgages that they are struggling to service. Homeownership may also restrict residential mobility and make it more difficult for parents to be flexible enough to take advantage of economic opportunities in other localities. This could also have an adverse effect on the SWB of children, particularly if the property is located in a depressed area or in a neighbourhood with poor facilities.

### **2.3 China's context**

China represents an interesting case in which to situate a study of the relationship between homeownership and SWB of children. For decades, homeownership was regarded as the quintessential American dream (Goodman & Mayer, 2018). Homeownership is now the quintessential Chinese dream. As Sito and Liu (2018) put it: "What was once a very American dream is now stitched into the hearts of the

ordinary Chinese. Homeownership has become the ultimate symbol of success in China, the mark of adulthood, readiness for a family, and ownership of one's financial destiny". China is becoming a nation of homeowners, with one of the world's highest rates of homeownership. Around 90% of households in China own their own home. The homeownership rate for millennials - i.e. those born between 1981 and 1998 - is 70%, which is much higher than the average global homeownership rate of 40% (Hongkong and Shanghai Banking Corporation [HSBC], 2017). The homeownership figure for millennials is expected to rise further with one report suggesting that 91% of millennial non-homeowners are intending to purchase a house in the next five years (HSBC, 2017).

The Chinese case is instructive for several reasons. First, pretty much all of the existing literature on homeownership and child outcomes focus on the United States or Western Europe. There is need for broader evidence, particularly from developing country settings. As Ferguson, Cassells, MacAllister and Evans (2013, p. 438) put it, the lack of evidence on homeownership and child outcomes outside of North America and Western Europe is "an important gap in the literature". In contributing to the literature on the relationship between homeownership status and child outcomes in general, we help to address this gap.

Second, the housing crisis in the United States and United Kingdom that followed foreclosures in the Global Financial Crisis, focused attention on the effects of this development for children's lives (see e.g. Clair, 2019; Leventhal & Newman, 2010). Studying China brings a different dimension to the table. Rather than concentrate on the effects of a sharp decline in homeownership on children's wellbeing, it allows us to examine whether a substantial increase in homeownership rates brings with it added benefits for children's wellbeing.

There are good reasons to think that China may differ along some of the conceptual links discussed in Section 2 to the United States or United Kingdom. Specifically, China has become a nation of homeowners, almost overnight, so the learning by doing effect, first articulated by Green and White (1997) from owning a house *en masse* can be expected to be particularly pronounced in China, strengthening the role of parental inputs into monitoring, and nurturing, their own children. The commodification of

housing *en masse* in China has also given rise to new kinds of neighbourhoods and sense of neighbourhood attachment within a short period, which does not have parallels in western contexts. The limited empirical evidence on this issue which does exist suggests that homeownership in China is associated with strong neighbourhood attachment, which is mainly based on satisfaction with the physical environment and sense of belonging (Zhu, Breitung & Li, 2012). This suggests that the role played by investment in homeownership, maintenance and neighbourhood stability may be particularly strong in the Chinese case, compared to western contexts.

Finally, the high cost of housing in China has contributed to very high levels of mortgage debt. Personal home mortgages in China expanded eightfold from three trillion RMB in 2008 to 24.9 trillion RMB in 2018 (Caixin, 2018), making people “slaves to their house” (*fang nu*). Financial stress associated with mortgage repayments is likely to lead to heightened emotional stress, potentially strengthening the role played by parental self-esteem and emotional support linking homeownership status with children’s SWB in China.

Taken together, these specific features of the Chinese context suggest that examining the relationship between homeownership status and children’s SWB in China can extend our theoretical understanding of the link between homeownership status and child outcomes outside the North American or Western European context. Specifically, we would expect the links between homeownership status and children’s SWB in China to be strong.

## **2.4 Data**

The CFPS survey, administered by the Institute of Social Science Survey at Peking University, uses a multi-stage probability-proportional-to-size sampling design to gather individual-, family- and community-level longitudinal data. The survey, among other issues, focusses on the economic and social activities of the Chinese population and, as such, contains a wealth of information covering topics such as economic activities, financial resources, family and community resources, family dynamics, educational outcomes, behavioural activities, and subjective views on various aspects of one’s life.

The baseline survey in 2010 successfully interviewed 14,960 households, consisting of 42,590 individuals living in these households in 25 provinces or administrative equivalents, representing almost 95% of the total population. The follow-up surveys at an interval of two years - 2012, 2014 and 2016 - re-surveyed the initial households and their respondents. Given the focus of this study is on the SWB of children, we focus on children in the 2012 and 2014 surveys aged between 10 and 15 who were interviewed with similar survey modules. In total 1,813 children (723 respondents in 2012 and 1,090 respondents in 2014) provided valid information for the key variables in this paper. The choice of 2012 and 2014 waves for the main analysis was based on the availability of the most complete data for the construction of the multi-item index that we use to measure children's SWB. The 2010 and 2016 waves had missing data for some items, while some other items were not consistently measured in these waves. Data for all four waves are used in a robustness checks, which uses a modified SWB index with fewer items, reflecting the lack of consistent data over the four waves. This check shows our results to be robust to different time periods and measures of SWB.

Since the focus of this study is on the SWB of children, of particular importance is how we obtain subjective data from children. Amato and Ochiltree (1987) provide empirical evidence that children aged as young as eight and nine years old have the ability to provide valid data. We use data from Child Module in the CFPS survey in which children who are between the age 10-15 years answer questions contained in that particular module of the survey. Data on children below the age of 10 were not used because their responses were completed by an adult household member, which cannot be substituted for children's self-reported data (White-Koning et al., 2005) while those above the age of 15 responded to the Adult Module which has a different set of questions. To account for the difficulty which children might experience in understanding the vocabulary used in the survey and the concepts about which they are questioned, we only draw on simple and straightforward questions which are free of ambiguity. In particular, we use ten subjectively measured response items that were consistently measured over the 2012 and 2014 waves to create the SWB index for our study. These questions, measuring different aspects of SWB, are (1) How would you rate your academic performance? (2) Do you think that you are a good student? (3) Are you satisfied with your school? (4) Are you confident about your future? (5) Do you think you are popular? (6) Is it easy for you to get along with others? (7) Are you

satisfied with your class advisor? (8) Are you satisfied with your foreign language teacher? (9) Are you satisfied with your Chinese language teacher? (10) Are you satisfied with your math teacher?

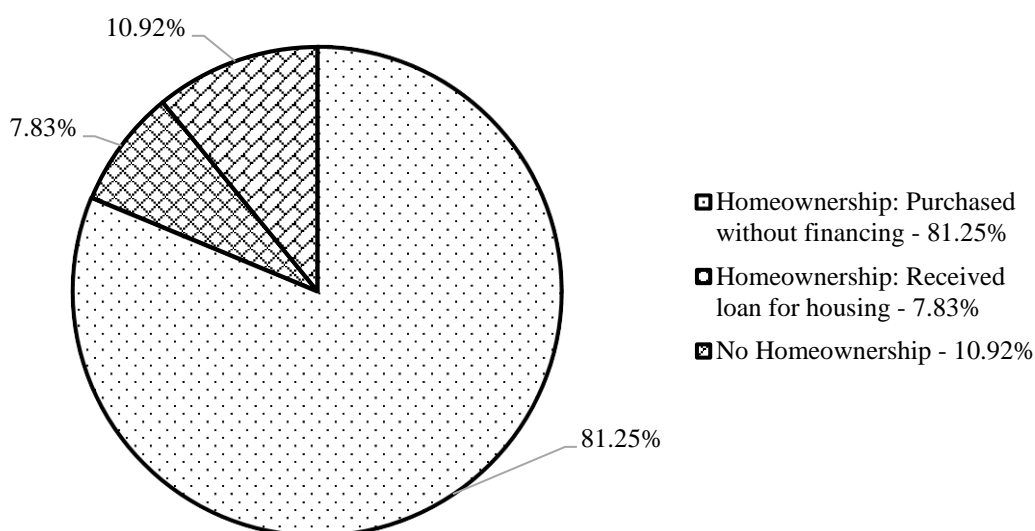
The specific choice of the questions in the index is partly dictated by data availability, but we wanted to ensure that there is a focus on wellbeing at school. Several studies (e.g. OECD, 2015) suggest school forms a central part of children's lives so we believe that this is appropriate especially when we are involving children between the ages 10-15. The advantage of using the ten items is that we can construct a multi-item index of SWB, which, it has been argued, is more reliable (see e.g., Angner, 2010; Morris, 2017; Smyth et al., 2010) than the single item index typically employed by economists. Since the questions in CFPS are measured on different Likert scales, we use the 'percentage of scale maximum' method to convert raw scores into standardised scores from 0-100 as discussed in Cummins and Lau (2005). In order to combine these ten responses into one index, these variables were subjected to factor analysis using principal component analysis in each wave. The results of the factor analysis are presented in the appendix in Table A2.1. The factor analysis shows that factor loadings of all these ten items are above 0.42 with the diagnostic tests of Bartlett test for sphericity showing that the variables are not inter-correlated. The Kaiser-Meyer-Olkin (kmo) score is around 0.79 indicating that the sample is acceptable, and the Cronbach alpha value is moderately high at 0.77. Each child's ten response items were then averaged with 0 indicating the lowest, and 100 the highest, SWB with the average score used to denote the child's SWB.

The main independent variable of interest in this study is the homeownership status of the household. CFPS classifies homeownership types in at least seven different categories. These are: (1) property rights solely owned by a family member [full homeownership] (2) property rights partly owned by a family member [partial homeownership]; (3) public housing (*gong fang*) provided by the work unit (*danwei*) [minor homeownership]; (4) cheap public rental housing; (5) public rental housing; (6) commercial housing rented in the market; and (7) living with friends or relatives. In our analysis we use a dichotomous variable denoted as "1" for homeowners who

have full homeownership while the rest are summed together as “0” representing non-homeowners.<sup>5</sup> Data on this variable in the CFPS sample is given in Figure 2.1.

CFPS also includes information on whether those who own their own home have a mortgage and the amount of repayments on the mortgage. We examine whether their parents owning a home with a mortgage affects the SWB of the children living in the home. Just under 90% of parents in the sample had full homeownership of their homes, while about 8% of parents in the sample had received a loan to purchase or construct their homes. These figures are representative of China as a whole (Trading Economics, 2018).

**Figure 2.1** Diagrammatic representation of home tenure status in the total sample



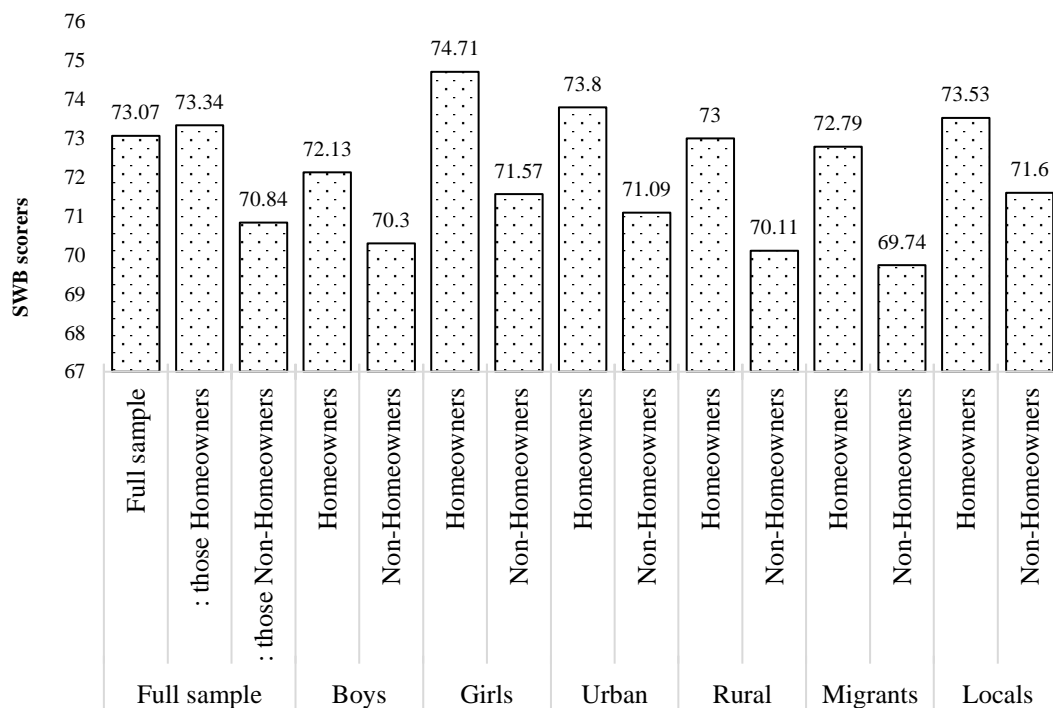
**Source:** China Family Panel Studies

<sup>5</sup> In China, homeowners can have full, partial or minor ownership (Cheng et al., 2016). Partial ownership is where the owner does not have a state-issued property deed and are usually acquired with housing purchased at prices subsidised by governments or enterprises. Minor homeownership (*gong fang*) refers to housing with limited or no property rights, built by the state or work units and rented/allocated to households. We also tried disaggregating homeownership into full ownership, partial ownership and minor ownership. When we did this, the results for partial and minor ownership were insignificant, most likely reflecting the very small percentage of respondents with partial (2.87%) and minor ownership (0.83%) in the sample.

Figure 2.2 shows that the average SWB of children in the sample is 73.07 percentage points. The International Wellbeing Group (2013) reports that the normative range for adult populations is 70-80 percentage points. This appears true for child samples as well. Migliorini et al. (2018), using the multi-item Personal Wellbeing index (PWI), which is similar in construction to the SWB index used in this study, finds that SWB is 71.3 percentage points for eight-year old children in Italy. Xu and Xie (2015) find that the SWB of children in China is 73.2 percentage points using an index composed of subjective measures of popularity, happiness, self-confidence and how easy going the child perceives himself or herself to be.

A simple breakdown of our data suggests that the children of homeowners have an average SWB index of 73.34, while children of non-homeowners have an SWB index of 70.84. Further disaggregation of the data shows that for subsamples based on gender, residential location and migration status of households, the mean SWB for children of homeowners is higher than non-homeowners.

**Figure 2.2 Subjective wellbeing by categories of homeownership**



We use a rich set of controls. These include variables with respect to children's personal attributes (age, gender, education expectations); household characteristics (family income, household size, migration status, residential area, child's family capital (level of trust that the child has in his/her parents)); parental characteristics (if parents are supportive of the child, the SWB of the parents, which is measured by the 'happiness score' of the father and marital status of the parents); housing characteristics (type of house, housing tenure); neighbourhood social capital (level of trust that the child has in his/her neighbours) and community social capital (level of trust that the child has in community government officials).

**Table 2.1 Descriptive Statistics**

<b>Variables</b>	<b>Mean/Proportions</b>
Age (years)	12.43
Boys (%)	53.67
Child education expectation (years)	15.37
Ln family income	10.35
Household size	4.77
Urban (%)	45.62
Migrants (%)	23.61
Family social capital (lowest = 0, highest = 100)	94.14
Parent encourage child (punish = 0, encourage = 1)	88.03
Happiness score of father (lowest = 0, highest = 100)	59.60
Parent married (%)	97.30
Type of house:	
Apartment (%)	18.86
Bungalow (%)	47.21
Quadrangle courtyard (%)	5.79
Villa (%)	0.99
Condominium villa (%)	0.22
Low-rise house (%)	26.92
Housing tenure (<15 years=0, ≥15 years=1) (%)	28.30
Neighbourhood social capital (lowest = 0, highest =	66.81
Community social capital (lowest = 0, highest = 100)	61.23
Province (25 provinces)	See Appendix Table A2.2

Table 2.1 presents descriptive statistics of the variables used in this study. These variables are described in detail in the appendix Table A2.2. Just over 50% of the sample were boys, 46% were residing in urban areas, and about 24% were migrants. The natural log of household income was 10.35, the average family size was five family members and 97.3% of the children were born to parents who were legally married.



The average years of education expectation for children were 15.37 years, which approximately equates to finishing junior college. Other family characteristics show that fathers are moderately happy, children have substantial trust in their parents and about 88% of parents always encouraged their children to do well at school. There are 28.3% of households who have lived in the same house for more than 15 years with 47.21% living in bungalows, 26.92% living in low-rise houses and 18.86% living in apartments, while 7% lived in either a quadrangle courtyard, villa or condominium villa. Children in the sample had moderate levels of trust in their neighbourhood and community officials.

## 2.5 The Empirical Model

Since we are particularly interested in the mechanism underpinning the relationship between homeownership and children's SWB, we estimate the following empirical regression model:

$$SWB_{it} = a_0 + \beta_1 H_{it} + \beta_2 \mathbf{X}'_{it} + \gamma_p + \tau_t + \varepsilon_{it} \quad (2.1)$$

where  $SWB_{it}$  is the SWB index for the respondent  $i$  in time  $t$ ;  $H_{it}$  captures the homeownership status of the respondent's household while the vector  $\mathbf{X}'_{it}$  captures a number of personal characteristics (age, gender, education expectation of the child), household characteristics (family income, household size, either in urban or rural area, is the family classified as migrant and the level of trust the child has in his/her parents), parental characteristics (whether parents encourage child in his/her school work, happiness score of the father, whether parents are married), households housing characteristics (type of house, duration of stay at the current location, whether received loan for housing); and neighbourhood and community characteristics (level of trust in the neighbours and local government officials). We also control for provincial fixed effects,  $\gamma_p$  to account for permanent differences across provinces and include year dummies,  $\tau_t$  to account for time-varying national determinants of homeownership and wellbeing.  $a_0$  and  $\varepsilon_{it}$  are respectively, the constant and error term in the model.

One could estimate equation 1 using ordinary least squares (OLS) or an ordered choice model. Ferrer-i-Carbonell and Frijters (2004) show that the results are not sensitive to

the choice of OLS, that treats SWB as cardinal, or an ordered logit/probit model, that treats SWB as ordinal. Ng (1997) suggests treating SWB as cardinal on theoretical grounds and, hence, favours the use of OLS. Since, we utilise two waves of CFPS, in our main results we report pooled OLS for the 2012 and 2014 waves for children aged 10-15, with robust standard errors, clustered at the household level.<sup>6</sup> Additionally, to ensure that the treatment of SWB as cardinal or ordinal does not affect our results, we also re-estimate the model using ordered logit and probit models. We also estimate our model for various sub-samples of the data as well as evaluate the role of different forms of homeownership on the SWB of children.

A potential econometric issue faced when attempting to find the causal effect is that unobservable variables may affect the correlation between homeownership and the child's SWB, despite the reasonably long list of control variables. Technically speaking, a variable is endogenous if it is correlated with the error term of the regression for any reason. It is possible that parents who own their homes may be systematically different from parents who rent and the same characteristics that make the homeowner parents more likely to own may also make them more likely to bring up happy and successful children (see e.g. Haurin et al., 2002; Lerman & McKernan, 2008). It may also be that we are not accounting for some omitted or unobserved factors (e.g. attitude, motivation, life goals and financial literacy) that affect the parents' decision to own, which are correlated with both the child's SWB and homeownership. It may be that people who own their own homes have a higher work ethic or are more industrious and arguably are more likely to invest more in their children and, as a result, raise happier children. If so, homeownership may be endogenous.

Ideally, to attribute a causal interpretation to the effects one would utilize a valid external instrumental variable (IV) which is correlated with homeownership, but is not correlated with the child's SWB except via their parents' homeownership status. We explored a number of potential candidates for a valid external instrument, drawing on

---

<sup>6</sup> Of the 1,813 children in the sample, there are 1,462 who are a single child (80.64%), 280 who are from a two-child family (15.44%), 63 who are from a three-child family (3.47%) and eight who are from a four-child family (0.44%). Clustering at the individual or community level does not affect our conclusions.

variables at the provincial level;<sup>7</sup> however none of these passed the diagnostics for a valid instrument.

Hence, in order to address the endogeneity of homeownership in the absence of a suitable external IV, we employ the approach proposed by Lewbel (2012), which utilizes a heteroskedastic covariance restriction to construct an internal IV. The Lewbel (2012) method has been shown to work in instances in which there are weak instruments (see e.g. Kelly, Dave, Sindelar & Gallo, 2014) or no instruments at all (see e.g. Millimet & Roy, 2016; Mishra & Smyth, 2015). Both Lewbel (2012) and Mishra and Smyth (2015) show that estimates produced using the Lewbel approach are consistent with those produced using a conventional external IV in cases in which a suitable external IV is available.

The Lewbel (2012) method entails estimating the following specifications:

$$Y_1 = X' \beta_1 + Y_2 Y_1 + \xi_1 \qquad \xi_1 = \alpha_1 U + V_1 \qquad (2.2)$$

$$Y_2 = X' \beta_2 + \xi_2 \qquad \xi_2 = \alpha_2 U + V_2 \qquad (2.3)$$

Assume  $Y_1$  is SWB,  $Y_2$  is the homeownership status of the parents and that  $U$  denotes unobserved characteristics, such as personal energy, attitude towards work or life goals.  $V_1$  and  $V_2$  are idiosyncratic errors. Lewbel (2012) uses heteroskedasticity in the data to estimate the IV regression. Lewbel (2012) suggests that one can take a vector  $Z$  of observed exogenous variables and use  $[Z - E(Z)] \xi_2$  as an instrument if:

$$E(X \xi_1) = 0, \quad E(X \xi_2) = 0, \quad \text{cov}(Z, \xi_1, \xi_2) = 0 \qquad (2.4)$$

and there is some heteroskedasticity in  $\xi_j$ . The intuition behind why  $[Z - E(Z)] \xi_2$  works as an instrument is that identification occurs by having regressors that are not correlated with the product of the heteroskedastic errors. The point is that the vector  $Z$  could either be a subset of  $X$  or equal to  $X$ . Using the above chosen set of instruments,

---

<sup>7</sup> Potential candidates for a suitable instrument that we considered included provincial level data on the number of construction units, the amount of highway investment, the amount of railway investment, the number of residential flats built, local government spending on housing security, savings deposits of households and the provincial level sex ratio, which might influence savings and, hence, funds available for housing loans.

one can use two-stage least squares (TSLS) to estimate the IV regression, as one would do with conventional IVs. As  $\xi_2$  is a population parameter, and it cannot be directly observed, we use its sample estimate  $\hat{e}_2$ , obtained from the first stage regression and consequently use the vector  $[Z-E(Z)]\hat{e}_2$  as IVs. The Lewbel (2012) approach assumes that there is heteroskedasticity in  $\xi_j$ . The exact form of heteroskedasticity requirement as derived in Lewbel (2012) is  $cov(Z, \xi_2^2) \neq 0$ . In practice, as an approximation, Lewbel (2012) suggests using the estimate of the sample covariance between  $Z$  and squared residuals from the first stage regression on  $X$  to test for this requirement, using the Breusch and Pagan test for heteroskedasticity.

In addition to modelling for the endogeneity of homeownership, we also suspect that other important variables such as family income and the happiness score of the father may be endogenous. Studies on the determinants of SWB, such as Cheng et al. (2016) and Knight, Song and Gunatilaka (2009), argue that unobserved adult personal characteristics such as personal energy, might increase income and SWB. We recognise that this potentially can be the case in our study as well. Parental energy is likely to increase household income and, at the same time, influence how parents take care of their children and the kind of home environment that they provide for their children. Unobserved parental characteristics, such as self-esteem and personal energy, may increase the father's happiness score which can also affect how he interacts with, and raises, his offspring. In addition, there may also be reverse causation running from the SWB of the child to the happiness of the father if, as seems likely, the happiness of the father depends at least in part on the SWB of his child.

We address these endogeneity concerns using external instruments, in addition to internally generated instruments using the Lewbel (2012) method. Specifically, we instrument for family income using the father's level of education, consistent with studies such as Knight et al. (2009), who instrument for income using father's education level in their study of the determinants of SWB in rural China. We instrument for the happiness score of the father using his job satisfaction. Several studies show that one's job satisfaction and life satisfaction are correlated (see e.g. Mishra et al., 2014). However, job satisfaction is unlikely to be correlated with the child's SWB, except through the happiness score of the father.

As an alternative strategy to the Lewbel (2012) method for addressing endogeneity of homeownership status, following previous studies that have estimated the impact of homeownership on adult SWB, such as Cheng et al. (2016) and Xu and Xie (2015), we use the matching estimates of the average treatment effects of homeownership on the child's SWB. Specifically, we apply propensity score matching (PSM), proposed by Rosenbaum and Rubin (1983), on the standard conditional independence assumption that, conditional on a set of variables, the treatment variable is independent of potential outcomes. To ensure the robustness of the PSM results, a region of common support is selected and we applied different matching methods, including nearest neighbour matching, radius matching, kernel matching and stratification methods to assess the range of estimates from the different methods.

As a further robustness check, we re-run the main model's specification over all the four waves and over different combinations of waves depending on data availability to ascertain if the effect of homeownership on SWB of children is consistent and not biased to different waves and measures. Additionally, in order to evaluate if the results are robust to variations over time, we examined the relationship between homeownership and SWB of children for a small subset of 216 children who were interviewed in 2010, 2012 and 2014 using the same child questionnaire, giving consistent data for these children over these three waves.

In Section 2.2 we identified several channels through which homeownership may influence the child's SWB. To examine the role of these channels, we examine the effect of several mediators on the relationship between homeownership and SWB using structural equation modelling (SEM), implemented with the *sem* command in STATA 15. Following Powdthavee and Wooden (2015), we bootstrap the standard errors with 200 replications.

## **2.6 Empirical Results**

The main results estimated with pooled OLS with cluster-robust standard errors are presented in Table 2.2. In all models we control for year and province fixed effects. In column (1) we examine the relationship between homeownership and SWB without controls, while in column (2) we control for the child's attributes. In column (3) we additionally control for the child's household characteristics, while in column (4) we

**Table 2.2 Determinants of subjective wellbeing for children, CFPS (OLS results)**

Variables	1		2		3		4		5		6	
<b>Homeownership Status:</b>												
Full homeownership (ref: no)	2.4664**	(2.32)	2.7560***	(2.67)	2.7826***	(2.86)	2.8264***	(2.90)	3.0075***	(3.05)	2.7994***	(3.00)
<b>Child personal characteristics:</b>												
Age			-2.8822	(-0.95)	-5.7304*	(-1.96)	-5.5456*	(-1.90)	-5.6413*	(-1.93)	-3.7146	(-1.30)
Age <sup>2</sup>			0.0898	(0.74)	0.2049*	(1.75)	0.1968*	(1.69)	0.2010*	(1.72)	0.1272	(1.11)
Gender (ref: Boys)			-1.9703***	(-3.41)	-1.7499***	(-3.08)	-1.6825***	(-2.97)	-1.6941***	(-2.98)	-1.7798***	(-3.28)
Child education expectation (in years)			0.8497***	(8.60)	0.7719***	(7.89)	0.7588***	(7.75)	0.7491***	(7.60)	0.7245***	(7.67)
<b>Household characteristics:</b>												
Ln family income					0.0370	(0.13)	-0.0001	(-0.00)	-0.0392	(-0.14)	-0.0709	(-0.25)
Household size					-0.2604	(-1.15)	-0.2806	(-1.23)	-0.2248	(-0.94)	-0.1558	(-0.71)
Urban					1.1225	(1.36)	1.0605	(1.28)	0.3796	(0.39)	0.9310	(1.02)
Migrants					-0.8856	(-0.98)	-0.8471	(-0.94)	-0.2894	(-0.30)	-0.8520	(-0.92)
Family social capital					0.2367***	(9.51)	0.2331***	(9.46)	0.2323***	(9.39)	0.1391***	(5.33)
<b>Parental Characteristics:</b>												
Parent encourage child							2.0024**	(2.17)	2.0101**	(2.17)	1.8463**	(2.07)
Happiness score of father							0.0115	(0.99)	0.0120	(1.03)	0.0121	(1.11)
Parent married							1.1732	(0.63)	1.0896	(0.58)	1.0845	(0.64)
<b>Household Housing characteristics:</b>												
Type of house (Ref: Low-rise house)												
Apartment									1.6839*	(1.65)	2.1054**	(2.12)
Bungalow									0.5415	(0.65)	0.6058	(0.76)
Condominium villa									-1.5210	(-0.27)	-3.1480	(-0.59)
Quadrangle courtyard									-0.0625	(-0.05)	0.0784	(0.06)
Villa									3.0916	(1.52)	1.4494	(0.71)
Housing tenure: more than 15 years									-0.3266	(-0.47)	-0.1991	(-0.30)
Received loan for housing									0.0394	(0.03)	0.7085	(0.61)
<b>Neighbourhood and Community capital:</b>												
Neighbourhood social capital											0.1137***	(7.68)
Community social capital											0.0746***	(6.26)
Province	Yes		Yes		Yes		Yes		Yes		Yes	
Year dummy	Yes		Yes		Yes		Yes		Yes		Yes	
Constant	63.0802***	(22.28)	73.9739***	(3.92)	72.2808***	(3.91)	68.7976***	(3.70)	69.4787***	(3.72)	53.7514***	(2.95)
N	1,813		1,813		1,813		1,813		1,813		1,813	
Adj. R-squared	0.0343		0.0894		0.1372		0.1391		0.1377		0.2101	

Notes: t-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

extend the model to also control for parental characteristics. In column (5) we add housing characteristics. The most complete specification in column (6) contains our preferred estimates which has full set of controls.

The main finding in column (1) is that the coefficient on the homeownership variable is positive and significant. This finding is robust to controlling for other characteristics across various specifications from columns (2) to columns (6). The final specification in column (6) shows that the SWB of children of homeowners is 2.79 percentage points higher than children of non-homeowners. The effect of homeownership on SWB of children is equivalent to about one and half times the effect of having supportive parents. The result is consistent with our hypothesised positive links between homeownership and SWB of children.

The results also show that children whose parents own apartments have 2.10 percentage points higher SWB than those living in low-rise houses. This is largely because low-rise houses are situated in old traditional neighbourhoods which are poorly maintained and are in bad condition. However, whether the parents have a mortgage on the property does not significantly affect the SWB of children. The relationship between having a home loan and the child's SWB is consistent with Cheng et al. (2016) who found that having a home loan has no significant effects on the SWB of adults in China.

Table 2.3 examines whether the effect of homeownership varies for different subgroups. In particular, we estimate the heterogeneous effects of homeownership on children based on their gender, residential location and migration status of households. The effect of homeownership on the SWB of children is different across genders. The estimates show that homeownership has a positive and significant effect on the SWB of boys, while it is positive, but insignificant, for girls. A possible explanation is that homeownership provides an opportunity for wealth accumulation, financial stability and residential stability in the future which is arguably more relevant for males than females (Grinstein et al., 2012). This is particularly applicable in the Chinese context in which parents often financially assist sons to buy their own first homes, which is important for success in the marriage market (Hu, 2013).

**Table 2.3 Determinants of subjective wellbeing in sub-samples, CFPS (OLS results)**

Variables	Sub-samples for:											
	Boys		Girls		Urban		Rural		Locals		Migrants	
<b>Homeownership Status:</b>												
Full homeownership (ref: no)	3.4329***	(2.72)	1.7779	(1.24)	2.7147**	(2.48)	2.4372	(1.38)	2.9025**	(2.49)	2.3363	(1.44)
<b>Child personal characteristics:</b>												
Age	-5.4426	(-1.37)	-2.8889	(-0.69)	-0.0789	(-0.02)	-5.6482	(-1.40)	-2.0007	(-0.59)	-8.2816	(-1.48)
Age <sup>2</sup>	0.2016	(1.27)	0.0889	(0.53)	-0.0164	(-0.10)	0.2040	(1.26)	0.0587	(0.44)	0.3138	(1.40)
Gender (ref: Boys)					-0.6096	(-0.73)	-2.7531***	(-3.74)	-2.1538***	(-3.50)	-0.7317	(-0.62)
Child education expectation (in years)	0.9081***	(7.19)	0.5207***	(3.65)	0.6817***	(4.64)	0.7998***	(6.49)	0.7024***	(6.73)	0.8068***	(3.76)
<b>Household characteristics:</b>												
Ln family income	-0.3331	(-0.86)	0.2240	(0.56)	0.7016	(1.52)	-0.4800	(-1.33)	-0.4259	(-1.31)	0.8283	(1.38)
Household size	0.0094	(0.03)	-0.2375	(-0.92)	-0.1316	(-0.44)	-0.1600	(-0.54)	-0.0722	(-0.30)	-0.3118	(-0.69)
Urban	2.8796**	(2.10)	-0.9988	(-0.86)					0.8584	(0.83)		
Migrants	-1.6851	(-1.25)	-0.2135	(-0.17)	-0.5984	(-0.61)						
Family social capital	0.1251***	(3.72)	0.1747***	(4.06)	0.1335***	(3.72)	0.1380***	(3.49)	0.1489***	(4.60)	0.1110**	(2.46)
<b>Parental Characteristics:</b>												
Parent encourage child	1.8562	(1.51)	1.9356	(1.49)	1.6428	(1.23)	2.1101*	(1.80)	2.0886**	(1.99)	0.6858	(0.40)
Happiness score of father	0.0231	(1.48)	0.0076	(0.51)	-0.0006	(-0.04)	0.0265*	(1.80)	0.0097	(0.76)	0.0244	(1.11)
Parent married	2.9824	(1.19)	-0.6172	(-0.27)	-2.0077	(-0.83)	3.0807	(1.26)	2.8207	(1.44)	-4.3093	(-1.26)
<b>Household Housing characteristics:</b>												
Type of house (Ref: Low-rise house)												
Apartment	1.2320	(0.91)	2.8840**	(2.09)	1.6531	(1.41)	2.9633	(1.27)	2.8434**	(2.38)	-0.5681	(-0.31)
Bungalow	0.7922	(0.73)	0.3845	(0.34)	1.1551	(0.95)	0.1098	(0.10)	0.2938	(0.31)	1.1043	(0.71)
Condominium villa	-1.7036	(-0.34)	-5.7793	(-0.82)	5.4899***	(2.75)	-12.9783***	(-8.28)	-2.5022	(-0.42)		
Quadrangle courtyard	0.4119	(0.21)	-0.1634	(-0.09)	3.2510*	(1.72)	-1.5613	(-0.86)	-0.8520	(-0.54)	2.8012	(1.15)
Villa	-0.5887	(-0.20)	1.0155	(0.33)	1.2714	(0.44)	4.5312**	(2.37)	1.3163	(0.61)	3.4677	(0.53)
Housing tenure: more than 15 years	-0.9437	(-0.97)	0.7914	(0.90)	0.0712	(0.07)	-0.3999	(-0.45)	-0.2215	(-0.29)	-0.9707	(-0.66)
Received loan for housing	-0.4008	(-0.24)	1.7287	(1.17)	1.0876	(0.78)	0.1537	(0.08)	0.4449	(0.34)	1.4571	(0.57)
<b>Neighbourhood and Community capital:</b>												
Neighbourhood social capital	0.1137***	(5.80)	0.1167***	(5.12)	0.1175***	(5.47)	0.1136***	(5.46)	0.1138***	(6.45)	0.1109***	(3.86)
Community social capital	0.0800***	(4.89)	0.0707***	(3.92)	0.0634***	(3.75)	0.0862***	(5.15)	0.0790***	(5.72)	0.0668***	(2.71)
Province	Yes		Yes		Yes		Yes		Yes		Yes	
Year dummy	Yes		Yes		Yes		Yes		Yes		Yes	
Constant	57.5774**	(2.29)	50.9749*	(1.91)	25.7491	(0.98)	69.0698***	(2.67)	45.2268**	(2.09)	77.1747**	(2.15)
N	973		840		827		986		1,385		428	
Adj. R-squared	0.2102		0.1854		0.2193		0.2096		0.2047		0.2132	

Notes: t-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .



Our results show that the effect of homeownership is more prominent in urban areas than in rural areas. The estimates show that homeownership significantly improves the SWB of children in urban areas by 2.71 percentage points, but is insignificant in rural areas. The significant, and positive, effect of homeownership in urban China can be attributed to the nature of homeownership in the two locations. Sole homeownership in urban areas provides urban households more autonomy over housing decisions, compared to collective nature of house sites in the rural areas. This allows urban children to better realise the perceived benefits of homeownership, which might not be the case in rural areas.

Similarly, for children of locals there is a significant and positive effect of homeownership on their SWB, while homeownership has an insignificant effect on the SWB of children of migrants. This is consistent with the findings of Cheng, Smyth and Wang (2013) for the effect of homeownership on the SWB of local adults in China born after 1980. A possible explanation is that migrants find it difficult to secure homes in good neighbourhoods, largely because of household registration (*hukou*) restrictions and, thus, end up securing homes in lower tier cities and sub-standard crowded apartments. The associated problems with this housing mean that homeownership for migrant children is not reflected in higher SWB. However, migrant children's higher education expectations and level of trust in their parents, neighbours and community continue to have a significant positive effect on their SWB.

In Table 2.4, we report results for the mediation analysis using alternative mediators through which homeownership may influence the child's SWB. Given the questions asked in CFPS, we were able to identify proxies for four of the five proposed channels in Section 2.2. The potential channel for which we could not identify proxies was parental involvement in the neighbourhood, including monitoring others' children. We identify three variables as proxies for parental inputs into monitoring and nurturing their own children. These are (1) the interviewer's assessment of the level of care that parents have in their child's education, based on the amount of the child's artwork, books and study materials in the house; (2) how often parents discuss what happens at school with their child; and (3) how often parents attend parent-teacher meetings. We include each of these variables as mediators separately in columns 1-3 of Table 2.4, together with the same controls as in our main model. Each of these variables are

**Table 2.4 Structural equation model of the relationship between homeownership and subjective wellbeing**

Variables	1	2	3	4	5	6	7	8
Full homeownership (ref: no)	2.9904*** (0.9923)	2.9381*** (0.9140)	2.8811*** (1.1084)	3.4034*** (1.0617)	3.4034*** (1.0551)	5.4253** (2.4808)	3.3179*** (1.1050)	2.9611*** (0.8987)
<i>Parental inputs into monitoring and nurturing their children</i>								
Home environment	1.6870*** (0.3872)							
Monitoring children		0.6587** (0.2608)						
Nurturing their children			0.9017*** (0.2318)					
<i>Homeowners live in better neighbourhoods</i>								
Cleanliness of neighbourhood				0.3986* (0.2228)				
Economic condition of the community					0.4121* (0.2232)			
<i>Homeowners invest more in home maintenance and repairs</i>								
Home maintenance and repairs						0.8439** (0.3882)		
<i>Parents' self-esteem and emotional support for their children</i>								
Parents home relationship							-0.3606*** (0.1255)	
Emotional support for children								0.2630*** (0.0559)
Control variables	Included	Included	Included	Included	Included	Included	Included	Included
Observations	1,760	1,813	1,545	1,702	1,702	248	1,752	1,800

**Notes:** (1). Reported results are total (direct and indirect) effects from a SEM. Bootstrapped standard errors (200 repetitions) are in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors are bootstrapped with 200 replications. (2). *Home environment* is the interviewer's assessment on a scale of 1-5 'If parents care about their child's education in terms of observing items such as child's artwork, books, or other study materials in the house'. (3). *Monitoring children* is the parent's response to the question 'How often have you discussed what happens at school with your child since this semester started/last semester?' on a scale of 1-5. (4). *Nurturing their children* is the parent's response to the item 'The parents attended parent-teacher meetings at school' on a scale of 1-5. (5). *Cleanliness of neighbourhood* is the interviewer's assessment on a scale of 1-7 of the 'Cleanliness of the roads in the village/residential community'. (6). *Economic condition of community* is the interviewer's assessment on a scale of 1-7 of the 'Economic condition of the village/residential community'. (7). *Home maintenance and repairs* is the parent's response to the question 'What was the total expenditure on home repairs and decoration in the past 12 months?' This data was only available for 2014. (8). *Parents home relationship* is the child's response to the question 'In the past month, how many times did your parents quarrel with each other?' (9). *Emotional support for children* is the child's response on the question 'In the past month, how many times did you and your parents have a heart-to-heart talk?'

channels through which homeownership is related to the child's SWB and the total effect of homeownership is still positively and significantly related to the child's SWB.

In columns 4 and 5 of Table 2.4, we report the results for two proxies to test whether the quality of the neighborhood mediates the effects of homeownership on child's SWB. The two proxies are the interviewer's assessment of the cleanliness of the roads in the village or residential community and the interviewer's assessment of the economic condition of the village or the residential community. In column 6 we test whether investment in homeownership and maintenance mediates the effects of homeownership on child's SWB, where investment in homeownership and maintenance is proxied by the household's total expenditure on home repairs and decoration in the past year. The results in columns 4-6 suggest that each of these variables are mediators and that the total effect of homeownership continues to be positively and significantly related to the child's SWB.

In columns 7 and 8 of Table 2.4 we examine whether parents' self-esteem and emotional support for their children mediates the relationship between homeownership and the child's SWB. To proxy this construct, we use the child's response as to the number of times that his or her parents quarreled with each other and (2) the number of times that the child and the parent had had a heart-to-heart talk in the past month. The results in column 7 show that an increase in the number of times that parents quarreled with each other had a significant negative effect on the SWB of their child. However, the greater the number of times that the parent and child honestly talked with each other about their feelings significantly enhanced the child's SWB.

Overall, the total effect of homeownership on SWB of the child remains positive and significant in each specification in Table 2.4, even after the inclusion of mediating variables to capture various channels through which homeownership affects the child's SWB.

In Section 2.3 we hypothesized that, given the specific characteristics of home ownership in China, each of these channels should be more pronounced in China than in western countries. How do the findings for the pathways compare with extant studies for the West? An important point to note is that not all studies formally test the

potential channels. Many of the best-known studies (eg. Green & White, 1997; Blau et al., 2019) propose that such channels exist linking homeownership with child outcomes, but do not formally test the strength of alternative pathways. But, among extant studies which do, findings have been mixed. For example, Haurin et al. (2002) found that parental attitudes and the home environment mediates the relationship between homeownership-child outcome relationship in the United States. Holupka and Newman (2012), however, found that the homeownership-child outcome relationship in the United States was not mediated by parental and neighborhood pathways. Hence, overall, the channels do appear to be stronger in China than in the West.

## **2.7 Extensions and robustness checks**

In the main results we treated SWB as cardinal. The ordered logit and probit results are presented in appendix Table A2.3. The effect of homeownership on the SWB of children is also positive and significant when SWB is treated as ordinal instead of cardinal.

To this point, we have employed pooled OLS, but are yet to account for the endogeneity issues raised in Section 2.5. We deal with the issue of endogeneity in Table 2.5. Column (1) in Table 2.5 reports results obtained using Lewbel (2012) to instrument for homeownership using the internally generated IV. The Breusch-Pagan test rejects the null hypothesis of constant variances, which is a precondition to implement the Lewbel (2012) approach. The OLS estimates are slightly downward biased as the point estimate after accounting for endogeneity show that the SWB of children of homeowners is 2.91 percentage points higher than children of non-homeowners. This is 0.12 percentage points higher than OLS estimates.

Columns (2.1) to (2.3) in Table 2.5 report results in which we use alternative strategies to deal with endogeneity of income. In column (2.1), we instrument for income using the education level of the father. The null hypothesis that income is exogenous is rejected by the Durbin-Wu-Hausman chi-square endogeneity test. The under-identification test rejects the null hypothesis that father's education level is not correlated with income. The result of a weak identification test also fails to reject the null hypothesis that father's education level is strongly correlated with income. The F-

**Table 2.5 Robustness checks (instrumenting endogenous variables)**

Variables	Homeownership		Family income				Happiness score of father			
	(1)	(2.1)	(2.2)	(2.3)	(3.1)	(3.2)	(3.3)			
	TOLS regression with Lewbel (2012) IV	TOLS regression with father's year of education as IV	TOLS regression with Lewbel (2012) IV	TOLS regression with father's year of education and internal instruments as IV	TOLS regression with Job satisfaction score as IV	TOLS regression with Lewbel (2012) IV	TOLS regression with job satisfaction score and internal instruments as IV			
<b>Homeownership Status:</b>										
Full homeownership (ref: no)	2.9169*** (2.75)	2.7406*** (2.92)	2.7707*** (3.01)	2.7635*** (3.00)	2.3445** (2.00)	2.7993** (3.04)	2.3319** (2.00)			
<b>Child personal characteristics:</b>										
Age	-3.7145 (-1.32)	-3.5757 (-1.24)	-3.6187 (-1.28)	-3.6479 (-1.29)	-1.2779 (-0.31)	-3.9468 (1.40)	-1.3701 (-0.35)			
Age <sup>2</sup>	0.1273 (1.13)	0.1224 (1.07)	0.1238 (1.10)	0.1250 (1.11)	0.0232 (0.14)	0.1365 (1.21)	0.0270 (0.17)			
Gender (ref: Boys)	-1.7784*** (-3.32)	-1.7604*** (-3.26)	-1.7737*** (-3.31)	-1.7658*** (-3.29)	-1.9507*** (-2.84)	-1.8085*** (-3.37)	-1.9585*** (-2.86)			
Child education expectation (in years)	0.7249*** (7.79)	0.7272*** (7.75)	0.7262*** (7.76)	0.7259*** (7.76)	0.7474*** (6.07)	0.7266*** (7.78)	0.7492*** (6.16)			
<b>Household characteristics:</b>										
Ln family income	-0.0699 (-0.25)	-0.5578 (-0.34)	-0.3402 (-0.64)	-0.3475 (-0.67)	0.1585 (0.37)	-0.452 (-0.16)	-0.1804 (0.46)			
Household size	-0.1573 (-0.73)	-0.0855 (-0.27)	-0.1187 (-0.54)	-0.1147 (-0.52)	-0.3471 (-1.40)	-0.1617 (-0.75)	-0.3470 (-1.41)			
Urban	0.9358 (1.04)	1.0817 (1.06)	1.0118 (1.13)	1.0183 (1.14)	0.8386 (0.74)	0.8823 (0.98)	0.7938 (0.72)			
Migrants	-0.8460 (-0.93)	-1.0536 (-0.92)	-0.9657 (-1.06)	-0.9651 (-1.05)	-1.0240 (-0.90)	-0.8125 (-0.89)	-0.9869 (-0.89)			
Family social capital	0.1391*** (5.40)	0.1381*** (5.29)	0.1385*** (5.38)	0.1386*** (5.39)	0.1572*** (4.32)	0.1414*** (5.44)	0.1580*** (4.36)			
<b>Parental Characteristics:</b>										
Parent encourage child	1.8497** (2.10)	1.8891** (2.15)	1.8723** (2.12)	1.8691** (2.12)	1.6872 (1.37)	1.8494** (2.09)	1.7609 (1.58)			
Happiness score of father	0.0121 (1.13)	0.0130 (1.19)	0.0126 (1.17)	0.0126 (1.17)	0.0140 (0.14)	-0.0103 (-0.46)	0.0018 (0.04)			
Parent married	1.0795 (0.64)	1.1474 (0.68)	1.1206 (0.67)	1.1194 (0.67)	2.2144 (0.86)	1.1225 (0.66)	2.4121 (1.12)			
<b>Household characteristics</b>	Included	Included	Included	Included	Included	Included	Included			
<b>Neighbourhood and Community capital</b>	Included	Included	Included	Included	Included	Included	Included			
Provinces	Included	Included	Included	Included	Included	Included	Included			
Year dummy	Included	Included	Included	Included	Included	Included	Included			
N	1,813	1,812	1,813	1,812	1,069	1,813	1,069			
Adj. R-squared	0.2101	0.2085	0.2096	0.2096	0.2152	0.2081	0.2142			
<i>First-stage</i>										
R-squared	0.684	0.028	0.280	0.297	0.033	0.217	0.158			
First-stage regression robust F	104.51***	44.82***	6.22***	8.13***	25.53***	8.01**	2.40***			
J p-value				0.177			0.219			

**Notes:** z-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Durbin-Wu-Hausman chi-square test endogeneity test rejects the null hypothesis that homeownership, income and father's happiness is exogenous. J p-value is greater than 5% significance level implying that we do not reject the null hypothesis for the overidentifying restriction test (instruments are valid).

statistics against the null that the excluded instruments are irrelevant in the first-stage regression is higher than 10, which satisfies the Staiger and Stock (1997) rule of thumb. These results suggest that father's education level is a valid instrument. The results with respect to the relationship between homeownership and SWB are the same as in column (6) in Table 2.2. As a check on the results in column (2.1), we report the estimates using the Lewbel (2012) IV alone in column (2.2) of Table 2.5 and the estimates using the Lewbel (2012) IV and conventional IV together in column (2.3) of Table 2.5. The coefficient on homeownership in both the columns are positive and significant and lies between 2.74 to 2.77 percentage points. However, the coefficient on income remains insignificant.

We use the same three prong strategy to instrument for the happiness score of the father as we did for family income. In column (3.1) of Table 2.5, we instrument for the happiness score of the father variable using his job satisfaction score. In column (3.2), we employ the Lewbel (2012) internal IV alone and in column (3.3) we combine job satisfaction as the external IV with the Lewbel (2012) internal IV. All the diagnostics tests suggest that our chosen external instrument is valid and the Breusch-Pagan test indicates that the heteroskedasticity condition is satisfied as a condition for using the Lewbel (2012) approach. The coefficient of homeownership in all three specifications is positive and significant, consistent with the OLS estimates, with magnitude between 2.33 to 2.79 percentage points. The effect of the happiness score of the father on SWB of his offspring remains positive, but is insignificant.

In Table A2.4 we present the IV estimates for the effect of homeownership on the SWB of different subsamples of children, which are very similar to the OLS estimates in Table 2.3.

As a further test to estimate if differences in SWB of children are due to homeownership and not to any other pre-existing differences, we use PSM to eliminate the potential influence of confounding factors. The results using common support of matching with nearest neighbour, radius, kernel and stratification matching methods are presented in Table 2.6. The estimates using these various methods of PSM show that the effect of homeownership on SWB of children is positive and significant. The

level of significance of the estimated coefficients are largely consistent with main results and are in the range 2.64 to 4.27 percentage points.

**Table 2.6 Propensity score matching estimates of the average treatment effects of homeownership on subjective wellbeing of children, CFPS**

Variable	Propensity Score Matching Methods							
	Nearest Neighbour Matching	Radius Matching	Kernel Matching	Stratification				
Full homeownership	4.273**	2.10	2.646***	2.59	2.882**	2.25	3.419**	1.99

**Notes:** t-statistics are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . The covariates used in generating propensity scores are age, gender, family income, migrants, type of house and housing tenure with common support.

While various covariates influencing the SWB of children apart from homeownership have been controlled for in the regression analysis, one might be worried whether the sample time period used or the construction of the SWB index is biasing the effect of homeownership on SWB. One might also be concerned as to whether the effect of homeownership on SWB has been consistent over the years. To address this issue, we first reconstruct the SWB index and re-estimate the main model using data from different combinations of the four waves depending on data availability. We reconstruct our SWB index by considering only those response items that were consistently measured over the four waves of CFPS.<sup>1</sup> These questions include (1) How would you rate your academic performance? (2) Do you think you are a good student? (3) Are you satisfied with your school? (4) Are you satisfied with your Chinese language teacher? (5) Are you satisfied with your math teacher? Further, we analysed a small sample of 216 children who were first surveyed in the first wave in 2010 and then had been subsequently re-surveyed in 2012 and 2014 using the same child questionnaire.

Using the modified index and controlling for most of the variables used in Table 2.2, we consistently find a significant and positive effect of homeownership on SWB of children. The results are presented in Table 2.7. In particular, the results are robust

<sup>1</sup> The response items used along with factor loadings and other tests on the properties of this modified SWB index is presented in appendix Table A2.5. The modified index exhibits satisfactory properties.

**Table 2.7 Robustness checks, CFPS (4 waves – 2010-2012-2014-2016)**

Variables	1		2		3	
	All waves		2012-2014-2016		2012-2014	
Full homeownership (ref: no)	0.9893*	(1.72)	1.8135**	(2.34)	2.2599**	(2.08)
Age	1.1855	(0.81)	-4.1247*	(-1.93)	-5.2281	(-1.58)
Age <sup>2</sup>	-0.0987*	(-1.69)	0.1152	(1.34)	0.1648	(1.25)
Gender (ref: Boys)	-2.3081***	(-6.95)	-2.1316***	(-5.06)	-1.9265***	(-3.08)
Child education expectation (in years)	0.7141***	(12.75)	0.6788***	(8.84)	0.7631***	(6.55)
Ln family income	-0.1348	(-0.81)	-0.1407	(-0.65)	-0.2198	(-0.67)
Urban	0.0846	(0.15)	0.8804	(1.22)	0.6886	(0.64)
Migrants	-0.3209	(-0.53)	-0.8069	(-1.07)	-1.2325	(-1.12)
Parent encourage child	2.0865***	(4.34)	2.0489***	(3.19)	2.5048**	(2.45)
Type of house (ref: Low-rise house)						
Apartment	1.1325*	(1.82)	1.5576**	(2.04)	2.1701*	(1.84)
Bungalow	-0.3205	(-0.72)	-0.0158	(-0.03)	0.9815	(1.06)
Quadrangle courtyard	1.6693**	(2.15)	0.8078	(0.73)	0.4135	(0.27)
Villa	0.6376	(0.37)	2.6198	(1.23)	0.7858	(0.24)
Condominium villa	-0.1352	(-0.04)	-2.2045	(-0.53)	1.8178	(0.50)
Housing tenure: more than 15 years	0.1661	(0.39)	-0.0802	(-0.12)	-0.0973	(-0.12)
Received loan for housing	0.9626	(1.28)	1.3772*	(1.68)	0.6650	(0.49)
Family social capital			0.0962***	(4.83)	0.1301***	(4.28)
Neighbourhood social capital			0.0940***	(7.73)	0.0932***	(5.59)
Community social capital			0.0690***	(7.37)	0.0696***	(5.05)
Parent married					1.5478	(0.74)
Happiness score of father					0.0040	(0.32)
Household size					0.1684	(0.60)
Provinces	Yes		Yes		Yes	
Year dummy	Yes		Yes		Yes	
Constant	57.2148***	(6.10)	69.2039***	(5.04)	67.4649***	(3.16)
N	8,600		4,439		1,899	
Adj. R-squared	0.0882		0.1538		0.1523	

**Notes:** t-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Model 1 included data for all the 4 waves of CFPS but excludes variables that were not collected in year 2010 (family social capital, neighbourhood social capital, community social capital) and variables that were collected but had missing data points in year 2016 (parent married, happiness score of father and household size). Hence, regressions have been estimated including the maximum available data points. Model 1 includes all 4 waves (2010-2012-2014-2016), model 2 includes 3 waves (2012-2014-2016) while model 3 includes only 2 waves (2012-2014) consistent with the two waves used in our main model.



over the four waves as well as when we use data from fewer waves. We also re-run the main specification as in column (6) of Table 2.2 over the 2012 and 2014 waves and find similar effects of homeownership on SWB. The estimates for the control variables are also largely consistent with the main results. These alternative estimates suggest that our estimates are not biased to data construction procedures and are consistent across different waves.

We also extend our analysis to evaluate if the results are robust to variations over time. Using the modified index and data over 2010, 2012 and 2014 we apply pooled OLS and panel data regression analysis to estimate the effect of homeownership on the SWB of children who had been surveyed in the three waves. The main limitation of using OLS is that unobserved time-invariant heterogeneity is left in the composite error term. While this may not be a concern if heterogeneity is uncorrelated with the observed covariates, there is a high chance of serial correlation in the composite error term when using pooled OLS data across time. Following Tani (2017), we relax the assumption of orthogonality between time-invariant individual unobserved heterogeneity and the observed covariates, and use panel random effects estimators. The Hausman test also fails to reject the null hypothesis that the difference in coefficients is not systematic, suggesting that the use of the random effects panel estimator is appropriate. The results using the pooled OLS and random effects estimator are presented in Table 2.8. The findings of this robustness test provide further confidence to our earlier results in suggesting that the effect of homeownership on SWB of children is positive and significant.

**Table 2.8 Robustness checks, CFPS (same children surveyed over 2010-2012-2014 waves)**

<b>Variables</b>	<b>Pooled OLS</b>	<b>Random effects</b>	<b>Fixed effects</b>
Full homeownership	4.2627* (2.45)	3.8047* (1.82)	1.8557 (0.69)
Other variables <sup>^</sup>	Include	Included	Included
N	648	648	648

**Notes:** t-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . (^) denotes that family social capital, neighbourhood social capital and community social capital variables are not included in the regression as they were not available in 2010. Hausman test fails to reject the null hypothesis ( $\text{Prob} > \text{Chi}^2 = 0.1694$ ) suggesting that the fixed effect is uncorrelated with all of the regressors which allows us to conclude that the random effects model rather than the fixed effects model is appropriate.

## **2.8 Conclusion**

There is now a large literature exploring the determinants of adults', and children's SWB, but very little attention has been given to the effect of homeownership on children's SWB. We have examined the relationship between homeownership and children's SWB in China. We also explored the heterogeneous effect of homeownership on the SWB of children based on gender, residential location and migration status of the household. A main takeaway from our results is that the SWB of children whose parents own their own home is consistently higher than children of parents who do not own their own home. This result holds for different subgroups and is robust to a number of checks for endogeneity and alternative ways to split the sample. A secondary takeaway from our findings is that there are several channels through which homeownership is related with the SWB of children. Specifically, we were able to test for, and found support for, four possible channels through which homeownership influences children's SWB.

An implication of our results is that government policies to promote full homeownership with residential property rights should be favoured over renting in order to realize higher SWB of children. In this respect, our results lend support to the furtherance of affordable housing programs - such as the Economical and Comfortable Housing Program and the Housing Provident Fund Program – as ways to promote homeownership (see e.g. Chen & Deng, 2014; Deng et al., 2011). Our finding that children who live in houses owned by their parents in urban areas have higher SWB lends support to Hu and Coulter (2017) who call for greater regulation of the real estate market in urban China, in order to increase housing affordability and improve wellbeing of those in urban areas. Our results also support Dietz and Haurin's (2003) call for policy intervention to remove discrimination in the housing market, such that the benefits of homeownership are not illegally denied to minority children. Our findings are also important for parents wanting to improve the SWB of their children. They suggest that homeownership provides an important antecedent to doing this.

The mediation results allow us to address the issue of why homeownership matters for children's subjective well-being. The results from the SEM suggest that parental inputs into their children's education, investment in home maintenance, the quality of the neighbourhood and parents' emotional support for their children mediate the

relationship between homeownership and children's SWB. These pathways suggest that homeownership has important spill over effects that enhance the child's SWB. One implication of these results is that policies to enhance the pathways might bring about similar positive effects to homeownership per se. For example, government investment in improving the quality of neighbourhoods might improve the SWB of children. Such a suggestion is consistent with studies such as Chetty et al. (2016) who conclude that better quality neighbourhoods improve outcomes for children later in life along a range of objective dimensions. In this respect, in 2017 China introduced a pilot programme in 12 major cities, giving tenants the same access to public services as homeowners, including the right to enrol their children in their neighbourhood school districts (Zheng, 2017). Another example, would be to invest in better-quality non-owner-occupied housing that would replicate the benefits of homeownership in terms of home physical environment. Some larger cities, such as Shanghai, are building new rental-only properties with a view to improving the rental market (Zheng, 2017).

Future research should expand on this work by examining the relationship between homeownership and SWB of children at various age groups across different income quintiles. Other directions for future research include examining the relationship between homeownership and SWB of children in other countries, perhaps where homeownership rates are lower, or examining the relationship between homeownership and objective outcomes of children, such as performance in school, in China, for which there are few studies.

There is also scope in the future to explore the role of housing characteristics such as neighbourhood conditions, dwelling size, sanitation and internet connections as moderators or mediators of the relationship between homeownership and child outcomes. This would provide a richer framework for designing appropriately targeted homeownership policies. Finally, one recent development in urban housing in China is the redevelopment of shantytowns. Li, Kleinhans and Han (2018) find that while low-income residents are pleased with the central government's Shantytown Redevelopment Projects (SRPs) initiative, they are not content with how these projects are implemented by local governments. This new development initiative provides an opportunity to study how the resultant homeownership of these SRPs houses would

impact on the SWB of children. It would also be interesting to evaluate how the SWB of children of those families impacted by the SRPs change over time.

## References

- Aaronson, D. (2000). A note on the benefits of homeownership. *Journal of Urban Economics*, 47(3), 356-369.
- Amato, P., & Ochiltree, G. (1987). Interviewing children about their families: A note on data quality. *Journal of Marriage and the Family*, 49, 669-675.
- Angner, E. (2010). Subjective well-being. *The Journal of Socio-Economics*, 39, 361-368.
- Asadullah, M., Xiao, S., & Yeoh, E. (2018). Subjective well-being in China, 2005–2010: The role of relative income, gender, and location. *China Economic Review*, 48, 83-101.
- Barker, D., & Miller, E. (2009). Homeownership and child welfare. *Real Estate Economics*, 37(2), 279-303.
- Ben-Porath, Y. (1967). The production of human capital and the life-cycle of earnings. *Journal of Political Economy*, 75(4), 352-365.
- Bernal, R., & Keane, M. (2011). Child care choices and children's cognitive achievement. *Journal of Labor Economics*, 29(3), 459-512.
- Blau, D. (1999). The effect of child care characteristics on child development. *Journal of Human Resources*, 34(4), 786-822.
- Blau, D., Haskell, N., & Haurin, D. (2019). Are housing characteristics experienced by children associated with their outcomes as young adults? *Journal of Housing Economics* (in press).
- Boyle, M. (2002). Homeownership and the emotional and behavioural problems of children and youth. *Child Development*, 73, 883-893.
- Cai, S., & Wang, J. (2018). Less advantaged, more optimistic? subjective well-being among rural, migrant and urban populations in contemporary China. *China Economic Review*. 52, 95-110.
- Caixin. (2018, November). China's growing mortgage debt drags on the economy. Retrieved June 2018, from <https://www.caixinglobal.com/2018-11-09/chinas-growing-mortgage-debt-drags-on-the-economy-101345146.html>
- Casas, F., & Rees, G. (2015). Measures of children's subjective well-being: Analysis of the potential for cross-national comparisons. *Child Indicators Research*, 8, 49-69.

- Chen, J. & Deng, L. (2014). Financing affordable housing through compulsory saving: The two-decade experience of Housing Provident Fund in China. *Housing Studies*, 29(7), 937-958.
- Chen, J., & Liu, X. (2012). The mediating role of perceived parental warmth and parental punishment in the psychological well-being of children in rural China. *Social Indicators Research*, 107, 483-508.
- Chen, Z., & Davey, G. (2008). Happiness and subjective wellbeing in mainland China. *Journal of Happiness Studies*, 9(4), 589-600.
- Cheng, Z., King, S., Smyth, R., & Wang, H. (2016). Housing property rights and subjective wellbeing in urban China. *European Journal of Political Economy*, 45, 160-174.
- Cheng, Z., Mishra, V., Nielsen, I., Smyth, R., & Wang, B. (2017). Wellbeing in China. *Social Indicators Research*, 132(1), 1-10.
- Cheng, Z., Smyth, R., & Wang, H. (2013). Housing and subjective wellbeing in urban China. Monash University, Department of Economics Discussion paper 39/13.
- Chetty, R., Hendren, N., & Katz, L. (2016). The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment. *American Economic Review*, 106(4), 855-902.
- Clair, A. (2019). Housing: An underexplored influence on children's wellbeing and becoming. *Child Indicators Research*, 12(2), 609-626.
- Cummins, R., & Lau, A. (2005). *Personal Wellbeing Index - School Children Manual*. Melbourne: School of Psychology, Deakin University.
- Cunha, F., & Heckman, J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of Human Resources*, 43(4), 738-782.
- Deng, L., Shen, Q. & Wang, L. (2011). The emerging housing policy framework in China. *Journal of Planning Literature*, 26(2), 168-183.
- Dietz, R., & Haurin, D. (2003). The social and private micro-level consequences of homeownership. *Journal of Urban Economics*, 54, 401-450.
- Dockery, A., Kendall, G., Li, J., Mahendran, A., Ong, R., & Strazdins, L. (2014). *Housing and children's development and wellbeing: A scoping study*. Melbourne: Australian Housing and Urban Research Institute.

- Ferguson, K., Cassells, R., MacAllister, J., & Evans, G. (2013). The physical environment and child development: An international review. *International Journal of Psychology*, 48(4), 437-468.
- Ferrer-i-Carbonell, A., & Frijters, P. (2004). How important is methodology for the estimates of the determinants of happiness? *The Economic Journal*, 114(497), 641-659.
- Gambaro, L., & Joshi, H. (2016). Moving home in the early years: what happens to children in the UK? *Longitudinal and Life Course Studies*, 7(3), 265-287.
- Goodman, L. & Mayer, S. (2018). Homeownership and the American dream. *Journal of Economic Perspectives*, 32(1), 31-58.
- Green, R., & White, M. (1997). Measuring the benefits of homeownership: Effects on children. *Journal of Urban Economics*, 41, 441-461.
- Grinstein-Weiss, M., Key, C., Yeo, Y., Yoo, J., Holub, K., Taylor, A., & Tucker, J. (2012). Homeownership, neighbourhood characteristics and children's positive behaviours among low- and moderate income households. *Urban Studies*, 49(16), 3543-3563.
- Haurin, D., Parcel, T., & Haurin, R. (2002). Does homeownership affect children's outcomes? *Real Estate Economics*, 30(4), 635-666.
- Holupka, S., & Newman, S. (2012). The effects of homeownership on children's outcomes: real effects or self-selection? *Real Estate Economics*, 40(3), 566-602.
- Hongkong and Shanghai Banking Corporation [HSBC] (2017, February). Beyond the bricks: the meaning of home. Retrieved March 2018, from <http://www.hsbc.com/-/media/hsbc-com/newsroomassets/2017/pdfs/170227-beyond-the-bricks-global-factsheet.pdf>
- Hu, F. (2013). Homeownership and subjective well-being in urban China: Does owning a house make you happier? *Social Indicators Research*, 110, 951-971.
- Hu, Y., & Coulter, R. (2017). Living space and psychological well-being in urban China: Differentiated relationships across socio-economic gradients. *Environment and Planning A*, 49(4), 911-929.
- International Wellbeing Group. (2013). *Personal Wellbeing Index - Adult Manual*. Deakin University. Melbourne: Australian Centre on Quality of Life.

- Jellyman, T., & Spencer, N. (2008). Residential mobility in childhood and health outcomes: A systematic review. *Journal of Epidemiology and Community Health*, 62(7), 584-592.
- Kelly, I., Dave, D., Sindelar, J., & Gallo, W. (2014). The impact of early occupational choice on health behaviors. *Review of Economics of the Household*, 12(4), 737-770.
- Knight, J., Song, L., & Gunatilaka, R. (2009). Subjective well-being and its determinants in rural China. *China Economic Review*, 20, 635-649.
- Lau, M., & Li, W. (2011). The extent of family and school social capital promoting positive subjective well-being among primary school children in Shenzhen, China. *Children and Youth Services Review*, 33, 1573-1582.
- Lerman, R., & McKernan, S. (2008). The effects of holding assets on social and economic outcomes of families: A review of theory and evidence. In S. McKernan, & M. Sherraden, *Asset building and low-income families*, 175-206. Washington, DC: Urban Institute Press.
- Leventhal, T., & Newman, S. (2010). Housing and child development. *Children and Youth Service Review*, 32(9), 1165-1174.
- Lewbel, A. (2012). Using heteroscedasticity to identify and estimate mismeasured and endogenous regressor models. *Journal of Business & Economic Statistics*, 30(1), 67-80.
- Li, J., & Liu, Z. (2018). Housing stress and mental health of migrant populations in urban China. *Cities*, 81, 172-179.
- Li, X., Kleinhans, R., & Ham, M. (2018). Shantytown redevelopment projects: State-led redevelopment of declining neighbourhoods under market transition in Shenyang, China. *Cities*, 73, 106-116.
- Migliorini, L., Tassara, T., & Rania, N. (2018). A study of subjective well-being and life satisfaction in Italy: How are children doing at 8 years of age? *Children Indicators Research*, 1-21.
- Millimet, D., & Roy, J. (2016). Empirical tests of the population haven hypothesis when environmental regulation is endogeneous. *Journal of Applied Econometrics*, 31, 652-677.
- Mishra, V., Nielsen, I., Smyth, R., & Newman, A. (2014). The job satisfaction-life satisfaction relationship revisited: Using the Lewbel estimation technique to estimate causal effects using cross-sectional data. Department of Economics,



- Monash University, Discussion Paper 26/14. Retrieved July 2018, from Department of Economics, Monash University, Discussion Paper 26/14: <https://www.monash.edu/business/economics/research/publications/2014/2614jobmishranielsensmythnewman.pdf>
- Mishra, V., & Smyth, R. (2015). Estimating returns to schooling in urban China using conventional and heteroskedasticity-based instruments. *Economic Modelling* 47: 166-173.
- Mo, X., & Burton-Bradley, R. (2018). 15 page resume for a 5 year old: The lengths Chinese parents go to for the right school. Australian Broadcasting Commission (ABC), November 7. Retrieved March 27 2019 from <https://www.abc.net.au/news/2018-11-07/the-lengths-chinese-parents-go-to-for-the-right-school/10465982>
- Mohanty, L., & Raut, L. (2009). Homeownership and school outcomes of children: Evidence from the PSID child development supplement. *American Journal of Economics and Sociology*, 68(2), 465-489.
- Morris, E. (2017). Is a fixer-upper actually a downer? Homeownership, gender, work on the home, and subjective well-being. *Housing Policy Debate*, 28(3), 342-367.
- Ng, Y-K. (1997). A case for happiness, cardinalism, and interpersonal comparability. *The Economic Journal*, 107, 1848-1858.
- Organisation for Economic Co-operation and Development [OECD]. (2009). *Doing better for children*. OECD Publishing, Paris, Retrieved June 30 2019, <https://doi.org/10.1787/9789264059344-en>.
- Organisation for Economic Co-operation and Development [OECD]. (2015). "How's life for children?" in *How's Life? 2015: Measuring well-being*, OECD Publishing, Paris, Retrieved June 30 2019, [https://doi.org/10.1787/how\\_life-2015-8-en](https://doi.org/10.1787/how_life-2015-8-en).
- Park, J., Fertig, A. & Allison, P. (2011). Physical and mental health, cognitive development and health care use by housing status of low-income young children in 20 American cities: A prospective cohort study. *American Journal of Public Health*, 101(S1), S255-S261.
- Powdthavee, N., & Wooden, M. (2015). Life satisfaction and sexual minorities: Evidence from Australia and the United Kingdom. *Journal of Economic Behavior & Organization*, 116, 107-126.

- Rees, G. (2018). The association of childhood factors with children's subjective wellbeing and emotional and behavioural difficulties at 11 years old. *Child Indicators Research*, 11(4), 1107-1129.
- Rees, G., & Bradshaw, J. (2018). Exploring low subjective well-being among children aged 11 in the UK: An analysis using data reported by parents and by children. *Children Indicators Research*, 11(1), 27-56.
- Rosenbaum, P., & Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41-55.
- Seligman, M. & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, 55(1), 5-14.
- Sito, P. & Liu, P. (2018). China property: How the world's biggest housing market emerged. *South China Morning Post*, November 26. Retrieved March 28 2019 from: <https://www.scmp.com/business/article/2174886/american-dream-home-ownership-quickly-swept-through-china-was-it-too-much>
- Smyth, R., Nielsen, I., & Zhai, Q. (2010). Personal wellbeing in urban China. *Social Indicators Research*, 92, 231-251.
- Staiger, D., & Stock, J. (1997). Instrumental variables regression with weak instruments. *Econometrica*, 65(3), 557-586.
- Stiglitz, J., Sen, A., & Fitoussi, J. (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress. Retrieved June 30 2019, from <https://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report>.
- Tani, M. (2017). Hukou changes and subjective well-being in China. *Social Indicators Research*, 132, 47-61.
- Tomyn, A., & Cummins, R. (2011). The subjective wellbeing of high-school students: Validating the personal wellbeing index-school children. *Social Indicators Research*, 101(3), 405-418.
- Tomyn, A., Fuller-Tyszkiewicz, M., Cummins, R., & Norrish, J. (2017). The validity of subjective wellbeing measurement for children: Evidence using the personal wellbeing index-school children. *Journal of Happiness Studies*, 18(6), 1859-1875.
- Trading Economics. (2018). China Homeownership Rate. Retrieved July 20, 2018, from [tradingeconomics.com: https://tradingeconomics.com/china/homeownership-rate](https://tradingeconomics.com/china/homeownership-rate)

- Whelan, S. (2017). Does homeownership affect education outcomes? *IZA World of Labour*(342). Retrieved from <https://wol.iza.org/articles/does-homeownership-affect-education-outcomes/long>
- White-Koning, M., Arnaud, C., Bourdet-Loubere, S., Bazex, H., Colver, A., & Grandjean, H. (2005). Subjective quality of life in children with intellectual impairment - How can it be assessed? *Developmental Medicine & Child Neurology*, 47, 281-285.
- Wu, L. (2014). Are only children worse off on subjective well-being? Evidence from China's one-child policy. *China Family Panel Studies Working Paper Series: WP14-003*. Retrieved June 26, 2018 from <http://www.issp.pku.edu.cn/cfps/d/file/wd/wp/wps/20140820/c65b3215d9214c86a9bbd5845bf1d032.pdf>
- Xu, H., & Xie, Y. (2015). The causal effects of rural-to-urban migration on children's well-being in China. *European Sociological Review*, 31(4), 502-519.
- Zavisca, J., & Theodore, G. (2016). The socioeconomic, demographic, and political effects of housing in comparative perspective. *Annual Review of Sociology*, 42, 347-367.
- Zheng, Y. (2017, August). China says renting is as good as owning a home, but how many will buy that argument? *South China Morning Post*. Retrieved July 2019, from <https://www.scmp.com/business/china-business/article/2105478/china-says-renting-good-owning-home-how-many-will-buy>
- Zhu, Y., Breitung, W., & Li, S. (2012). The changing meaning of neighbourhood attachment in Chinese commodity housing estates: Evidence from Guangzhou. *Urban Studies*, 49(11), 2439–2457.

## APPENDICES

**Table A2.1 Factor analysis for the subjective wellbeing items**

Item	Factor loadings		
	2012	2014	Total
Academic achievement	0.464	0.436	0.449
Good student	0.410	0.428	0.420
Satisfied with school	0.598	0.666	0.633
Better future	0.586	0.530	0.561
Popular	0.488	0.459	0.475
Easy to get along with	0.511	0.422	0.470
Satisfied with class advisor	0.714	0.719	0.716
Satisfied with foreign language teacher	0.582	0.598	0.589
Satisfied with Chinese language teacher	0.665	0.670	0.668
Satisfied with math teacher	0.626	0.647	0.637
Eigenvalues	3.271	3.228	3.250
Percentage of variance explained	0.327	0.323	0.325
Kaiser-Meyer-Olkin (kmo)	0.789	0.792	0.794
Bartlett test of sphericity (p-value)	0.000	0.000	0.000
Alpha	0.767	0.764	0.772

**Notes:** The details of the 10 questions used in this index are given in Table A2. Principle component analysis method is used with eigenvalues showing that there is one factor. Kaiser-Meyer-Olkin (kmo) score is used to determine the sampling adequacy and the kmo score is just above 0.78 implies that the sample is acceptable. The Bartlett test for sphericity which tests if the variables are not inter-correlated finds that they are not [reject the null hypothesis ( $p < 0.05$ )]. The factor loadings of all these four items are above 0.41 which is fairly acceptable. The Cronbach's alpha is also moderately high at 0.76 which shows internal consistency among the variables in the index. The index also explains about a third of the variances in the sample.

**Table A2.2 Definition of variables**

<b>Variables</b>	<b>Definition of variables</b>
Subjective wellbeing	This variable is constructed by taking an average of 8 questions as validated in Table A1 using factor analysis. These 8 questions have data in Likert scale on various scales but were standardised on a 0-100 distribution with 0 rating the lowest and 100 being the highest wellbeing. These questions measure subjective judgement on the different aspects of life by the child. These measures include on Academic achievement [1. How would you rate your academic performance], Good student [2. Do you think that you are a good student?], Satisfied with school [3. Are you satisfied with your school?], Better future [4. Are you confident about your future?], Popular [5. Do you think you are popular?], Easy to get along with [6. Is it easy for you to get along well with others?], Satisfied with class advisor [7. Are you satisfied with your class advisor?], Satisfied with foreign language teacher [8. Are you satisfied with your foreign language teacher?], Satisfied with Chinese language teacher [9. Are you satisfied with your Chinese language teacher?], Satisfied with math teacher [10. Are you satisfied with your math teacher?].
Homeownership	The household has either full, partial or minor ownership residential property rights.
Full homeownership	The household has full ownership residential property rights.
No Homeownership	The household does not have full residential property rights and lives either in homes that are partly owned by family members or are provided by the work unit including those who live in public or commercial rental house or with family/relatives.
Age	Age of the survey respondents measured in years.
Gender	Gender of the survey respondent. (Boys=1; Girls=0)

Child education expectation	Highest expectation for child's own education. The five options are converted to corresponding years of schooling as per CFPS 2017 User Manual as: 1. No school [0 years] 2. Primary school [6 years] 3. High school [12 years] 4. College [16 years] 5. Graduate [22 years].
Ln family income	Natural logarithm of total family income.
IHS family income	Inverse hyperbolic since (IHS) transformation of total family income.
Household size	The number of household members.
Urban	Whether the respondent currently lives in a household that is in urban residential location. Measured as a dummy variable with (0) as currently living in rural area and (1) as living in urban area.
Migrant	Is defined as a respondent living in urban residential location but having an agricultural/rural <i>hukou</i> . Migrants without a local urban <i>hukou</i> cannot access the same rights and social benefits enjoyed by urban residents.
Family social capital	Measures the degree of trust the respondents have on their parents measured with the question "How much do you trust your parents?" This question is measured in Likert scale (0-10) and are standardised on a 0-100 distribution with (0) being distrustful and (100) being very trustworthy.
Parent encourages child	Measures how parents react when the child's test score is lower than expectation. This is denoted as (1) when parents encourage the child by contacting the teacher, asking the child to study harder and help the child more while it is denoted (0) if parents take stricter actions against the child such as physical punishment, scold the child and ground the child.
Happiness score of father	Measures the happiness score of the respondent's father with the question "How happy are you?" This question is measured in Likert scale and are standardised on a 0-100 distribution with (0) very unhappy and (100) being very happy.

Education level of father (years)	Measures the years of education of the father with conversion scale representing (0 years) Illiterate/Semi-illiterate; (6 years) Primary school; (9 years) Junior primary school; (12 years) Senior middle school; (15 years) Junior college; (16 years) College; (19 years) Master's degree; and (22 years) Doctoral degree.
Job satisfaction score of father	Measures the job satisfaction score of the respondent's father with the question "Overall satisfied with the current job" This question is measured in Likert scale and are standardised on a 0-100 distribution with (0) very unhappy and (100) being very happy.
Parent married	Measures whether the respondent's parents are legally married. This is represented with a dummy value (1) if the parents are legally married and staying together and (0) if they are either not married, in cohabitation, divorced or widowed.
Type of house:	
Apartment	The household lives in an apartment house type. This is denoted (1) as living in apartment and (0) as living in other types of house.
Bungalow	The household lives in a bungalow house type. This is denoted (1) as living in a bungalow and (0) as living in other types of house.
Quadrangle courtyard	The household lives in a quadrangle courtyard house type. This is denoted (1) as living in a quadrangle courtyard and (0) as living in other types of house.
Villa	The household lives in a villa house type. This is denoted (1) as living in a villa and (0) as living in other types of house.
Condominium villa	The household lives in a condominium villa house type. This is denoted (1) as living in a condominium villa and (0) as living in other types of house.
Low-rise house	The household lives in a low-rise house house type. This is denoted (1) as living in a low-rise house and (0) as living in other types of house.

Housing tenure	Denotes a value of (1) for households living in the same house for more than 15 years and (0) for those living living in the same house for less than 15 years.
Received loan for housing	Denotes a value of (1) for households that received mortgage loan when purchasing/decorating house and (0) for those who did not take mortgage loan to acquire housing property.
Neighbourhood social capital	Measures the degree of trust the respondents have on their neighbours measured with the question "How happy are you?" This question is measured in Likert scale (0-10) and are standardised on a 0-100 distribution with (0) being very unhappy and (100) being very happy.
Community social capital	Measures the degree of trust the respondents have on their local government officials also known as cadre (ganbu) measured with the question "How much do you trust cadres?" This question is measured in Likert scale (0-10) and are standardised on a 0-100 distribution with (0) being distrustful and (100) being very trustworthy.
Province	25 provinces/municipalities/autonomous regions: Anhui, Beijing, Chongqing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Shaanxi, Shandong, Shanghai, Shanxi, Sichuan, Tianjin, Yunnan and Zhejiang.

---



**Table A2.3 Determinants of subjective wellbeing for children, CFPS (ordered logit & ordered probit model results)**

Variables	Ordered logit		Ordered probit	
<b>Homeownership Status:</b>				
Full homeownership (ref: no)	0.4140***	(2.96)	0.2374***	(2.99)
<b>Child personal characteristics</b>				
Age	-0.5577	(-1.23)	-0.3987	(-1.56)
Age <sup>2</sup>	0.0190	(1.04)	0.0141	(1.38)
Gender (ref: Boys)	-0.2530***	(-2.97)	-0.1594***	(-3.31)
Child education expectation (in years)	0.1194***	(7.80)	0.0649***	(7.43)
<b>Household characteristics</b>				
Ln family income	-0.0233	(-0.54)	-0.0108	(-0.43)
Household size	-0.0206	(-0.57)	-0.0107	(-0.57)
Urban	0.0831	(0.59)	0.0807	(0.97)
Migrants	-0.0963	(-0.67)	-0.0763	(-0.92)
Family social capital	0.0220***	(5.34)	0.0122***	(5.73)
<b>Parental Characteristics</b>				
Parent encourage child	0.2400*	(1.69)	0.1531**	(2.02)
Happiness score of father	0.0014	(0.81)	0.0010	(1.07)
Parent married	0.1159	(0.40)	0.0862	(0.59)
<b>Household characteristics</b>				
Type of house (Ref: Low-rise house)				
Apartment	0.3518**	(2.29)	0.1829**	(2.09)
Bungalow	0.1231	(1.03)	0.0665	(0.97)
Condominium villa	0.0328	(0.15)	-0.0023	(-0.02)
Quadrangle courtyard	0.2588	(0.84)	0.0967	(0.53)
Villa	-0.6620	(-0.69)	-0.3809	(-0.82)
Housing tenure: more than 15 years	-0.0935	(-0.89)	-0.0225	(-0.38)
Received loan for housing	0.1524	(0.85)	0.0722	(0.71)
<b>Neighbourhood and Community capital</b>				
Neighbourhood social capital	0.0173***	(7.46)	0.0102***	(7.90)
Community social capital	0.0125***	(6.68)	0.0066***	(6.20)
Province	Yes		Yes	
Year dummy	Yes		Yes	
N	1,813		1,813	

Notes: t-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

**Table A2.4 Determinants of subjective wellbeing in sub-samples, CFPS (IV results)**

Variables	TSLS regression with Lewbel (2012) IV for sub-samples for:											
	Boys		Girls		Urban		Rural		Locals		Migrants	
<b>Homeownership Status:</b>												
Full homeownership (ref: no)	4.1808***	(2.99)	1.7028	(1.08)	2.4084*	(1.77)	2.4773	(1.36)	2.8262**	(2.18)	2.3797	(1.47)
<b>Child personal characteristics:</b>												
Age	-5.4565	(-1.40)	-2.8884	(-0.71)	-0.0828	(-0.02)	-5.6530	(-1.43)	-1.9979	(-0.60)	-8.3362	(-1.57)
Age <sup>2</sup>	0.2024	(1.30)	0.0889	(0.55)	-0.0168	(-0.11)	0.2042	(1.29)	0.0585	(0.44)	0.3158	(1.49)
Gender (ref: Boys)					-0.6713	(-0.83)	-2.7532***	(-3.83)	-2.1538***	(-3.56)	-0.7448	(-0.67)
Child education expectation (in years)	0.9126***	(7.40)	0.5206***	(3.76)	0.6769***	(4.74)	0.7998***	(6.64)	0.7023***	(6.85)	0.8073***	(3.98)
<b>Household characteristics:</b>												
Ln family income	-0.3280	(-0.87)	0.2234	(0.57)	0.6928	(1.54)	-0.4798	(-1.36)	-0.4262	(-1.33)	0.8211	(1.45)
Household size	0.0007	(0.00)	-0.2364	(-0.94)	-0.1249	(-0.43)	-0.1606	(-0.55)	-0.0707	(-0.30)	-0.3106	(-0.72)
Urban	2.9005**	(2.16)	-1.0030	(-0.88)					0.8521	(0.84)		
Migrants	-1.6242	(-1.23)	-0.2143	(-0.18)	-0.6338	(-0.67)						
Family social capital	0.1250***	(3.81)	0.1748***	(4.18)	0.1356***	(3.92)	0.1380***	(3.58)	0.1489***	(4.68)	0.1114***	(2.61)
<b>Parental Characteristics:</b>												
Parent encourage child	1.8726	(1.56)	1.9324	(1.53)	1.6316	(1.26)	2.1105*	(1.84)	2.0883**	(2.02)	0.6951	(0.43)
Happiness score of father	0.0232	(1.52)	0.0076	(0.53)	-0.0015	(-0.09)	0.0265*	(1.84)	0.0097	(0.77)	0.0245	(1.18)
Parent married	2.9294	(1.21)	-0.6153	(-0.28)	-2.1293	(-0.90)	3.0817	(1.29)	2.8206	(1.46)	-4.3084	(-1.33)
<b>Household Housing characteristics:</b>												
Type of house (Ref: Low-rise house)												
Apartment	1.3091	(0.99)	2.8803**	(2.16)	1.7143	(1.52)	2.9669	(1.30)	2.8401**	(2.42)	-0.5701	(-0.33)
Bungalow	0.8062	(0.76)	0.3815	(0.35)	1.1865	(1.00)	0.1124	(0.10)	0.2912	(0.31)	1.0959	(0.75)
Condominium villa	-1.4444	(-0.28)	-5.7713	(-0.84)	5.3814***	(2.74)	-12.9790***	(-8.48)	-2.5145	(-0.43)		
Quadrangle courtyard	0.4118	(0.21)	-0.1629	(-0.09)	3.2985*	(1.80)	-1.5595	(-0.88)	-0.8529	(-0.55)	2.7966	(1.21)
Villa	-0.6276	(-0.21)	1.0122	(0.34)	1.2444	(0.45)	4.5330**	(2.43)	1.3149	(0.62)	3.4046	(0.55)
Housing tenure: more than 15 years	-1.0239	(-1.07)	0.7984	(0.93)	0.1300	(0.12)	-0.4030	(-0.46)	-0.2154	(-0.29)	-0.9830	(-0.70)
Received loan for housing	-0.5286	(-0.32)	1.7367	(1.21)	1.2010	(0.88)	0.1507	(0.08)	0.4543	(0.35)	1.4410	(0.60)
<b>Neighbourhood and Community capital:</b>												
Neighbourhood social capital	0.1134***	(5.93)	0.1167***	(5.27)	0.1168***	(5.61)	0.1136***	(5.59)	0.1138***	(6.56)	0.1110***	(4.08)
Community social capital	0.0801***	(5.01)	0.0707***	(4.03)	0.0633***	(3.86)	0.0862***	(5.28)	0.0790***	(5.82)	0.0668***	(2.86)
Province	Yes		Yes		Yes		Yes		Yes		Yes	
Year dummy	Yes		Yes		Yes		Yes		Yes		Yes	
Constant	56.9005**	(2.32)	51.0381**	(1.97)	26.9532	(1.05)	69.0615***	(2.74)	45.2803**	(2.13)	77.6564**	(2.30)
N	973		840		827		986		1,385		428	
Adj. R-squared	0.2099		0.1854		0.2198		0.2096		0.2047		0.2151	
<i>First stage</i>												
R-squared	0.737		0.784		0.609		0.921		0.781		0.797	
First-stage regression robust F	73.12***		59.65***		16.45***		173.36***		60.65***		48.23***	

**Notes:** z-statistics clustered at household level are in parenthesis; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Durbin-Wu-Hausman chi-square test endogeneity test rejects the null hypothesis that homeownership is exogenous

**Table A2.5 Factor analysis for the subjective wellbeing items** (as used in robustness tests)

Item	Factor loadings				
	2010	2012	2014	2016	Total
Academic achievement	0.606	0.561	0.547	0.542	0.569
Good student	0.598	0.492	0.517	0.507	0.533
Satisfied with school	0.677	0.690	0.704	0.708	0.693
Satisfied with Chinese language	0.669	0.689	0.696	0.684	0.684
Satisfied with math teacher	0.656	0.675	0.697	0.695	0.679
Eigenvalues	2.064	1.966	2.033	2.006	2.020
Percentage of variance explained	0.412	0.393	0.406	0.401	0.404
Kaiser-Meyer-Olkin (kmo)	0.667	0.637	0.656	0.654	0.655
Bartlett test of sphericity (p-value)	0.000	0.000	0.000	0.000	0.000
Alpha	0.644	0.614	0.633	0.624	0.631

**Notes:** These 4 questions include measures on Academic achievement [1. How would you rate your academic performance], Good student [2. How good a student do you think you are?], Satisfied with school [3. Are you satisfied with your school?], Satisfied Chinese language teacher [4. Are you satisfied with your Chinese language teacher?], Satisfied math teacher [5. Are you satisfied with your math teacher?].

## **CHAPTER 3**

### **HOUSING WEALTH AND HAPPINESS IN URBAN CHINA**

This chapter presents co-authored work with Russell Smyth, Zhiming Cheng and Haining Wang. The chapter uses data from China Household Finance Survey (CHFS) administered by Southwestern University of Finance and Economics. The authors would like to thank three anonymous referees of *Cities* for insightful comments on an earlier version that greatly improved the paper.

## **Abstract**

China has experienced rapid growth in inequality in housing wealth. We examine how housing wealth and housing wealth inequality are associated with happiness, drawing on panel data from three waves of the China Household Finance Survey (CHFS). We find that housing wealth and housing wealth inequality matter for happiness. More housing wealth increases happiness with diminishing returns to owning a second and third house. The relationship between housing wealth inequality and happiness depends on the reference group and the level of housing wealth inequality. An increase in housing wealth inequality among individuals of the same gender and similar age and education who live in the same city as me provides a signal that I also could accumulate housing wealth and this prospect makes me happier up to a threshold. However, once housing wealth inequality passes that threshold, this lowers my happiness because the wealth of those toward the top of the distribution seems out of reach. Similarly, a general increase in housing wealth inequality across the province in which I live lowers my happiness, which is consistent with a jealousy or status effect. We also employ the concentration index (CI) to examine the effect of housing wealth inequality on happiness inequality. The wealth-related CIs for happiness are all positive, suggesting that higher happiness is more concentrated among people with higher housing wealth.

### 3.1 Introduction

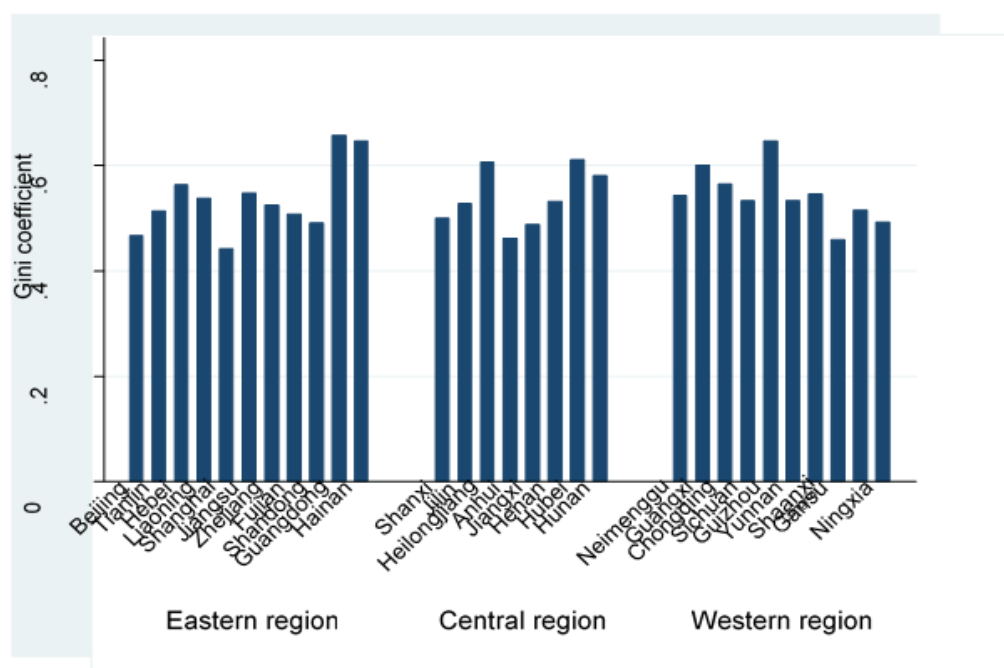
Piketty's (2014) *Capital in the Twenty-First Century* has put an academic spotlight on the role that inequality in housing wealth has played in contributing to steadily rising inequality in many economies since the 1970s and 1980s. Recent institutional and socioeconomic developments have reinforced the importance of housing wealth across many economies, including an increased role of homeownership and commodification of housing wealth, even in economies in which housing markets have traditionally been less important (Arundel, 2017). Yet, despite the growing importance of housing wealth inequality, the housing wealth dimension is not well understood in the international housing literature. Recently, studies such as Dorling (2014) and Arundel (2017) have called for much closer attention to be given to the role of housing wealth inequality in the housing and urban environment literature. We respond to this call by examining how housing wealth inequality affects people's happiness.

To do so, we situate our study in urban China. Urban China is an excellent illustration of a society in which housing markets were traditionally not important, but the commodification of housing and rapid growth in home ownership over the last three decades has created massive housing wealth inequality. The housing reforms, which commenced in 1988, have transformed the former socialist housing allocation system into a housing market. As a result, there has been a large increase in housing prices. House prices increased by over 10 per cent per year in real terms between 2003 and 2014 (Glaeser *et al.*, 2017) and have been growing nearly twice as fast as national income (Chen & Wen, 2017). Approximately 80 per cent of urban households own their houses and housing assets account for nearly 80 per cent of household wealth, which is much higher than in most other countries (Xie & Jin, 2015).

One reason for rising housing wealth inequality is that a high proportion of houses in the private sector that were previously public rental housing were sold with subsidies to sitting tenants. Hence, those with political connections and resourceful work units initially benefited the most during the privatization process (Yi & Huang, 2014). Housing inequality is also intergenerational. While urban China's older population benefitted most from the windfalls during the housing reforms (Park & Shen, 2015), first generation low-income households struggle to get a foothold in the housing market, which affects the starting point for the social mobility of the next generation

(Ren & Hu, 2016). There is also substantial variation in housing wealth inequality across provinces. Figure 3.1 shows that the Gini coefficients in the central and western regions are relatively higher than that in the eastern region in 2015, based on the China Household Finance Survey (CHFS) data used in this study.

**Figure 3.1 Housing wealth inequality by province in 2015**



**Source:** 2015 China Household Finance Survey

As a consequence of the housing reforms, a social and spatial sorting of households and neighbourhoods is emerging with significant residential segregation (Huang & Jiang, 2009). Big cities, such as Beijing and Shanghai, have seen the creation of high-end luxury neighbourhoods sitting alongside poor communities (Ko, 2017). It has been reported that 15 per cent of households own multiple properties (Ren & Hu, 2016) with some wealthy individuals owning much more. Some individuals in Beijing and Shanghai own more than 100 condominium units (Murayama, 2016). Many of these condominiums are unoccupied with the residential vacancy rate in Chinese cities higher than in major US cities (Holdstock, 2017). Yet, low income households, often referred to as the ‘low end population’, depend on cheap housing options, such as illegal rental properties (Chen, 2018).

We use the 2011, 2013 and 2015 waves of CHFS to examine how housing wealth and inequality in housing wealth is related to happiness. We include not only current residence but also other houses the respondent may own in calculating total house wealth. We also examine whether housing wealth inequality contributes to differences in happiness within reference groups, as well as employing the concentration index (CI) to analyse housing wealth-related inequality in happiness. We find that higher happiness is more concentrated among people with more housing wealth (measured by total house value).

Our study extends the emerging literature on the relationship between consumption or wealth inequality – rather than just income alone – and happiness in China (Cheng *et al.*, 2018; Cheng *et al.*, 2016; Lei *et al.*, 2018; Wang *et al.*, 2019a, 2019b) to focus on the roles of housing wealth inequality. The relationship between housing wealth inequality and happiness is important for various reasons. One is that housing wealth inequality in China is becoming increasingly visible (Chen, 2018). Hence, a study such as this speaks directly to spatial comparisons, which have been shown to be important for happiness (Buttrick *et al.*, 2017; Huang, 2018). Second, there is widespread recognition that an uneven distribution of wealth has the potential to be a source of social conflict and increases the risk of instability (Li *et al.*, 2008). This potentially extends to housing wealth inequality with the Chinese government increasingly concerned about the implications of residential segregation for social unrest (Ko, 2017; Murayama, 2016). This is particularly important given that housing wealth inequality is a major cause of wealth inequality in China. Housing wealth contributed to 63 per cent of overall household wealth inequality in 2002 (Li & Wan, 2015). This figure increased to 76 per cent by 2012 (Xie & Jin, 2015). Third, inequality in housing wealth also has broader socio-economic implications. For example, Wei and Zhang (2011) show that housing wealth is linked to the ability of young males to find a marriage partner.

### **3.2 Literature review**

Housing inequality in China has been extensively studied in terms of housing conditions and facilities, number of houses owned, housing prices and the housing price-income ratio (Huang & Li, 2014; Yi & Huang, 2014). At the same time, a large literature has evolved on the factors correlated with happiness in China (see eg.



Appleton & Song, 2008; Asadullah *et al.*, 2018; Cheng, 2014; Cheng *et al.*, 2017; Cheng & Smyth, 2015a, 2015b, 2017; Cheng *et al.*, 2015; Cheng *et al.*, 2014; Knight & Gunatilaka, 2012; Knight *et al.*, 2009; Li *et al.*, 2018a; Li *et al.*, 2018b; Mishra *et al.*, 2014; Tani, 2017; Wang & Cheng, 2017; Wang *et al.*, 2019a; Wang *et al.*, 2017). A smaller subset of this literature examines the relationship between housing and happiness. Studies find that happiness is correlated with homeownership (Hu, 2013); housing conditions (Zhang *et al.*, 2018); living space (Hu & Coulter, 2017) and housing stress and disadvantage among rural-urban migrants (Li & Liu, 2018). Cheng *et al.* (2016) develop a theoretical model that shows how a gradient of housing property rights related to happiness in China and test the predictions of the theoretical model using data from the 2011 CHFS, which is the first wave of the dataset used in the present study.

We extend this literature to examine how housing wealth inequality affects happiness in China. The two closest studies to ours are Li *et al.* (2015) and Zhang and Zhang (2019). Li *et al.* (2015) use the first two waves of CHFS to examine how housing wealth, as one component of overall household wealth, affects happiness. Li *et al.* (2015) find that housing as an asset, along with other household assets, is positively correlated with happiness and that happiness increases with the average assets of the community in which one lives (i.e. there is a signalling effect). We differ from Li *et al.* (2015) in that our focus is on housing wealth inequality. Using cross-sectional data from 2011 CHFS, Zhang and Zhang (2019) find that the appreciation in value of one's home residence, relative to original purchase price, is positively correlated with happiness. We differ from Zhang and Zhang (2019) in that we use panel data regression to examine the relationship between time-variant within-household housing wealth change and happiness, net of effects of time-invariant unobservables (e.g. time-invariant risk preference, social capital and personality) that may bias the estimates.

To summarize, while there is growing international interest in housing wealth inequality as a contributor to overall wealth inequality following Piketty's (2014) tome, there are no existing studies for China, or other countries, that examine how housing wealth inequality affect happiness, employing panel data, which is what we seek to do in the current study.

### 3.3 How does housing wealth of others affect happiness in Chinese cities?

We assume interdependent preferences in which one's utility depends not only on one's housing wealth, but also a combination of one's housing wealth and the housing wealth of relevant others. Following Hirschman and Rothschild (1973) and Senik (2008) assume a simplified society in which there are only two individuals (or groups of individuals): A and B.

Let A's happiness ( $HAPP^A$ ) depends on her own housing wealth ( $HW^A$ ), her expected housing wealth ( $E^A$ ) and, in part, the observed housing wealth of B ( $HW^B$ ). A's happiness function is then  $HAPP^A = V(HW^A, E^A(HW^B), HW^B)$ . The signs on  $\partial V/\partial HW^A$  and  $\partial V/\partial E^A$  are positive, but the sign on the partial derivative  $\partial V/\partial HW^B$  is ambiguous. Specifically,  $\partial V/\partial HW^B = [(\partial V/\partial E^A)(\partial E^A/\partial HW^B)] + V_3$ . The term  $(\partial V/\partial E^A)(\partial E^A/\partial HW^B)$  represents the information effect of B's housing wealth ( $HW^B$ ) on A's happiness ( $HAPP^A$ ) and is positive. The term  $V_3$  represents the comparison effect and captures the direct effect of  $HW^B$  on  $V$ . The sign on  $V_3$  depends on whether an increase in B's housing wealth generates a signalling effect, in which case it will be positive, or a jealousy/status effect, in which case the sign will be negative. Overall, the sign on  $\partial V/\partial HW^B$ , hence, depends on the relative strength of the information and comparison effects. The sign on  $\partial V/\partial HW^B$  will be positive if the signalling effect dominates or, if the status effect dominates, but the information effect outweighs the comparison effect.

Whether the signalling or jealousy/status effects dominate is a direct function of the extent to which A feels that she can emulate the success of B in accumulating housing wealth. This, in turn, is a function of two factors. The first is the extent to which the environment is more mobile and uncertain (Hirschman & Rothschild, 1973). The signalling effect is likely to be more important in societies in which the environment is uncertain and there are greater opportunities for upward social mobility (Senik, 2008). The second is the extent to which B's characteristics, in terms of ability to accumulate housing wealth, are similar to A. In this respect, an uncertain environment in which there are opportunities for upward social mobility are a necessary, but not sufficient, condition for the signalling effect to dominate. If the conditions under which A can potentially emulate the success of B do not exist, A has no prospect to accumulate housing wealth. But, even if opportunities for upward social mobility exist,

this does not mean that everybody will be upwardly social mobile. Indeed, in fast moving uncertain environments, such as China, in which some people get ahead, others will be left behind, widening inequalities in housing wealth accumulation. And, if opportunities for upward social mobility exist in *general*, whether A thinks that she will be well-placed to take advantage of them, will depend on whether B, who she sees accumulating housing wealth, has similar attributes to her. If A observes B accumulating housing wealth and B has similar attributes to A, A will feel that she can emulate B's success.

How important do we expect the signalling and jealousy/status effects to be in China, relative to the West? China differs from the West in the following salient respects. First, as a post-socialist transition society, its environment is more mobile and unstable than established western democracies. This implies that there is greater potential for more rapid housing wealth accumulation for those with the right attributes. Second, greater inequalities in housing wealth will be created within a shorter period. The combination of these factors means that, essentially, we expect the two effects to be more stark, relative to what one would observe in established western democracies. On the one hand, when we observe others with very similar characteristics to us accumulating wealth, we expect to see a stronger signalling effect than in the West. The reason is that the greater opportunities for upward social mobility create greater potential for one to accumulate housing wealth more quickly than in the West, generating welfare-enhancing 'anticipatory feelings' (Caplin & Leahy, 2001). At the same time, if I do not have the same, or similar, characteristics as those whom I observe accumulating housing wealth, that I feel will enable me to emulate their success, I am likely to experience a stronger jealousy effect than in the West because the resulting gap generated by others getting richer is likely to be larger. This might be reinforced in the Chinese case if I feel that in creating the mobile and uncertain environment in which others accumulate housing wealth, the government no longer cares about those with my characteristics. This is likely to be particularly true for certain groups that benefitted from socialist housing allocation in urban China prior to 1988, but do not have the skills to adapt to, and thrive in, the mobile and uncertain environment that characterises post-Mao China.

### 3.4 Data and methods

We use data from the 2011, 2013 and 2015 waves of the CHFS, administrated by the Southwestern University of Finance and Economics in China (Gan *et al.*, 2014). The CHFS collects information on individual, household and community characteristics. It employs a stratified three-stage probability proportion to size (PPS) random sampling design weighted by population size in each stage. In the first stage, 80 counties (including county-level cities and districts) were selected from 2585 primary sampling units (PSUs) from all provinces and municipalities in China. In the second stage four urban neighbourhood committees or rural villages were selected from each PSU from the first stage. In the third stage 20-50 households (depending on the levels of urbanisation and economic development) were selected from each neighbourhood committee or village chosen in the second stage. The 2011 baseline data covers 8,438 households and 29,324 individuals from 320 communities across 25 mainland provinces. In 2013 and 2015 households were re-surveyed. New households were also surveyed. The sampling framework covers 29 mainland provinces and municipalities. The 2013 wave covers 28,141 households and 97,906 individuals and the 2015 wave covers 37,289 households and 133,183 individuals. Given the fact that migrants face formidable institutional and economic barriers in pursuing home ownership in urban China due to their hukou status and other restrictions (Chen *et al.*, 2011), we restrict our sample to urban locals in this study. In total, there are 4,576 individuals in the 2011 wave, 16,665 individuals in the 2013 wave and 20,968 individuals in the 2015 wave in our analytical sample.

We use a two-way fixed effects panel regression model that controls for both individual and time fixed effects to examine the relationship between housing wealth and individual happiness. The individual fixed effects allow us to eliminate the influence of unobserved time-invariant individual characteristics, such as optimism, resilience and intelligence, while the time fixed effects allow us to eliminate the effects of unobserved time-varying characteristics common to all individuals, such as economic and housing market growth, on happiness.<sup>9</sup>

---

<sup>9</sup> Note that 2011-2015 CHFS data is an unbalanced panel data in which some individuals were observed only once (e.g. new survey respondents in each wave or respondents who left the survey after one wave and did not re-join the survey thereafter). The fixed effects estimator can be applied with unbalanced panel data (Semykina & Wooldridge, 2010). In fixed effects linear regression, cross-sectional singleton observations are included in the model to estimate the constant term and panel-level effect, but they

The happiness function is as follows:

$$Happiness_{it} = \alpha + \beta Inequal_{it} + \gamma House_{it} + \delta Wealth_{it} + \theta Debt_{it} + \rho HHinc_{it} + \varphi X_{it} + \mu_i + \sigma_t + \varepsilon_{it} \quad (3.1)$$

where subscript  $i$  denotes the individual and  $t$  represents the specific wave of the survey.

$Happiness_{it}$  is measured, on a five-point scale ranging from 1 (very dissatisfied) to 5 (very satisfied), by the response to the survey question: Are you satisfied with your life? Only one adult member in each household answered this question.

$Inequal_{it}$  is housing wealth inequality measured by the Gini coefficient or Theil index within the individual's reference group, defined by city of residence, gender, age and education.<sup>10</sup> Following the literature (Clark *et al.*, 2008; Huang *et al.*, 2016; Oshio *et al.*, 2011; Wang *et al.*, 2019a), reference groups are first defined at the city level. Within each city, further reference groups are constructed along the three dimensions of gender, age and education. Age is divided into six categories: younger than 20, 20-29, 30-39, 40-49, 50-59, and 60 or above. Education is divided into three categories according to the years of education one received: primary school and below (0-6 years), high school (9-12 years) and college or above (15 years or more). Therefore, there are thirty-six reference groups in total within each city ( $2 \times 6 \times 3 = 36$ ).

The Gini coefficient measures the degree of wealth equality. The Gini coefficient can vary from zero (perfect equality) to one (perfect inequality). A Gini coefficient of zero means that every household has the same housing wealth, while a coefficient of one indicates that a single household possesses all the housing wealth. The Theil index measures the entropic distance that the population is away from an egalitarian state, in

---

play no role in estimating the coefficients and standard errors for independent variables. The identifying assumption of fixed effects is that unobservable factors that might simultaneously affect the dependent and independent variable of the regression are time-invariant. Fixed effects estimation exploits within-individual variation over time. Across-individual variation is not used to estimate the regression coefficients because this variation might reflect omitted variable bias. In other words, including singleton observations in fixed effects regression will not bias the results because the identifying assumption of the fixed effects estimator does not rely on the singleton observations.

<sup>10</sup> To provide a point of comparison, we also provide results for the Gini coefficient and Theil index, defined at the province and city levels, in later analysis (models 1 and 2 of Table 2 and Table A3).

which every household has the same housing wealth. A Theil index of zero indicates perfect equality, in which every household has an equal proportion of housing wealth in the population, while a Theil index of one represents perfect inequality. The Gini coefficient is relatively more sensitive to changes in the middle of the wealth distribution, while the Theil index is relatively more sensitive to changes that affect the upper tail of the wealth distribution (Atkinson & Bourguignon, 2015; Gastwirth, 2017).

$House_{it}$  is the total amount of housing wealth.  $Wealth_{it}$  is the total amount of other categories of household wealth, excluding housing wealth.  $Wealth_{it}$  includes financial wealth (e.g. social insurance account balance, cash, savings, stocks, funds, bonds, gold and non-RMB assets) and non-financial wealth (e.g. agricultural productive assets, business assets, land and vehicles).  $Debt_{it}$  is the total amount of formal and informal household debt.  $HHinc_{it}$  is the total amount of annual household income, including wages, agricultural production income, business income, investment income and transfers. All categories of household wealth, debt and income have been deflated by the consumer price index (CPI), using 2011 as the base year, and were transformed into natural logarithms prior to analysis. Since some households may have a zero value for one or more proxies of debt or wealth, we add one to the amount of each wealth or debt measure prior to transforming that measure into its natural logarithm.

$X_{it}$  is a vector of control variables that the existing literature suggests are correlated with happiness; namely, age, gender, marital status, education, health status, degree of risk aversion, job status, whether the respondent has medical insurance, whether the respondent has superannuation, family size, number of children and the province in which the respondent resides. Appendix Table A3.1 contains definitions and descriptive statistics for each of the control variables. Of the remaining variables,  $\mu_i$  is the individual fixed effect;  $\sigma_t$  is the time (wave) fixed effect; and  $\varepsilon_{it}$  is the error term.<sup>11</sup>

In equation (3.1) we include a rich set of observed control variables and employ two-way fixed effects regression. However, there may exist unobservables that bias the

---

<sup>11</sup> We tested for multi-collinearity between the variables in Equation (3.1) using pairwise correlations and variance inflation factors. The results, which are available on request, suggest multi-collinearity is not a problem.

relationship between happiness and housing wealth and its inequality. To address this, we employ an approach proposed by Oster (2019) to evaluate whether, and to what extent, our results suffer from omitted variables bias. Oster (2019) argues that movements in both coefficient and R-squared should be considered when evaluating whether omitted variable bias is present. Oster (2019) extends the methodology for analysing coefficient stability under the assumption that the relationship between treatment and unobservables can be recovered from the relationship between the treatment and observables. Oster (2019) proposes two approaches to evaluate robustness to omitted variable bias. One approach is to assume a value for  $R_{max}$  and calculate the value of  $\delta$  for which the treatment effect equals zero.  $R_{max}$  is R-squared from a hypothetical regression of the outcome on treatment and both observed and unobserved controls. A value of  $R_{max} = 1.3\tilde{R}$  is suggested to estimate a bias-adjusted treatment effect bound ( $\tilde{R}$  is R-squared from the regression with controls). A value of  $\delta$  can be interpreted as the degree of selection on unobservables, relative to observables, that would be necessary to explain away the result. The value of  $\delta$  which produces  $\beta=0$  with  $R_{max} = 1.3\tilde{R}$  should exceed one.

Another approach is to use bounds on  $R_{max}$  and  $\delta$  to develop a set of bounds for the treatment effect,  $[\tilde{\beta}, \beta^*(\min\{1.3\tilde{R}, 1\}, 1)]$ , in which  $\tilde{\beta}$  is estimated with  $R_{max} = \tilde{R}$  and  $\delta=0$  in the regression with controls,  $\beta^*$  is the bias-adjusted treatment effect estimated with  $R_{max} = \min(1.3\tilde{R}, 1)$  and  $\delta=1$  in the full model. There are two standards for robustness. First, in cases in which the inclusion of controls moves the coefficient toward zero, the identified set should not include zero. Second, the identified set should fall within  $\pm 2.8$  standard errors of the controlled estimate, which is the bounds of the 99.5 per cent confidence interval. This standard represents a test of whether the magnitude of the estimate in the regression with controls is similar to the bias-adjusted estimate. This standard is also applicable to those cases in which adding the controls moves the coefficient away from zero.

Table 3.1 presents summary statistics on the measures of happiness, housing wealth and inequality in housing wealth defined at the city-gender-age-education level. The mean happiness score increased slightly from 3.73 to 3.74 between 2011 and 2015, but was only 3.66 in 2013. The modest increase in happiness levels in recent years is

consistent with the trends observed in China (Asadullah *et al.*, 2018; Easterlin *et al.*, 2012). In the CHFS sample, 73.88 per cent of households owned one house, 12.93 per cent of households owned two houses and 2.01 per cent of households reported owning three houses.<sup>12</sup> Total housing wealth in logs increased from 11.18 in 2011 to 11.67 in 2015. The wealth of the first house accounts for the largest proportion, being responsible for more than 98 per cent of total housing wealth. Results of a MANOVA test ( $W=0.9986$ ,  $p=0.0000$ ) indicate that there are significant differences in housing wealth structures across the three waves. Both the Gini coefficient and Theil index show that there was a sharp increase in housing wealth inequality within the city-gender-age-education defined reference group between 2011 and 2015. The Gini coefficient increased from 0.36 to 0.41 across the three waves and the Theil index increased from 0.31 to 0.37.<sup>13</sup>

**Table 3.1 Summary statistics of key variables, China Household Finance Survey 2011-2015**

	2011		2013		2015	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Happiness	3.73	0.81	3.66	0.85	3.74	0.83
Housing wealth	11.18	4.23	11.14	4.52	11.67	3.94
Wealth of 1 <sup>st</sup> house	11.05	4.19	10.95	4.52	11.49	3.94
Wealth of 2 <sup>nd</sup> house	1.99	4.60	1.94	4.60	1.92	4.61
Wealth of 3 <sup>rd</sup> house	0.26	1.82	0.29	1.93	0.26	1.85
Gini coefficient	0.36	0.17	0.39	0.18	0.41	0.16
Theil index	0.31	0.25	0.36	0.25	0.37	0.25

We employ a regression-based decomposition analysis of the CI to capture the contribution of housing wealth inequality to happiness inequality. The CI is calculated based on the concentration curve, which plots the cumulative proportion of happiness against the cumulative proportion of the sample, ranked according to housing wealth,

<sup>12</sup> Hence, the percentage of households owning two or three houses (14.94 per cent) accords with the statement that 15 per cent of households own multiple properties (Ren & Hu, 2016) cited in the introduction.

<sup>13</sup> For the full sample, the overall Gini coefficient for total housing wealth is 0.64. The decomposition of this Gini coefficient shows that the first house is the biggest contributor to overall housing wealth inequality, accounting for 74.88 per cent, while the contributions of the second and third houses are only 18.33 and 3.58 per cent, respectively (see Appendix Table A3.2 for full results).

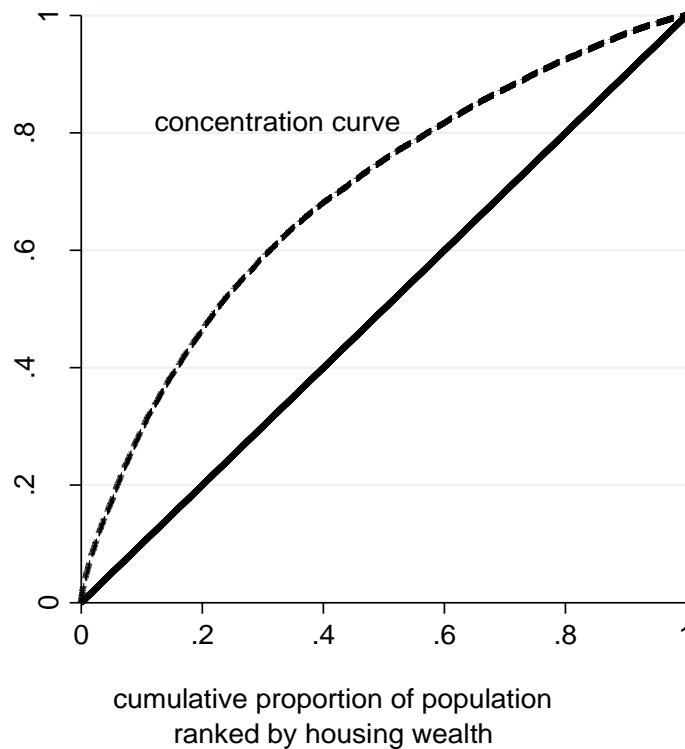


beginning with the person with least wealth (see Figure 3.2). The CI is defined as twice the area between the concentration curve and the line of equality (the diagonal), and for happiness, it can be expressed as follows:

$$CI = \frac{2}{n\mu} \sum_{i=1}^n happiness_i \times R_i - 1 \quad (3.2)$$

where  $n$  is the size of the population,  $\mu$  is the mean of happiness, and  $R_i$  is the fractional rank of individuals by housing wealth. CI takes a value of zero when there is no housing wealth-related happiness inequality. In the case in which happiness is higher, a positive (negative) CI indicates that higher happiness is more concentrated among people with higher (lower) wealth. The larger the absolute value of CI, the greater the degree of happiness inequality. Because the measure of happiness in this study is a bounded variable, we adopt the normalized concentration indices proposed by Erreygers (2009), which are based on the standardized version of the variable of interest and, hence, are scale invariant.

**Figure 3.2** Concentration curve for housing wealth-related happiness



Given the relationship between happiness and the various explanatory factors in Equation (3.1), the CI for happiness can be decomposed as:

$$CI = \sum_k (\beta_k \bar{x}_k / \mu) CI_k + GC_\varepsilon / \mu \quad (3.3)$$

where  $\beta_k$  is the estimated coefficients in Equation (1),  $\bar{x}_k$  is the mean of determinant  $x_k$  and  $\mu$  is mean happiness.  $CI_k$  is the concentration index for determinant  $x_k$ , which is defined analogously to CI.  $GC_\varepsilon$  is a generalized concentration index for the residual  $\varepsilon_i$ , which is defined as  $GC_\varepsilon = \frac{2}{n} \sum_{i=1}^n \varepsilon_i R_i$ . The CI can be decomposed into the explained component, which measures the contribution of determinants, and the unexplained component.

### 3.5 Main results

Table 3.2 presents the fixed effects estimates for the Gini coefficient and Theil index. We include a full set of controls as specified in Appendix A3.1 as well as wave fixed effects.

We first examine the relationship between provincial housing wealth inequality and happiness. In Models 1 and 2 we construct a Gini coefficient and Theil index for housing wealth inequality at the province level and examine their impact on happiness. The results show that provincial housing wealth inequality has a significant, and negative, effect on an individual's happiness. This result suggests a jealousy or status effect and is in line with findings in studies that have found a negative association between happiness and income inequality in urban China, usually when income inequality is measured by the Gini coefficient in a broad geographical area, such as province (Huang, 2018; Smyth & Qian, 2008; Wu & Li, 2017).

In models 3 and 4 we examine the relationship between happiness and housing wealth inequality using a city-gender-age-education defined reference group. People of the same age, education and gender living in the same city are likely to be a much more relevant reference group, than all people living in the same province. The results in models 3 and 4 show that both measures of housing wealth inequality are positive and significant, suggesting that the increase in housing wealth inequality experienced in

**Table 3.2 Fixed effects estimates of housing wealth and housing wealth inequality on happiness**

Reference group	Province		City-gender-age-education		City-gender-age-education	
	(1)	(2)	(3)	(4)	(5)	(6)
Gini	-0.4917** (-2.48)		0.1201*** (3.27)		0.1414 (1.35)	
Theil		-0.2960*** (-3.54)		0.0668*** (2.91)		0.1799*** (3.53)
Gini <sup>2</sup>					-0.0306 (-0.21)	
Theil <sup>2</sup>						-0.1110** (-2.57)
Housing wealth	0.0069*** (4.00)	0.0069*** (3.93)	0.0078*** (5.00)	0.0079*** (5.02)	0.0078*** (4.96)	0.0080*** (5.05)
<i>N</i>	38,299	38,299	38,299	38,299	38,299	38,299
adj. <i>R</i> <sup>2</sup>	0.0386	0.0390	0.0387	0.0386	0.0387	0.0389

**Notes:** *t* statistics in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; all specifications control for a full set of controls as specified in Appendix Table A1 as well as wave fixed effects; full results are available from the authors.

recent years has improved an individual's happiness. Model 3 shows that a standard deviation increase in the Gini coefficient (a 0.17 increase) is associated with an increase in the happiness score of 0.02 points, which corresponds to an increase of 2.41 per cent standard deviations. The effect size of the Theil index is very similar. Model 4 shows that a one standard deviation increase in the Theil index (a 0.25 increase) is associated with a 0.017-point increase in the happiness score.

The reason for the different signs on income inequality between Models 1 & 2 and 3 & 4, relate to how the reference group is defined. When an individual observes an increase in housing wealth inequality at the province level, this generates a jealousy effect because he/she feels unable to replicate the success of those who have accumulated a lot of housing wealth. However, an increase in housing inequality among a much more precise reference group, defined as those of the same age, education and gender living in the same city, provides a strong signalling effect. If others with very similar characteristics have been able to build housing wealth, it provides hope that he/she can as well. These results are consistent with the prediction

of the conceptual model in Section 3.2. The signalling effect is likely to dominate in an unstable environment in which there are opportunities for upward social mobility, if one feels that those who are successful can be emulated, creating anticipatory feelings.

Another reason for the positive effect of within-group inequality on happiness is that individuals have different tastes for within-group and between-group inequality, perceiving the former as equal and the latter as unequal (Ferrer-i-Cabonell & Ramos, 2014). Models of relative concern suggest that some individuals have compassion and concern for those who own less than them, while others have pride and gain satisfaction from others having less. The presence of compassion seems to be the basis of inequality aversion and presence of pride could generate a positive relationship between inequality and happiness. Even in a rivalry model in which pride dominates, a distinction can be made between endowment and reward inequality which have negative and positive effects on happiness, respectively (Hopkins, 2008).

In models 5 and 6 we examine the non-linear relationship between housing wealth inequality and happiness by adding the square terms of Gini coefficient or Theil index in the specifications. The results in Model 6 show that the coefficient for the squared term of the Theil index is significant and negative, suggesting that housing wealth inequality and happiness exhibit an inverted U-shaped relationship. For an individual with average housing wealth, the inflection point of the Theil-happiness relationship is 0.81. The value of inflection point is relatively high, considering that the mean and median values of the Theil index in the full sample are 0.35 and 0.33, respectively. This finding is consistent with studies that have found a similar non-linear relationship between income inequality and happiness (Yu & Wang, 2017).

One plausible explanation for this finding is that the inverted U-shaped relationship is determined by the relative strength of the jealousy effect and signalling effect. Up to a certain level of inequality, housing wealth of the region-gender-age-education reference group might seem most attainable, and hence, an increase in inequality signals an opportunity to obtain greater housing wealth in the future, which makes individuals happier. However, as the level of inequality in housing wealth increases beyond a critical point, the housing wealth of individuals at the top of the distribution

becomes out of reach for most members in the reference group. As a result, higher inequality makes individuals less hopeful of realizing upward wealth mobility and engenders a jealousy or status effect, which lowers happiness.

The results across Models 1-6 also show that own housing wealth has a significant and positive effect on happiness, after controlling for other factors potentially correlated with happiness. A standard deviation increase in housing wealth is associated with an increased happiness score of approximately 0.03 points. This finding is consistent with those of Otis (2017).

Table 3.3 presents the fixed effects results for housing wealth and housing wealth inequality for different numbers of houses. The results suggest that housing wealth associated with the first and second houses is positively related with one's happiness.

**Table 3.3 Fixed effects estimates**

	(1)	(2)
Gini – 1 <sup>st</sup> house	0.1363*** (3.64)	
Gini – 2 <sup>nd</sup> house	-0.0235 (-1.54)	
Gini – 3 <sup>rd</sup> house	0.0096 (0.63)	
Theil – 1 <sup>st</sup> house		0.0769*** (3.20)
Theil – 2 <sup>nd</sup> house		-0.0052 (-0.87)
Theil – 3 <sup>rd</sup> house		0.0021 (0.46)
Wealth of 1 <sup>st</sup> house	0.0072*** (4.77)	0.0073*** (4.79)
Wealth of 2 <sup>nd</sup> house	0.0064*** (3.26)	0.0061*** (3.15)
Wealth of 3 <sup>rd</sup> house	0.0065 (1.56)	0.0067 (1.62)
<i>N</i>	38,299	38,299
adj. <i>R</i> <sup>2</sup>	0.0394	0.0393

**Notes:** *t* statistics in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; all specifications include a full set of controls as specified in Appendix Table A1 as well as wave fixed effects; full results are available from the authors.

This finding is consistent with previous studies that have found that the number of houses one acquires matters for subjective wellbeing (Cheng et al., 2016). However, only the housing wealth inequality of the first house has a significant and positive relationship with happiness, while the inequality of the second and third houses has no significant association with happiness. The effect size is slightly greater than that of total housing wealth reported in models 3-4 in Table 3.2. Increasing the Gini coefficient and Theil index of the first house by one standard deviation is associated with an increase in an individual's happiness by 0.023 points and 0.018 points, respectively.

Table 3.4 presents the estimates of the CIs for happiness and housing wealth and decomposition results for the contribution of housing wealth to wealth-related happiness inequality. The wealth-related CIs for happiness are all positive, suggesting that higher happiness is more concentrated among people with higher housing wealth. The average total housing wealth-related CI for happiness is 0.0436 when the reference group is defined as city of residence, gender, age and education. Of the three houses, the housing wealth-related CI from the first house for happiness is the highest (0.0408), slightly lower than that of total housing wealth-related happiness inequality. Housing wealth-related CIs from the second and third houses are 0.0142 and 0.0029, respectively. In contrast to the wealth-related CIs for happiness, the extent of total housing wealth inequality is only 0.1178, which is relatively lower than that of housing wealth from the first and second houses. The CI for housing wealth from the second house is the highest, reaching 0.3626, followed by the CIs for wealth from the first and third house.

We next examine the contribution of housing wealth to happiness inequality. The contribution of total housing wealth inequality to happiness inequality is estimated based on the fixed effects estimates of Model 3 in Table 3.2, and the contributions of wealth inequalities from different numbers of houses are estimated based on the estimates of Model 1 in Table 3.3. The decomposition analysis shows that total housing wealth contributes 6.49 per cent to happiness inequality. As expected, wealth from the second house is the biggest contributor to happiness inequality, accounting for 8.52 per cent. Meanwhile, the contributions of wealth from owning the first and third house account for 6.41 and 1.64 per cent of the variation in happiness inequality.

**Table 3.4**      **Decomposition of the concentration index of happiness**

	CI of happiness	CI of wealth	%
All houses	0.0436	0.1178	6.49
1 <sup>st</sup> house	0.0408	0.1199	6.41
2 <sup>nd</sup> house	0.0142	0.3626	8.52
3 <sup>rd</sup> house	0.0029	0.0993	1.64

**Notes:** all specifications include a full set of controls as specified in Appendix Table A3.1 as well as wave fixed effects.

### 3.6 Robustness checks

To check whether our results are biased by omitted variables, we adopt the approach proposed by Oster (2019). Table 3.5 presents the results for this robustness check. The first column presents the effects of housing wealth and its inequality, without any control variables, and relevant robust standard errors and R-squared values. Column 2 presents the estimates with the full set of controls (adapted from Table 3.2). Column 3 shows the bias-adjusted treatment effects and standard errors under the assumption that  $R_{max}=1.3R$  ( $R_{max}=0.0503$ ) and  $\delta=1$ . All three adjusted treatment effects for housing wealth and inequality have the same sign as the estimated effects. The bias-adjusted coefficients are still significant at the 5 per cent confidence level. The bounds of the set  $[\tilde{\beta}, \beta^*(R_{max}, 1)]$  does not include zero and falls within  $\pm 2.8$  standard errors of the controlled estimates. Although the inclusion of controls causes the coefficients on housing wealth inequality to move away from zero, we find that including a full set of controls and unobservables does not lead to significantly different conclusions than just including the controls. The treatment effects suggest that a one standard deviation increase in the Gini coefficient and Theil index lead to a 0.023-point and 0.020-point increase in the happiness score, respectively, slightly higher than the effect sizes estimated based on just including the controls. Moreover, there is only a small movement in the coefficient on housing wealth toward zero when a full set of controls is included, decreasing from 0.0099 to 0.0078. Column 4 calculates the values of  $\delta$  such that  $\beta=0$  and  $R_{max}=0.0503$ . The value of  $\delta$  for housing wealth is greater than one, while the values of  $\delta$  for inequality are negative. This is because the inclusion of controls has moved the coefficients away from zero instead of toward zero. However, their absolute values exceed one. Both robustness checks suggest unobservables are

not biasing the estimates and that the coefficients estimated in the regression with controls are robust.

**Table 3.5 Robustness check: coefficient stability**

	Baseline effect $\beta$ (S.E.) [ $R^2$ ]	Controlled effect $\tilde{\beta}$ (S.E.) [ $R^2$ ]	Bias-adjusted $\beta^*$ $R_{max}=1.3R$	$\delta$ for $\beta=0$ given $R_{max}$
Gini	0.0547 (0.0346) [0.0001]	0.1201 (0.0367) [0.0393]	0.1355 (0.0627)	-9.16
Theil	0.0176 (0.0221) [0.0000]	0.0668 (0.0230) [0.0392]	0.0797 (0.0393)	-5.77
Housing wealth	0.0099 (0.0015) [0.0018]	0.0078 (0.0016) [0.0393]	0.0069 (0.0031)	7.66

In models 1-4 in Table 3.2 we provide separate results for the effects on happiness of general provincial inequality (as a reference) and within-reference group inequality (the focus of this paper). In a study on income inequality and happiness in urban China, Jiang *et al.* (2012) control for both within-group and general inequality and suggest that one should distinguish between income inequalities within different social groups that are arguably more unfair than general inequality, which is relatively neutral. As a robustness check, in models 1 and 2 in Table 3.6 we include both within group housing wealth inequality and provincial general housing wealth inequality. The results are consistent with those in models 1-4 in Table 3.2.<sup>14</sup>

Thus far, we have followed the standard practice by adding one to the amount of housing wealth prior to the log transformation in order to accommodate households with no urban housing wealth. We conduct further robustness tests to ensure that our results are not biased by the log transformation approach or by samples that have zero housing wealth.

<sup>14</sup> We also tried alternative specifications in which we controlled for housing wealth inequality at the province level, at the city level and within the city-gender-age-education defined reference group. The results are reported in Appendix Table A3.3. When we control for all three simultaneously in the same specification, housing wealth inequality defined at the city level and at the city-gender-age-education level have a positive and significant effect on an individual's happiness. The effect size of housing wealth inequality at the city level is relatively higher. A one standard deviation increase in housing wealth at the city level (a 0.08 increase) is associated with a 0.036 points increase in the happiness score.



**Table 3.6 Robustness check: fixed effects estimates with different specifications**

	+ provincial inequality		+ zero housing wealth				IHS transformation		+ provincial inequality & zero housing wealth		- housing wealth	Remove zero housing wealth samples	housing wealth categories
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Gini – within group	0.1280*** (3.49)				0.1245*** (3.39)		0.1283*** (3.50)		0.1320*** (3.60)		0.1129*** (3.07)	0.1290*** (3.25)	0.1129*** (3.07)
Theil – within group		0.0759*** (3.30)				0.0678*** (2.95)		0.0716*** (3.13)		0.0765*** (3.33)			
Gini – province	-0.5317*** (-3.19)		-0.4689*** (-2.80)						-0.5096*** (-3.05)				
Theil – province		-0.3186*** (-4.35)		-0.2873*** (-3.91)						-0.3101*** (-4.23)			
Zero housing wealth (ref: non-zero housing wealth)			0.3679*** (4.03)	0.3665*** (4.01)	0.3845*** (4.22)	0.3786*** (4.15)			0.3761*** (4.12)	0.3686*** (4.03)	-0.0772*** (-3.84)		
Housing wealth	0.0077*** (4.92)	0.0078*** (4.92)	0.0348*** (4.90)	0.0346*** (4.87)	0.0370*** (5.21)	0.0366*** (5.16)	0.0277*** (6.68)	0.0278*** (6.68)	0.0362*** (5.09)	0.0357*** (5.02)		0.0406*** (5.15)	
Housing wealth (ref: zero housing wealth)													
Low													0.0443** (2.06)
Medium													0.0829*** (3.95)
High													0.1133*** (5.07)
<i>N</i>	38,299	38,299	38,299	38,299	38,299	38,299	38,299	38,299	38,299	38,299	38,299	34,036	38,299
adj. <i>R</i> <sup>2</sup>	0.0392	0.0394	0.0394	0.0397	0.0396	0.0394	0.0390	0.0389	0.0400	0.0402	0.0383	0.0430	0.0391

**Notes:** *t* statistics in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; all specifications control for a full set of controls as specified in Appendix Table A3.1 as well as wave fixed effects; full results are available from the authors

In models 3-6 in Table 3.6, we re-estimate models 1-4 in Table 3.2, adding a dummy variable set equal to 1 if the respondent has no housing wealth in addition to controlling for housing wealth. The results are consistent with those reported in models 1-4 in Table 3.2. That the dummy variable for zero housing wealth is positive and significant suggests that households who have no housing wealth are happier than those with housing wealth, once we control for the positive effect of housing wealth on happiness. As an alternative to taking the log transformation of the wealth measures, in Models 7-8 we apply the inverse hyperbolic sine (IHS) transformation to measures of housing wealth, debt, assets and household income (Friedline *et al.*, 2015) and re-estimate model 3 in Table 3.2.<sup>15</sup> The results for the within-group Gini, with the IHS transformed wealth measure and the log transformed wealth measure are consistent.

In models 9 and 10 in Table 3.6, we re-estimate models 1 and 2 in Table 3.6, adding a dummy variable set equal to 1 if the respondent has no housing wealth in addition to controlling for housing wealth. As in models 3-6, the dummy variable for households with zero housing wealth is positive. The results in models 9 and 10 suggest that first two columns in Table 3.6 are robust to this alternative approach to dealing with households with no housing wealth. In model 11 we do not control for housing wealth and find that the coefficient on the dummy for zero housing wealth is negative and significant, consistent with our interpretation for the coefficient on the dummy variable for households with zero housing wealth in models 3-6 and 9-10. In model 12 we restrict the sample to those who have housing wealth and remove those who do not. The approach proposed by Semykina and Wooldridge (2013) is employed to address possible sample selection bias in estimation. In model 13 we replace the continuous housing wealth variable with a categorical variable. In models 11-13 the findings for the within-group Gini are consistent with the main results.

Since housing wealth inequality is correlated with non-housing wealth inequality and household income inequality within the city-gender-age-education defined reference group (the pairwise correlation coefficient between two of these three Gini coefficients ranges from 0.54 to 0.62.), as a further check we test whether our results are driven by the non-housing wealth inequality and household income inequality. Appendix Table

---

<sup>15</sup> The IHS transformations can be expressed as  $ihs(x) = \log(\sqrt{x^2 + 1} + x)$ .

A3.4 shows that our point estimate on the impact of housing wealth inequality is still significant and not affected by the inclusion of non-housing wealth and household income inequalities. This result suggests that the effect of housing wealth inequality on an individual's happiness is distinct from non-housing wealth inequality and household income inequality.

### **3.7 Conclusion**

Housing wealth inequality in urban China has been increasing in recent years. This is important because inequality in housing wealth is a major contributor to total wealth inequality in urban China. It is also an extremely visible indicator of differences between the 'haves' and 'have nots' and, as such, likely to be important when it comes to relative effects. In this respect, although China has only recently developed a housing market, it is illustrative of concerns about the effects of rising house wealth inequality in other countries (Piketty, 2014). While a number of studies have examined the effect of inequality in consumption, income and overall household wealth on happiness, there has, to this point, been no in-depth treatment of how housing wealth and inequality in housing wealth is associated with happiness, either for China or other countries. This is in spite of calls for more attention to be given internationally to the role of housing wealth inequality (Arundel, 2017).

The picture that emerges from our study is that housing wealth is positively associated with happiness in urban China. This is true for the in-group comparison and when city is the reference point. This is consistent with extant findings from studies such as Otis (2017) and Wang et al. (2018). There are, however, diminishing returns, to wealth from owning a second house and the wealth from owning a third house is statistically insignificant.

A general increase in housing wealth inequality at the province level lowers happiness. The reason is that individuals are unable to relate to those at the top end of the distribution and, hence feel unable to replicate their success. This engenders a jealousy effect. However, an increase in housing wealth inequality within a narrowly defined reference group – those of the same gender and similar age and education living in the same city – up to a certain point increases happiness. The reason is that individuals feel empowered by the success of others with very similar characteristics to them and

this generates a signalling effect in which people feel that success for them is just around the corner. If others of the same age, education and gender, living in the same city as me have been able to accumulate housing wealth, I should be well placed to replicate their success. The signalling effect dissipates when housing wealth inequality passes a threshold at a relatively high level of inequality. Beyond the threshold, the success of those at the top of the distribution appears out of reach, even when, on paper, they seem similar to me. I have ‘missed the boat’ - increase in housing wealth inequality makes me jealous of what they have achieved and serves to lower my happiness.

An important policy implication of our findings is that the government should take steps to reduce general inequality in housing wealth at the provincial level, which lowers happiness. One step that the Chinese government is taking is to subsidise low-income housing. For example, in 2017, the government planned to build two million units of public rental housing to provide affordable homes for low-income groups (Than, 2017). However, as Huang (2013) discusses, there have been reports of local governments relabelling existing housing as new affordable housing, while, in other cases, the new housing is being built in remote locations with poor services. And the better-quality housing that is being built in good locations is often ending up in the hands of middle-income households, ministries or other government agencies who often acquire multiple houses. Some cities, such as Chongqing and Shanghai, have introduced fixed asset taxes to curb housing wealth at the top of the distribution, but the taxes have had limited effect. While an argument in favour of a fixed asset tax our finding of diminishing returns to housing wealth from owning a second and third house, politically, few in the Chinese government want a more general fixed asset tax because they are among those who have the most housing wealth and would lose most from such a tax (Murayama, 2016). An alternative policy option is to create more opportunities for those without housing wealth to build at least modest levels of housing wealth. If individuals can see realistic opportunities to build wealth from the growth in housing prices and can see that others with characteristics similar to them, living in the same city, have been successful in so doing, housing wealth inequality up to relatively high levels can provide a strong signalling effect.

## References

- Appleton, S., & Song, L. (2008). Life satisfaction in urban China: Components and determinants. *World Development*, 36(11), 2325-2340.
- Arundel, R. (2017). Equity inequity: Housing wealth inequality, inter and intra-generational divergences, and the rise of private landlordism. *Housing, Theory and Society*, 34(2), 176-200.
- Asadullah, M. N., Xiao, S., & Yeoh, E. (2018). Subjective well-being in China, 2005–2010: The role of relative income, gender, and location. *China Economic Review*, 48, 83-101.
- Atkinson, A. B., & Bourguignon, F. (Eds.). (2015). *Handbook of Income Distribution* (Vol. 2): Elsevier.
- Buttrick, N. R., Heintzelman, S. J., & Oishi, S. (2017). Inequality and well-being. *Current Opinion in Psychology*, 18, 15-20.
- Caplin, A., & Leahy, J. (2001). Psychological expected utility theory and anticipatory feelings. *The Quarterly Journal of Economics*, 116(1), 55-79.
- Chen, G. (2018). The Increasing Visibility of Inequality in Urban China. Retrieved from <https://www.chinausfocus.com/political-social-development/the-increasing-visibility-of-inequality-in-urban-china>
- Chen, J., Guo, F., & Wu, Y. (2011). One decade of urban housing reform in China: Urban housing price dynamics and the role of migration and urbanization, 1995–2005. *Habitat International*, 35(1), 1-8.
- Chen, K., & Wen, Y. (2017). The great housing boom of China. *American Economic Journal: Macroeconomics*, 9(2), 73-114.
- Cheng, H., Chen, C., Li, D., & Yu, H. (2018). The Mystery of Chinese People's Happiness. *Journal of Happiness Studies*, 19(7), 2095-2114.
- Cheng, Z. (2014). The effects of employee involvement and participation on subjective wellbeing: Evidence from urban China. *Social Indicators Research*, 118(2), 457-483.
- Cheng, Z., King, S. P., Smyth, R., & Wang, H. (2016). Housing property rights and subjective wellbeing in urban China. *European Journal of Political Economy*, 45(Suppl), 160-174.
- Cheng, Z., Mishra, V., Nielsen, I., Smyth, R., & Wang, B. Z. (2017). Wellbeing in China. *Social Indicators Research*, 132(1), 1-10.

- Cheng, Z., & Smyth, R. (2015a). Crime victimization, neighborhood safety and happiness in China. *Economic Modelling*, 51, 424-435.
- Cheng, Z., & Smyth, R. (2015b). Sex and happiness. *Journal of Economic Behavior & Organization*, 112, 26-32.
- Cheng, Z., & Smyth, R. (2017). China's imbalanced sex ratio and satisfaction with marriage. *The Singapore Economic Review*, 62(04), 765-782.
- Cheng, Z., Smyth, R., & Guo, F. (2015). The impact of China's new Labour Contract Law on socioeconomic outcomes for migrant and urban workers. *Human Relations*, 68(3), 329-352.
- Cheng, Z., Wang, H., & Smyth, R. (2014). Happiness and job satisfaction in urban China: A comparative study of two generations of migrants and urban locals. *Urban Studies*, 51(10), 2160-2184.
- Clark, A. E. (2003). Inequality-aversion and income mobility: a direct test. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.561.6200&rep=rep1&type=pdf>
- Clark, A. E., Frijters, P., & Shields, M. A. (2008). Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles. *Journal of Economic Literature*, 46(1), 95-144.
- Dorling, D. (2014). *All That Is Solid: How the Great Housing Disaster Defines Our Times, and What We Can Do About It*. London: Allen Lane.
- Easterlin, R. A., Morgan, R., Switek, M., & Wang, F. (2012). China's life satisfaction, 1990–2010. *Proceedings of the National Academy of Sciences*, 109(25), 9775-9780.
- Ferrer-i-Cabonell, A., & Ramos, X. (2014). Inequality and happiness. *Journal of Economic Surveys*, 28(5), 1016-1027.
- Friedline, T., Masa, R. D., & Chowa, G. A. (2015). Transforming wealth: Using the inverse hyperbolic sine (IHS) and splines to predict youth's math achievement. *Social science research*, 49, 264-287.
- Gan, L., Yin, Z., Jia, N., Xu, S., Ma, S., & Zheng, L. (2014). *Data You Need to Know About China*. Berlin: Springer.
- Gastwirth, J. L. (2017). Is the Gini index of inequality overly sensitive to changes in the middle of the income distribution? *Statistics and Public Policy*, 4(1), 1-11.
- Glaeser, E., Huang, W., Ma, Y., & Shleifer, A. (2017). A real estate boom with Chinese Characteristics. *Journal of Economic Perspectives*, 31(1), 93-116.

- Hirschman, A. O., & Rothschild, M. (1973). The changing tolerance for income inequality in the course of economic development: With a mathematical appendix. *The Quarterly Journal of Economics*, 87(4), 544-566.
- Holdstock, N. (2017). 'Half these apartments are empty': Mao's former home city struggles with growth. Retrieved from <https://www.theguardian.com/cities/2017/mar/20/changsha-changing-mao-growth-housing-services>
- Hopkins, E. (2008). Inequality, happiness and relative concerns: What actually is their relationship? *Journal of Economic Inequality*, 6(4), 351-372.
- Hu, F. (2013). Homeownership and subjective wellbeing in urban China: Does owning a house make you happier? *Social Indicators Research*, 110(3), 951-971.
- Hu, Y., & Coulter, R. (2017). Living space and psychological well-being in urban China: Differentiated relationships across socio-economic gradients. *Environment and Planning A*, 49(4), 911-929.
- Huang, J. (2018). Income Inequality, Distributive Justice Beliefs, and Happiness in China: Evidence from a Nationwide Survey. *Social Indicators Research*, 142, 83-105.
- Huang, J., Wu, S., & Deng, S. (2016). Relative income, relative assets, and happiness in urban China. *Social Indicators Research*, 126(3), 971-985.
- Huang, Y. (2013). Lack of affordable housing threatens China's urban dream. Retrieved from <https://www.chinadialogue.net/article/show/single/en/6365-Lack-of-affordable-housing-threatens-China-s-urban-dream>
- Huang, Y., & Jiang, L. (2009). Housing inequality in transitional Beijing. *International Journal of Urban and Regional Research*, 33(4), 936-956.
- Huang, Y., & Li, S.-m. (Eds.). (2014). *Housing Inequality in Chinese Cities*. New York: Routledge.
- Jiang, S., Lu, M., & Sato, H. (2012). Identity, Inequality, and Happiness: Evidence from Urban China. *World Development*, 40(6), 1190-1200.
- Knight, J., & Gunatilaka, R. (2012). Income, aspirations and the hedonic treadmill in a poor society. *Journal of Economic Behavior & Organization*, 82(1), 67-81.
- Knight, J., Lina, S., & Gunatilaka, R. (2009). Subjective well-being and its determinants in rural China. *China Economic Review*, 20(4), 635-649.
- Ko, T.-y. (2017). Why Beijing wants private housing compounds to open up to public. Retrieved from <http://www.ejinsight.com/20170831-why-beijing-wants-private-housing-compounds-to-open-up-to-public/>

- Lei, X., Shen, Y., Smith, J. P., & Zhou, G. (2018). Life satisfaction in China and consumption and income inequalities. *Review of Economics of the Household*, 16(1), 75-95.
- Li, J., Fang, M., Wang, W., Sun, G., & Cheng, Z. (2018a). The Influence of Grit on Life Satisfaction: Self-Esteem as a Mediator. *Psychologica Belgica*, 58(1), 51–66.
- Li, J., Li, H., & Gan, L. (2015). Jiating zichan-fuzhai yu xingfugan: 'xingfu-shouru' zhimi de yige jieshi (家庭资产-负债与幸福感: “幸福-收入”之谜的一个解释; Household Assets, Debts and Happiness: An Explanation to “Happiness-Income” Puzzle). *Nankai jingji yanjiu (南开经济研究; Nankai Economic Studies)*, 2015/5, 3-23.
- Li, J., & Liu, Z. (2018). Housing stress and mental health of migrant populations in urban China. *Cities*, 81, 172-179.
- Li, J., Wang, W., Sun, G., Jiang, Z., & Cheng, Z. (2018b). Supervisor–subordinate guanxi and job satisfaction among migrant workers in China. *Social Indicators Research*, 139(1), 293–307.
- Li, P., G., C., Zhang, Y., & Li, W. (2008). *Report on China's Harmonious and Stable Society*. Beijing: Social Science Literature Press.
- Li, S., & Wan, H. (2015). Evolution of wealth inequality in China. *China Economic Journal*, 8(3), 264-287.
- Mishra, V., Nielsen, I., & Smyth, R. (2014). How does relative income and variations in short-run wellbeing affect wellbeing in the long run? Empirical evidence from China’s Korean minority. *Social Indicators Research*, 115(1), 67-91.
- Murayama, H. (2016). Sky high condo prices fueling social inequality in China. Retrieved from <https://asia.nikkei.com/Economy/Sky-high-condo-prices-fueling-social-inequality-in-China>
- Oshio, T., Nozaki, K., & Kobayashi, M. (2011). Relative income and happiness in Asia: Evidence from nationwide surveys in China, Japan, and Korea. *Social Indicators Research*, 104(3), 351-367.
- Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business and Economic Statistics*, 37(2), 187-204.



- Otis, N. (2017). Subjective well-being in China: Associations with absolute, relative, and perceived economic circumstances. *Social Indicators Research*, 132(2), 885-905.
- Park, A., & Shen, Y. (2015). Understanding wealth and housing inequality among China's older population. *China Economic Journal*, 8(3), 288-307.
- Piketty, T. (2014). *Capital in the Twenty-First Century*. Cambridge: Belknap Press.
- Ren, Q., & Hu, R. (2016). Housing inequality in urban China. *Chinese Journal of Sociology*, 2(1), 144-167.
- Semykina, A., & Wooldridge, J. M. (2013). Estimation of dynamic panel data models with sample selection. *Journal of Applied Econometrics*, 28(1), 47-61.
- Senik, C. (2008). Ambition and jealousy: Income interactions in the 'Old' Europe versus the 'New' Europe and the United States. *Economica*, 75(299), 495-513.
- Smyth, R., & Qian, X. (2008). Inequality and happiness in urban China. *Economic Bulletin*, 4(23), 1-10.
- Tani, M. (2017). Hukou changes and subjective well-being in China. *Social Indicators Research*, 132(1), 47-61.
- Than, E. (2017). China plans to build two million new units of public housing for 2017. Retrieved from <https://www.reuters.com/article/us-china-property/china-plans-two-million-new-units-of-public-housing-for-2017-xinhua-idUSKBN17K00R>
- Wang, B. Z., & Cheng, Z. (2017). Environmental perceptions, happiness and pro-environmental actions in China. *Social Indicators Research*, 132(1), 357-375.
- Wang, H., Cheng, Z., & Smyth, R. (2019a). Consumption and Happiness. *Journal of Development Studies*, 55(1), 120-136.
- Wang, H., Cheng, Z., & Smyth, R. (2019b). Wealth, Happiness and Happiness Inequality in China. In G. Brulé & C. Suter (Eds.), *Wealth(s) and Subjective Well-Being* (pp. 445-461). Cham: Springer.
- Wang, W., Li, J., Sun, G., Cheng, Z., & Zhang, X.-a. (2017). Achievement goals and life satisfaction: the mediating role of perception of successful agency and the moderating role of emotion reappraisal. *Psicologia: Reflexão e Crítica*, 30(25), 1-12.
- Wei, S.-J., & Zhang, X. (2011). The competitive saving motive: evidence from rising sex ratios and savings rates in China. *Journal of Political Economy*, 119(3), 511-564.

- Wu, X., & Li, J. (2017). Economic growth, income inequality and subjective wellbeing: Evidence from China. *Research in Social Stratification and Mobility*, 52, 49-58.
- Xie, Y., & Jin, Y. (2015). Household wealth in China. *Chinese Sociological Review*, 47(3), 203-229.
- Yi, C., & Huang, Y. (2014). Housing consumption and housing inequality in Chinese cities during the first decade of the twenty-first century. *Housing Studies*, 29(2), 291-311.
- Yu, Z., & Wang, F. (2017). Income Inequality and Happiness: An Inverted U-Shaped Curve. *Frontiers in Psychology*, 8(2052), 1-6.
- Zhang, C., & Zhang, F. (2019). Effects of housing wealth on subjective well-being in urban China. *Journal of Housing and the Built Environment*, 1-21.
- Zhang, F., Zhang, C., & Hudson, J. (2018). Housing conditions and life satisfaction in urban China. *Cities*, 81, 35-44.

## APPENDICES

**Table A3.1 Summary statistics, China Household Finance Survey 2011, 2013 and 2015**

Variable	Definition	Mean / percentage	Standard Deviation
Housing wealth	Household housing wealth (of all houses) in logarithm (inverse hyperbolic sine (HIS) transformation)	11.41	4.22
Debt	Household debt, in logarithm	2.78	4.78
Assets	Household assets excluding housing wealth, in logarithm	11.08	1.89
Income	Household income, in logarithm	10.18	2.77
Male	Male=1; female=0	48.21%	
Age	Years	51.45	14.99
Age squared		2,871.39	1,585.36
Education	Years	10.26	4.14
Marital status:			
Unmarried	Reference group	5.10%	
Married		84.25%	
Other		10.65%	
Risk aversion	Scale: high=1; low=5	4.02	1.20
Health status	Scale: very healthy=1; very unhealthy=5	2.88	1.08
Medical insurance	Yes=1; no=0	91.44%	
Superannuation	Yes=1; no=0	80.85%	
Job status			
Employed	Reference group	27.91%	
Self-employed		10.24%	
Agricultural work		8.19%	
Other jobs		5.60%	
No work		48.06%	
Family size	Number of family members	2.61	1.58
Children	Number of children	0.82	1.25
Province	Details available from authors		

**Table A3.2 Decomposition of Gini coefficient by source of housing wealth (full sample)**

Housing wealth source	Wealth share ( $S_k$ )	Gini coefficient ( $G_k$ )	Gini correlation ( $R_k$ )	Relative contribution [( $S_k \times G_k \times R_k$ ) / $G$ ]
Wealth of 1 <sup>st</sup> house	0.8026	0.6154	0.9668	0.7488
Wealth of 2 <sup>nd</sup> house	0.1474	0.9309	0.8523	0.1833
Wealth of 3 <sup>rd</sup> house	0.0253	0.9899	0.9139	0.0358
Total housing wealth ( $G$ )		0.6377		

**Notes:**  $S_k$  measures how important the wealth source is with respect to total wealth;  $G_k$  measures how equally or unequally distributed the wealth source is;  $R_k$  measures how the wealth sources and the distribution of total wealth are correlated; *relative contribution* measures the share of individual wealth source in total housing wealth inequality.

**Table A3.3 Fixed effects estimates of housing wealth inequality within different reference groups on happiness**

	(1)	(2)	(3)	(4)
Gini – province	-0.4917*** (-2.94)			-0.7567*** (-4.40)
Gini – city		0.3714*** (3.90)		0.4520*** (4.44)
Gini – group			0.1201*** (3.27)	0.0939** (2.48)
Housing wealth	0.0069*** (4.47)	0.0074*** (4.76)	0.0078*** (5.00)	0.0078*** (4.97)
<i>N</i>	38,299	38,299	38,299	38,299
adj. <i>R</i> <sup>2</sup>	0.0386	0.0389	0.0387	0.0400

**Notes:** *t* statistics in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; all specifications control for a full set of controls as specified in Appendix Table A3.1 as well as wave fixed effects; full results are available from the authors.

**Table A3.4 Housing wealth, non-housing wealth and happiness**

	<b>Happiness</b>
Gini – housing wealth	0.1239*** (3.01)
Gini – non-housing wealth	-0.0223 (-0.62)
Gini – household income	0.0518 (1.33)
Housing wealth	0.0076*** (4.87)
Debt	-0.0027** (-2.27)
Assets	0.0307*** (7.32)
Income	0.0045 (1.43)
<i>N</i>	37,969
adj. <i>R</i> <sup>2</sup>	0.0387

**Notes:** *t* statistics in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; all specifications control for a full set of controls as specified in Appendix Table A3.1 as well as wave fixed effects; results are available from the authors.

## **CHAPTER 4**

### **PETROL PRICES AND SUBJECTIVE WELLBEING**

This chapter presents co-authored work with Russell Smyth and Sefa Awaworyi Churchill. This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The Household, Income and Labour Dynamics in Australia (HILDA) Survey was initiated and funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the authors and should not be attributed to either DSS or the Melbourne Institute. We thank David Gargett from the Department of Infrastructure, Regional Development and Cities for sharing the city-level monthly diesel and unleaded petrol price data. An earlier version of this paper was presented at a PhD conference in the Faculty of Business and Economics at Monash University. We thank conference participants, Choon Wang, Mark Wooden, Kenneth Clements and two anonymous referees for very helpful comments on earlier versions of this paper.

## **Abstract**

We examine the effect of petrol prices on subjective wellbeing (SWB) using household panel data. To do so, we use 17 waves of the Household, Income and Labour Dynamics in Australia (HILDA) survey. Based on our preferred instrumental variable estimates, we find that a standard deviation increase in petrol prices leads to a decline of 0.0157–0.0245 standard deviations in SWB. The finding that increases in petrol prices significantly lower SWB is robust to alternative measures of wellbeing and alternative ways of addressing endogeneity, as well as employing different sources of fuel price data measured at a range of frequencies. We also examine the channels through which petrol prices influence SWB and find that maintaining social networks is an important way through which petrol prices influence SWB.

**Keywords:** subjective wellbeing; life satisfaction, petrol prices, Australia



## 4.1 Introduction

There is a growing interest among policymakers in using measures of subjective wellbeing (SWB) to evaluate the impact of policy (see eg. DiMaria, Peroni & Sarccino, 2019; Sachs, Becchetti & Annet, 2016). Improving SWB has, thus, become an important policy objective in many countries. This development reflects greater attention, among economists, to indicators of social progress other than Gross Domestic Product (GDP) more generally. The Stiglitz Commission (Stiglitz, Sen & Fitoussi, 2009), for instance, recommended the use of subjective measures, such as SWB, to measure, and monitor, social progress. Economists are, thus, increasingly turning their attention to understanding what determines how satisfied people are with their lives and why some people are more satisfied with their lives than others (see for e.g. Awaworyi Churchill, Appau & Farrell, 2019; Barring-Leigh & Escande, 2018; Cheng, Mishra, Nielsen, Smyth & Wang, 2017; Dolan, Peasgood & White, 2008).

Running parallel with increased interest in SWB, spurred by the adverse effects of the first oil price shock on consumers, economists have spent a lot of time better understanding the implications of movements in petrol prices. For example, the feathers and rockets hypothesis, which states that when the price of oil increases, retail petrol prices shoot up like rockets, but when the opposite occurs, they float down like feathers (Bacon, 1991) has been the subject of several studies (see for e.g. Bachmeier & Griffin, 2003; Borenstein, Cameron & Gilbert, 1997; Chen, Finney & Lai, 2005; Duffy-Deno, 1996; Galeotti, Lanza & Manera, 2003; Honarvar, 2009; Liu, Margaritis, & Tourani-Rad, 2010; Valadkhani, 2013a). Other studies have sought to better understand pricing dynamics in petrol markets (see for e.g. Chua, De Silva, & Suardi, 2017; Davey, 2010; Valadkhani, 2013a, 2013b; Wang, 2008, 2009). An implicit motivation for such studies is that petrol price increases, as well as volatility in petrol prices, have adverse welfare effects on consumers and that through improving our understanding of petrol price movements we can reduce harmful welfare effects.

A natural extension of such studies, particularly given economists' keen interest in the antecedents of SWB at the individual level, is to directly examine how petrol price movements affect SWB, controlling for the myriad other factors correlated with SWB. Such an approach provides an estimate of the magnitude of the effect of changes in petrol prices on SWB. Further, by calculating the income equivalence of the change in

SWB due to a change in petrol prices, it can be used to measure the economic significance of a change in petrol prices. Such an estimate can be very useful in evaluating the impacts of policies related to setting petrol prices, which complement findings from studies of petrol price dynamics.

We examine the relationship between petrol prices and SWB employing household panel data. Specifically, we use 17 waves of longitudinal data from the Household, Income and Labour Dynamics in Australia (HILDA) survey, covering the period 2001-2017. We know the exact month in which each participant was interviewed in the HILDA survey, so for each wave we are able to match monthly city-level petrol price data for the city in which the participant lives in the month in which the participant was interviewed to the participant's responses to the life satisfaction question: "How satisfied are you with your life?" In addition to controlling for observed characteristics of participants that are correlated with SWB, the use of household panel data allows us to account for unobserved factors that eliminate the influence of unobserved time-invariant individual fixed effects. We also pay careful attention to addressing the endogeneity of petrol prices using both external and internal instruments.

Our main identification strategy is to instrument for petrol prices using a price-weighted index of leading companies involved in the exploration, development and production of oil listed on the New York Stock Exchange (NYSE) - the NYSE Arca Oil Stock prices index. We match the NYSE Arca Oil Stock price in the month in which the participant was interviewed with the petrol price in the city in which the participant lived in that month. Adopting this approach, our two-stage least squares (2SLS) estimates suggest that a standard deviation increase in petrol prices are associated with a decline in SWB between 0.0157 and 0.0245 standard deviations. This result is robust to alternative ways of addressing endogeneity, the use of both unleaded and diesel petrol prices from different sources and at different frequencies and various sensitivity checks, including use of alternative specifications. We also find that maintaining social networks - maintaining contact with family and friends outside the home - is an important channel through which petrol prices have an adverse effect on SWB.

Rising petrol prices have been a cause of concern to consumers in many countries in the world. For example, in the UK, consumers have sporadically protested against petrol price rises over the last two decades; most notably in the 2012 fuel crisis. In 2018 Gallup polling in the US, 35 per cent of respondents reported that gasoline price rises caused them financial hardship and 41 per cent said that the high price of gasoline would cause them to drive less (Norman, 2018). Most recently, in 2019 petrol price rises sparked widespread protest in France.

Petrol price increases in Australia are highly representative of what has happened in many developed countries that are heavily reliant on imported petroleum (Commonwealth of Australia, 2019). Since 2000, the annual national average price of petrol in Australia has increased more than 50 per cent from \$0.89 per litre to \$1.47 per litre at the end of 2018. Frustration at rising petrol prices have routinely generated spontaneous protests among motorists. For example, on the back of a social media campaign, an estimated 160,000 motorists participated in a two-day “National Fuel Strike” in October 2018 (Drew, 2018).

Our contribution is related to at least three strands of literature that are broadly concerned with the effect of petrol price movements on wellbeing. One set of studies examine the effect of changes in petrol prices on participation in physical activity and health outcomes. Studies have found that increases in petrol prices lead to improvement in air quality (Shaw, Hales, Edwards, Howden-Chapman & Stanley, 2018), a reduction in obesity rates (Coutemanche, 2011) and increases in individual physical activity (see for e.g. Hou et al., 2011; Sen, 2012). These studies show that higher petrol prices reduce car air pollutants in the environment; encourage individuals to use other modes of transport, such as walking, bicycling or taking public transport; increase the amount of time spent at home doing yard work; and reduce the frequency of eating out at restaurants, each of which tend to promote healthy lives. Leading a healthy life has been shown to be correlated with higher SWB (Dolan et al., 2008). We differ from these studies in that they do not specifically examine the effect of petrol prices on SWB.

A second set of studies to which our contribution is related is the literature that links leisure activities with SWB (see for e.g. Kuykendall, Tay & Ng, 2015; Liu & Yu, 2015;

Reynolds & Lim, 2007; Sirgy, Uysal & Kruger, 2017). These studies proffer that satisfaction with leisure activities favourably contribute to SWB. In particular, time spent driving for a weekend family getaway or sight-seeing has a positive effect on life satisfaction (Morris, 2015). Driving can also be important to maintain social networks that are important for a happy life. Harrison and Ragland (2003) find that giving up, or reduced, driving has adverse consequences, including increased dependence on others for transport, loss of independence, reduced out-of-home activity, increased depressive symptoms and decreased life satisfaction. An important intermediate input to making people happier via travel is the cost of transportation (Stanley & Vella-Brodrick, 2009), with higher petrol prices making it more expensive to commute, curtailing leisure activities outside the home and reducing opportunities for social networking.

The studies closest to ours, however, are Graham and Chattopadhyay (2010) and Boyd-Swan and Herbst (2012) who each examine the relationship between gasoline price and an individual's self-reported life satisfaction in the US. Graham and Chattopadhyay (2010) use a cross-sectional Gallup Daily poll survey for the United States, merged with daily national average gasoline prices over the period January 2008 to December 2009. These authors find a negative correlation between gasoline prices and individual wellbeing. Boyd-Swan and Herbst (2012) model the relationship between state-level gasoline price and individual SWB using a repeated cross-sectional survey for the US over the period 1985—2012, similarly finding a negative relationship between gasoline prices and SWB.

We differ from these studies in several important ways. The first is that we provide some firm evidence on the relationship between petrol prices and SWB for a country other than the US which has experienced rising petrol prices that one would expect to affect SWB. Second, beyond our focus on a country other than the US, we differ methodologically from these studies. While Graham and Chattopadhyay (2010) and Boyd-Swan and Herbst (2012) used cross-sectional data and do not address the endogeneity of petrol prices, we use panel data and employ a range of approaches to address endogeneity. Specifically, using panel data allows us to control for time invariant unobserved individual specific characteristics that may simultaneously affect petrol price and SWB, but were not accounted for in these two studies.

Importantly, petrol prices in Australia exhibit high volatility, consistent with a rocket and feather effect (Valadkhani, 2013a; Valadkhani & Smyth, 2018). Between the last quarter of 2018 and the first quarter of 2019 alone, monthly city-level average petrol prices fluctuated between a low of \$1.17 per litre and a high of \$1.65 per litre, reflecting the highly volatile nature of petrol prices in Australia.<sup>16</sup> The large variation in petrol prices that has occurred in Australia makes it a particularly useful setting in which to draw causal inferences.

A third difference is that Graham and Chattopadhyay (2010) and Boyd-Swan and Herbst (2012) use average state-level petrol price to proxy petrol prices faced by individuals. Average state-level petrol prices, however, might not accurately reflect the actual petrol prices in the individual's local geographic area at the time that they reported their life satisfaction. We address this issue by taking advantage of knowing the month and the city in which the participant was interviewed. Specifically, we match the petrol price in the city in which the person lives in the month in which they were interviewed, in order to capture the relationship between petrol prices facing the participant and their self-reported SWB more precisely.

Fourth, unlike these earlier studies, we examine several channels through which petrol prices potentially influence a person's SWB. Specifically, we consider the mediating role of maintaining social networks out of the home - seeing extended family and keeping in touch with friends - and consumption choices, proxied by eating out of home.

The rest of this paper is structured as follows: Section 4.2 provides a brief discussion of the underlying mechanisms that links petrol prices to SWB. Section 4.3 describes the data and variables used in this study, while Section 4.4 sets out the empirical strategy adopted in this study. The discussion of the results is contained in Section 4.5. The final section concludes.

---

<sup>16</sup> Monthly city-level petrol price data was provided by David Gargett, Department of Infrastructure, Regional Development and Cities, in personal communication, 2019.

## **4.2 Why should petrol prices influence subjective wellbeing?**

Boyd-Swan and Herbst (2012) present a simple model in which utility is expressed as a function of consumption of goods and services, current health, leisure and a set of demographic factors. In this model, consumption can either be health enhancing, for example, through participating in physical activity or eating healthy foods, or health reducing through, for example, eating unhealthy calorie dense foods or engaging in sedentary activities.

The model also captures the benefits of leisure travel activities. Past research has linked leisure activities with SWB (see for e.g. Inoguchi, 2018; Liu & Yu, 2015; Newman, Tay & Diener, 2014; Sirgy et al., 2017). Sirgy et al. (2017) argues that every leisure activity is associated with certain goal-benefits related to basic needs (health, safety, sensation-seeking, economic, hedonic and escape) as well as growth needs (symbolic, aesthetic, mastery, moral, relatedness and distinctiveness benefits). The central idea is that the more that leisure activities bring benefits associated with basic and growth needs, the greater the likelihood that such activities will contribute significantly to satisfaction with leisure activities, ultimately, enhancing SWB.

Within this framework, an increase in petrol prices are predicted to have ambiguous effects on SWB that operate through two main channels. First, price-induced effects to leisure activities and consumption generate substitution and income effects that could lead to behavioural change that influence health and SWB. Second, the economic environment could directly affect SWB without corresponding changes in individual behaviour.

### **4.2.1 Substitution effects**

When petrol prices rise, the opportunity cost of undertaking leisure activities involving driving increases. This results in substitution effects because, as the price of petrol rises, the relative cost of engaging in non-driving alternatives decrease which encourages a shift to these activities. Boyd-Swan and Herbst (2012) argue that people respond to rising petrol prices by driving less which, in turn, adversely affects SWB by reducing engagement in wellbeing-enhancing leisure activities, associated with basic and growth needs (Sirgy et al., 2017), which includes maintaining, and building, social networks outside the home.

For many people, the main reason for driving the car through the week is the daily commute to work. This is particularly the case in countries such as Australia in which a high proportion of the population live in the outer suburbs of the large cities, where housing is relatively less expensive, and undertake long commutes into the city to work each day (Awaworyi Churchill & Smyth, 2019). An increase in petrol prices will reduce the relative cost of taking public transport to work. However, in the Australian case, at least, the outer suburbs are not well serviced by public transport and, in peak commuting times, buses and trains are crowded making it very difficult to get a seat. There is also a general lack of public transport infrastructure serving the outer suburbs in most of the major Australian cities. As Armstrong, Davison, Malan, Gleeson and Godfrey (2015, p.21) state: “Fringe developments are characterised by low housing and low employment density, limited (if any) mixed-use development and poor access to public transport. Together, this increases distances between where people live and where they need to travel for work, shopping, socialising and recreating”. Thus, taking public transport invariably involves a much longer and less comfortable commute, which adversely effects SWB (see for e.g. Lorenz, 2018; Zhu, Li, Chen, Liu & Zeng, 2019).

An increase in petrol prices could generate substitution effects which enhance SWB. Studies have found that as petrol prices rise, some individuals substitute away from driving in favour of more physically demanding modes of transportation that may include walking or cycling, which are correlated with having better health and higher SWB (see for e.g. Jones, Steinbach, Roberts, Goodman & Green, 2012; Ma, Zhang, Ding & Wang, 2018). Individuals may respond to rising petrol prices by reducing consumption of calorie-dense foods at restaurants and increase their consumption of healthier home-cooked food. These substitution effects are associated with positive outcomes in terms of realizing basic and growth needs as well as having favourable health effects which contribute to higher SWB.

#### **4.2.2. Income effects**

Rising petrol prices might also induce income effects that can reduce SWB. This is likely to be the case when few welfare-enhancing alternatives are available. In the Australian case, poor public transport options mean that many people have no other

option but to absorb the cost of higher petrol prices (Currie, Delbosch & Pavkova, 2018). In these circumstances, it is likely that individuals will allocate more disposable income to fuel expenses, which means that less income will be available for other wellbeing-enhancing activities. For instance, individuals may forgo gym memberships, decrease frequency of health check-ups and decrease the frequency of going to movies with the family, all of which adversely impact on SWB.

#### **4.2.3. Macro-economic conditions and psychological health**

Another conceptual argument stems from the work of Catalano and Dooley (1983), in which they propose the economic stress hypothesis and find strong links between macroeconomic conditions and psychological health. The economic stress hypothesis states that rising fuel prices may increase anxiety and signal possible macroeconomic uncertainty in the overall economy. Given that petrol prices are typically displayed on large signs at the front of petrol stations, they are highly visible. Their visibility is reinforced by the readily available apps that track petrol prices and indicate the petrol stations offering the lowest prices. The economic stress hypothesis posits that people make predictions about the state of the economy based on the movements in petrol prices that they observe and draw inferences about implications for their lives. If petrol prices increase people may perceive that this is a signal that the economy is not faring well with adverse implications – for example higher taxes – which lower SWB.

### **4.3 Data and Variables**

We use restricted release version 17 of HILDA survey and make use of data from wave 1 through to wave 17, covering the period 2001 to 2017. The HILDA survey is funded by the Australian government's Department of Social Services to collect nationally representative longitudinal data, in order to facilitate research on economic and social issues facing Australian households. An important feature of this survey is that the same households and individuals are interviewed in repeat years, which allows us to see how their lives are changing overtime. Along with the Panel Study of Income Dynamics, British Household Panel Survey and German Socioeconomic Panel, it represents one of the longest running household panels in the world.

The initial HILDA sample consisted of approximately 7,500 households and 19,900 individuals. In wave 11 an additional 5,462 individuals and 2,153 households were



added to account for the changes in the composition of the original households (Summerfield et al., 2018). The HILDA survey interviews individuals aged 15 and above, but we restrict our sample to only those who are at least 18 years old. One of the main channels through which petrol prices potentially affect SWB is through an individual's ability to drive a vehicle. The minimum driving age varies between states and territories in Australia. In most states it is 17 years old, while it is 16.5 years in the Northern Territory and 18 years in Victoria. Hence, restricting the sample to those aged 18 years and above, ensures comparability and consistency across all states and territories. We match monthly city-level petrol price data to the month in which each participant was interviewed in each survey year. Allowing for missing observations in our main outcome and explanatory variables, our final sample consists of 14,953 individuals with 118,342 observations who are included in at least two waves of the HILDA survey.<sup>17</sup>

#### **4.3.1 Main outcome variable**

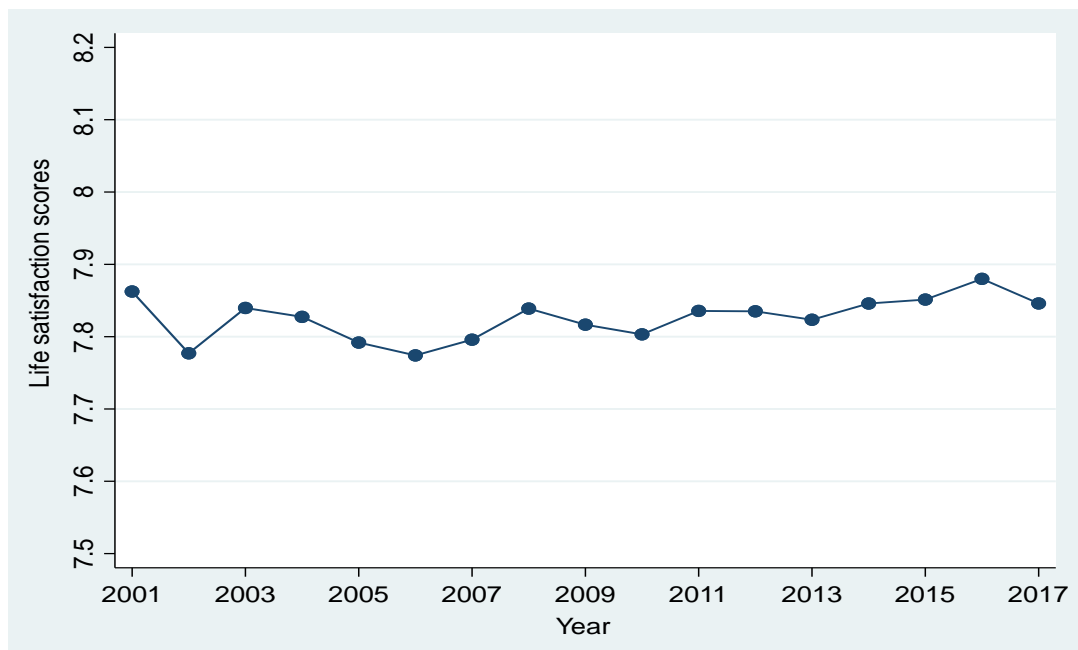
Our main outcome variable, SWB, is a measure of overall life satisfaction based on the HILDA survey question “How satisfied are you with your life?” Respondents were asked to self-report scores to this question on a scale of 0—10, where 0 is labelled as ‘totally dissatisfied’ and 10 is ‘totally satisfied’. Other household panel surveys, such as the British Household Panel Survey, the European Union Statistics on Income and Living Conditions and the German Socioeconomic Panel ask this question in almost the same form and it is widely used as a measure of SWB in the economics literature (see for e.g. Grover & Helliwell, 2019; Headey & Yong, 2019; Solé-Auró & Lozano, 2019). Self-reported life satisfaction scores have been shown to be correlated with other measures of wellbeing, such as daily mood ratings, recall of number of positive and negative events and physiological measures of wellbeing, including the number of ‘genuine’ – Duchenne - smiles (Diener & Suh, 1997). Cummins (2018) demonstrates that self-reported life satisfaction scores are reliable and stable over time.

---

<sup>17</sup> There are 171,746 observations at the city-level containing data on life satisfaction and petrol prices. When we cap age at  $\geq 18$ , this number falls to 130,282 observations (i.e. we lose 41,464 observations). When we restrict the sample to individuals appearing in at least two waves of the survey, the sample falls to 126,520 observations (i.e. we lose 3,762 observations). We lose a further 8,178 observations, giving us our final sample size of 118,342, due to missing variables for one or more of the control variables.

In our sample, the average score for life satisfaction is 7.83 out of 10 with a standard deviation of 1.47 (see Table A4.1). Figure 4.1 plots the trend in the mean of the life satisfaction scores of participants in our sample over time. The trends in our life satisfaction scores are consistent with observed life satisfaction in western countries (International Wellbeing Group, 2013). In Australia, Kubiszewski, Zakariyya and Costanza (2018) and Nguyen, Fleming and Su (2015) find life satisfaction scores to be stable and between the narrow ranges of 7.0 to 8.0.

**Figure 4.1 Trends in life satisfaction in sample over time: HILDA waves 1-17**



**Source:** Derived from HILDA

In Table 4.1, a simple breakdown of our data suggests that individuals who own a vehicle have higher SWB than those who do not. Females and those who are married, but do not have children, report higher life satisfaction scores than their counterparts. Further disaggregation of the data at the subsample level shows that senior citizens, aged 65 years and above, are more satisfied with their life than those in other age categories. We also note that individuals who earn more than the median income are happier with their life than those who are below the median level of income. However, differences in education attainment and employment status do not appear to be associated with differences in the life satisfaction scores of participants.

**Table 4.1 Subjective wellbeing by various categories**

<b>Categories</b>	<b>Mean</b>	<b>Sample size</b>
<b>Full sample</b>	<b>7.83</b>	<b>118,342</b>
<b>Vehicle ownership</b>		
Own a vehicle	7.86	85,546
Do not own a vehicle	7.75	32,796
<b>Gender</b>		
Males	7.79	55,417
Females	7.86	62,925
<b>Age groups</b>		
Ages 18—34	7.84	39,589
Ages 35—64	7.70	59,683
Ages 65+	8.21	19,070
<b>Education level</b>		
High school and below	7.84	49,000
Tertiary education	7.82	69,342
<b>Employment status</b>		
Employed	7.84	79,415
Unemployed	7.80	38,927
<b>Household Income level</b>		
Less than median	7.70	56,981
More than median	7.95	61,361
<b>Marital Status</b>		
Married	7.99	59,429
Not married	7.66	58,913
<b>Children in household</b>		
Yes	7.77	35,960
No	7.85	82,378

**Notes:** Subjective wellbeing is measured by life satisfaction on a scale of 0-10 (lowest = 0, highest =10)

As a robustness check on our main findings, instead of using responses to the life satisfaction question, we use the Mental Health Inventory (MHI-5) scale and the Kessler Psychological Distress Scale (K10), the latter of which is just contained in waves 7, 9, 11, 13, 15 and 17 of the HILDA survey. Both seem particularly apt measures given that the economic stress hypothesis states that rising petrol prices will reduce individual's psychological health via their perceived effect on macroeconomic conditions (Catalano & Dooley, 1983). The MHI-5 and K10 are mental health scale based on questions that reflect one's nervousness, psychological fatigue, agitation and depression. The five-item MHI-5 is measured on a 0—100 scale. The 10-item K10

questionnaire has a five-level response scale, which is aggregated to generate a mental health scale with a minimum possible score of 10 (good mental health) and a maximum possible score of 50 (poor mental health) (ABS, 2019a). We also employ a measure of participants' risk categories based on the K10 scale. In the latter, participants are categorised as low risk of psychological distress if their K10 scores are within the range 10—15, moderate risk if between the range 16—21, high risk if between the range 22—29, and very high risk if between the range 30—50. This measure is reported on a 1—4 ordinal scale, in which 1 corresponds with 'low risk' and 4 corresponds with 'very high risk'. Descriptive statistics for the MHI-5 scale and both versions of the K10 are contained in Table A4.1.

### **4.3.2 Petrol prices**

Australia has a population of approximately 25 million people and 19.5 million registered motor vehicles; of which, three quarters are powered by petrol and the other quarter by diesel (Australia Bureau of Statistics, 2019). At the beginning of the millennium, petrol prices averaged \$0.78 per litre, but by 2018 the national average price of unleaded petrol had increased to \$1.47 per litre. The areas most affected by higher petrol prices have been in regional Australia, in which petrol prices were regularly higher than \$1.60 per litre in 2018.

In our main results, we use city-level monthly unleaded petrol price data, which is sourced from the Department of Infrastructure, Regional Development and Cities.<sup>18</sup> In sensitivity checks, we also employ a range of other petrol price data. First, we use city-level monthly diesel prices over the same period, which are from the same source. Second, we use annual diesel and unleaded petrol price data obtained at the city-level from the Australian Institute of Petroleum website for the period 2004-2017.<sup>19</sup> Third, in order to incorporate analysis at a wider geographical area, we also obtain annual data at the state-level from the Australian Institute of Petroleum website for both petrol and diesel over the period 2002-2017 and 2004-2017, respectively. Fourth, we use

---

<sup>18</sup> The data were provided by David Gargett, Department of Infrastructure, Regional Development and Cities, in personal communication, 2019.

<sup>19</sup> This data is publicly available at <https://www.aip.com.au/>

petrol and diesel price data sourced from Western Australia’s Fuel Watch website for Western Australian regions for the period 2001-2017.<sup>20</sup>

### **4.3.3 Covariates**

Individual SWB is correlated with a number of socio-demographic factors (see for e.g. Ambrey & Fleming, 2014; Boyd-Swan & Herbst 2012; Dolan, Peasgood & White, 2008) for which we need to control. Consistent with the life satisfaction literature, we control for variables such as age, gender, marital status, employment status, income and education status, among others. Following Boyd-Swan and Herbst (2012), we also control for state-level population density and per capita income in order to account for state-level differences which might exist due to the degree of urbanization and wealth. Boyd-Swan and Herbst (2012) argue that including population density and state-level per capita income helps avoid finding a spurious relationship, due to changing trends in population and economic conditions that can influence state transportation systems, causing changes in demand and price of petrol.

### **4.3.4 Channels**

We examine the role of social networks outside the home and consumption choices as channels through which petrol price movements potentially effect SWB using questions in specific waves. In waves 6, 10 and 14 of the HILDA survey, respondents were asked a series of questions about their level of community participation or social networks outside of their homes. Specifically, respondents were asked: “In general, how often do you see members of your extended family (or relatives not living with you) in person?” Responses were coded on a six-point scale where 1 represents “never” and 6 represents “very often”. Using a similar scale, respondents were also asked the question: “In general, how often do you make time to keep in touch with friends?” Our measures of social networks are based on responses to these questions. To examine the role of consumption choices as a potential channel we use the HILDA variable that captures household expenditure on meals eaten outside the home. Descriptive statistics of all the variables are presented in appendix Table A4.1.

---

<sup>20</sup> This data is publicly available at <https://www.fuelwatch.wa.gov.au/>

#### 4.4 Empirical Method

Given that we have individual-level survey data on SWB and monthly city-level petrol prices over the period 2001—2017, we begin our analysis by establishing an empirical relationship between monthly petrol prices and self-reported life satisfaction in the month of interview. We estimate versions of the following standard reduced form regression model:

$$SWB_{i,mct} = \alpha_0 + \beta P_{mct} + \gamma X'_{ict} + \lambda S'_{ct} + \vartheta_i + \varphi_c + \rho_m + \tau_t + \varepsilon_{i,mct} \quad (4.1)$$

where  $SWB_{i,mct}$  is the life satisfaction of individual  $i$  in city  $c$  in month  $m$  at time  $t$ . The month corresponds to the participant's month of interview, while time corresponds with the year of each wave of the HILDA survey.  $P$  represents real monthly unleaded petrol prices for each city at time  $t$  while the vector  $\mathbf{X}'_{ict}$  captures a number of demographic controls correlated with SWB. The model also includes a vector  $\mathbf{S}'_{ct}$  which represents state-level covariates – per capita income and population density. We also include in our model  $\vartheta$  which controls for time invariant unobserved individual characteristics and city-fixed effects  $\varphi$  to account for permanent differences across cities (e.g., average fuel efficiency of vehicles, and access to public transportation) that may simultaneously affect petrol prices and SWB.  $\rho$  in our model controls for monthly fixed effects to account for seasonal variations (e.g., changing monthly weather patterns) and  $\tau$  are year dummies which are included to account for time-varying aggregate trends influencing petrol prices and wellbeing over time (e.g., government policies affecting the entire economy, natural disasters and international political unrest).  $\alpha$  and  $\varepsilon$  are respectively, the constant and error term in the model.

In our baseline model, to estimate equation (4.1) we use pooled ordinary least squares (POLS) and, exploiting the panel structure of the data, panel fixed effects to control for time-invariant characteristics of individuals that are typically not observed that confound estimates of causal effects with this kind of survey data. SWB can be treated as cardinal or ordinal. Ferrer-i-Carbonell and Frijters (2004) show that the findings are not sensitive to treating measures of wellbeing as cardinal or ordinal. In our main results, we treat SWB as cardinal, but in the robustness checks we test the sensitivity of our findings to treating SWB as being ordinal.

The error term in equation (4.1) may include other variables that are difficult to control, but may be correlated with petrol prices, resulting in either overestimation (upward bias) or underestimation (downward bias) of our baseline estimates due to omitted variables, simultaneity bias and measurement error. In our case, an example of an omitted variable for which we are unable to control is the time spent driving. Driving time and petrol prices may be negatively correlated because increased driving time could mean that people who drive more are able to get lower average fuel prices as they pass more petrol stations on their journey and, as a result, are able to benefit from a wider range of fuel price variation (Yatchew & No, 2001), which enhances their SWB. Some studies, though, suggest that longer commuting or driving time to work adversely affects SWB (see for e.g. Lorenz, 2018; Zhu, Li, Chen, Liu & Zeng, 2019), while time spent driving for family getaways or sight-seeing has a positive effect on life satisfaction (Morris, 2015). Hence, although the estimator will not be consistent due to the correlation between the error term and price, intuitively increased driving time could lead to either underestimation or overestimation in the true relationship, and thus, on balance, the overall direction of bias from omitted variables cannot be precisely predicted.

Another potential source of endogeneity comes from the fact that petrol prices might suffer from measurement error. Fernandez-Blanco, Orea and Prieto-Rodriguez (2013) use a theoretical model to show that average prices are imperfect proxies for the underlying price and that the use of average prices introduces measurement errors, even when the original prices may be exogenous. The third source of endogeneity comes from simultaneity bias. For instance, happier people may spend more time with their family and friends and, as a result, make more effort to see them frequently. Increased visits to maintain social networks would intuitively mean travelling often allowing people to benefit from price variations and as a result, pay less for petrol. This will understate the true extent of petrol prices, suggesting a downward bias in the OLS and FE estimates. Overall, given the combination of potential measurement errors; omitted variable and simultaneity bias, it is difficult to state the general direction of bias with certainty, but we suggest that the overall direction of bias would come from underestimation that will result in a downward bias in the baseline estimates.

Our main identification strategy to address endogeneity is to instrument for petrol prices using the Arca Oil Stock prices index, which is price-weighted index of leading companies involved in the exploration, development and production of oil listed on the NYSE. This index proxies the performance of the oil industry, which ultimately influences oil and petrol prices globally. To serve as a good instrument, the NYSE Arca Oil Stock prices index should be correlated with petrol prices and be orthogonal to the error term in Equation (1). Intuitively, we expect that stock prices of the world's major oil suppliers will be correlated with petrol prices. However, movements in NYSE Arca Oil Stock prices are unlikely to be directly related to the SWB of participants in the sample. If participants hold shares in NYSE Arca Oil Stocks, movements in these stocks would have a direct effect on their SWB, but this is unlikely.

While there are no data, of which we are aware, on the proportion of Australians who hold shares in NYSE Arca Oil Stocks, a 2017 survey by Deloitte Access Economics (2017) found that just 8 per cent of Australians held shares listed on stock markets outside Australia. Moreover, as the survey acknowledged, this likely represents an upper bound estimate because some participants may have interpreted the question as asking if they held shares in international companies listed on the Australian Stock Exchange (Deloitte Access Economics, 2017, p.4). Thus, the proportion of Australians holding shares on the NYSE, and specifically in NYSE Arca oil Stocks, is likely to be very low.

Another potential threat to the exogeneity condition is that movements in NYSE Oil Stock could influence movements in oil stocks on the Australian Stock Exchange and, thus, influence the SWB of individuals holding these shares. However, findings concerning the relationship between the US and Australian stock markets have, at best, been mixed. Valadkhani and Chen (2014) find that stock market volatility in Australia is Granger caused by US stock market volatility, but Allen and MacDonald (1995), Narayan and Smyth (2004) and Roca (1999) find that there is no long-run relationship between the Australian and US stock markets. Even if one accepts that movements in the US market moves the Australian market, in 2017 less than one third (31 percent) of Australians owned shares (Deloitte Access Economics, 2017). There are no questions in HILDA that specifically ask participants if they own shares, although, in



each wave of the HILDA survey, participants were asked if they “received income from dividends”. Responses to this question is an upper bound estimate on if they own shares. Responses were coded as “received” or “did not receive” income from dividends. Over all waves, those reporting that they received dividends ranged from 16 to 28 percent of participants, slightly less than the figure reported in the Deloitte Access Economics report. It is likely that most of these participants typically held very small parcels of shares. Deloitte Access Economics (2017) found that most Australians who held shares were “mum or dad investors”, who held a small number of shares in one or two privatized former government-owned companies, such as Qantas and Telstra. Thus, overall it is unlikely that movements in the NYSE Arca Oil price index would influence the SWB of participants through the Australian stock market.

Movements in the Dow Jones Industrial Average are reported in the Australian media. Hence, conceivably it is also possible that movements in the US stock market might be a proxy for the state of the economy more generally and, in this sense, have an effect on the SWB of Australians irrespective of whether they own shares. Frijters, Johnson, Shields and Sinha (2015), also using HILDA, examine whether the Australian and US stock market directly affects the SWB of Australians. While they find that movements in the Australian stock market influences the SWB of Australians, they find that movements in the Dow Jones Industrial Average only has a weak effect (at 10 percent) on the SWB of Australians and only for males. Moreover, when movements in the All Ordinaries are controlled for in the same specification, the effect of the Dow Jones Industrial Average on SWB becomes insignificant. Given that the NYSE Arca Oil price index is much narrower in its coverage and is virtually unreported in the Australian media, it is very unlikely that, first, many Australians would even be aware of it and, second, that movements in it would impact on their SWB, unless they held oil stocks.

It is important to be clear here about our source of variation. Our petrol price data is at the city-level and at monthly frequency. Given that we have information on the specific month of each year in which respondents were interviewed in the HILDA survey, we take advantage of this information and match petrol price information against the year and month of interview of each respondent. We also do the same for our instrument, the NYSE Arca Oil Stock prices, which is available at the monthly frequency as well.

Thus, while individuals may live in the same city, we still observe variations in our observations because these individuals may be interviewed in different months, in which petrol prices may be different.

For example, take two participants, one of whom lives in Melbourne and the other in Sydney. Assume that in 2015, the Melbourne participant was interviewed in February and the Sydney participant was interviewed in March and that in 2016 the Melbourne participant was interviewed in March and the Sydney participant was interviewed in May. The variation comes from the fact that they faced differently monthly petrol prices and, hence, the effect of oil prices on petrol prices will vary across both individual/cities and time.<sup>21</sup>

As we employ monthly NYSE Arca Oil Stocks prices as our IV, participants interviewed in different months in a given year will face different stock prices; however, participants interviewed in the same month in a given year will face the same stock price, irrespective of the city in which they live. An important check on the validity of our instrument, hence, is that the variation in any characteristics correlated with the timing of interview at the city-month-level, such as weather conditions, are not correlated with NYSE Arca Oil Stocks prices. As a check we link the average maximum temperature at the city-month level<sup>22</sup> to the individual's month of interview and then regress average temperature on the IV using Equation (4.1) with a full set of controls. The results for this test are presented in appendix Table A4.2. The coefficient on the NYSE Arca Oil price index is insignificant in both the POLS and FE specification, suggesting that the NYSE Arca Oil Stocks prices are a valid IV.

As a robustness check, we use Dated Brent crude oil prices as an alternative instrument for petrol prices. Petrol prices in Australia are directly influenced by international crude oil prices given that Australia imports almost all of its refined petroleum (Commonwealth of Australia, 2019). While there are a number of widely used international benchmark prices such as Dubai, Dated Brent, Nigerian Forcados and

---

<sup>21</sup> This example would also hold if both participants lived in Melbourne or both participants lived in Sydney because petrol prices obviously differ from month to month within the same city.

<sup>22</sup> The data on temperature, which is publicly available is sourced from the Bureau of Meteorology, Australia at <http://www.bom.gov.au/climate/data/index.shtml>

West Texas Intermediate (WTI), Dated Brent crude oil is the most relevant benchmark for the price of petrol and diesel in Australia.<sup>23</sup> Amadeo (2019) documents that the crude oil price represents the major component of the price of petrol with the rest dependent on refinery and distribution costs, company profits and government taxes. Given that taxes and profit margins largely remain stable, the daily change in petrol prices tend to reflect crude oil price fluctuations. However, movements in crude oil prices are unlikely to be directly related to the SWB of any individual in the sample. Thus, if crude oil prices change, the only mechanism via which such changes will affect SWB will be through petrol prices.

Despite our arguments above that, for the participants in the HILDA survey, it is unlikely that either NYSE Arca Oil Stocks prices or Dated Brent crude oil prices will directly affect SWB, one may still be concerned that the exclusion criteria will not be satisfied. As a further sensitivity check, we also adopt the Lewbel (2012) heteroskedasticity based approach which does not require any exclusion restriction to be satisfied. This method uses the presence of heteroskedasticity as a precondition for identification to construct internally generated instruments based on a heteroskedastic covariance restriction. This approach has been used in several studies as a robustness check on the findings with external instruments (see for e.g. Awaworyi Churchill & Smyth, 2019; Lewbel, 2012; Mishra & Smyth, 2015).

In Section 4.2 we argued that petrol prices influence SWB through channels related to leisure activities and consumption choices. While it is difficult to isolate, and test, the role of all potential channels, we examine the role of social networks and consumption choices. For factors such as eating outside the home and maintaining contact with family and friends to qualify as potential channels linking petrol prices to SWB, in addition to being correlated with petrol prices, they should also be correlated with SWB and their inclusion as additional covariates in the regression linking SWB to petrol prices should decrease the magnitude of the coefficient on petrol prices or render it statistically insignificant (Alesina & Zhuravskaya, 2011). To examine the role of

---

<sup>23</sup> See the Australian Institute of Petroleum website <https://aip.com.au/pricing/international-prices/international-market-watch> for a discussion of Dated Brent crude oil as the relevant benchmark for Australia. In results that are not reported we also instrumented for petrol prices using Dubai, Nigerian Forcados and WTI and the results were the same reflecting very high correlation between alternative international benchmark prices.

these factors, consistent with the literature (see e.g., Powdthavee & Wooden, 2015), we adopt a multiple mediation method using a structural equation model (Baron & Kenny, 1986), that also allows us to understand how much of the effects of petrol prices on SWB can be explained by its effects on the potential channels or mediating factors (i.e., the indirect effects of petrol prices). The multiple mediation method allows us to estimate how much of the indirect relationship between petrol prices and SWB is channelled through social networks, and how much is channelled through household expenditure on meals eaten out. In addition to isolating the indirect and direct effects of petrol prices taking into account the potential channels, the use of a structural equation model has the added advantage of allowing errors to be correlated across individual models with the system of equations.

## **4.5 Results**

### **4.5.1 Baseline results**

Table 4.2 presents the baseline results for equation (4.1), in which we estimate the relationship between petrol prices and SWB. Each column presents coefficients, robust standard errors (in parentheses) and standardised coefficients (in brackets) associated with petrol price and SWB, in which we progressively add more controls. In columns (1) and (2), we use POLS and panel fixed effects respectively to examine the relationship between petrol prices and SWB with only demographic controls. State-level controls are added in columns (3) and (4) and city-level fixed effects are added in columns (5) and (6). We are using monthly petrol prices to match the SWB of participants in the month in which they were interviewed over time. Thus, in our preferred specification, in columns (7) and (8) we add month fixed effects to capture seasonality, that is regular and predictable each year and can be linked with a specific time of year, and year fixed effects, that capture annual time trends and year to year variations, together with a full set of controls, state-level controls and city-level fixed effects. The control of both month and year fixed effects in the same specification are particularly important given that they each play unique roles. Given that month fixed effects are regular and predictable from year to year, they capture seasonal variations within a year. The Australian summer is in December to February when it is very hot and there are summer holidays. The Australian winter is in June to August when it is relatively cold. The month effects are controlling these seasonal effects on SWB, depending on when the respondent completed the survey. The month fixed effects,

though, are not able to capture shocks caused by episodic events that extend over prolonged periods and occur irregularly in some years, but not others, such as financial crises or a pandemic. All specifications are estimated with cluster-robust standard errors at the individual level.

We find a negative association between petrol prices and SWB in all cases. In our preferred specifications, the coefficient on petrol prices is negative with an effect size of 0.1092 using POLS and 0.1137 using panel fixed effects respectively. This suggests that, on average, individuals who face a one dollar per litre increase in the petrol price have 0.1092—0.1137 lower life satisfaction on a 0—10 scale. Between 2016 and 2018 Australia experienced an annual average increase of 14.02 cents per litre, which corresponds with a reduction in life satisfaction scores between 0.0153 and 0.0159 on a 0—10 scale. These point estimates though appear small in magnitude, intuitively make sense, especially given that SWB does not vary very much. Boyd-Swan and Herbst (2012) find reduction in life satisfaction scores by 0.048 on a 1—6 scale for a one dollar per gallon increase in price of gasoline in the US.<sup>24</sup> In terms of the standardised coefficients, in our preferred specification the POLS results suggest that a one standard deviation increase in petrol prices is associated with a 0.0115 standard deviation decline in SWB, while the panel fixed effects results suggest that a one standard deviation increase in petrol prices is associated with a 0.0120 standard deviation decline in SWB.

In Table A4.3, in the appendix, we present the full results for the POLS and panel fixed effects models with a full set of controls (columns 7 and 8 in Table 4.2). The signs and significance of the covariates are generally consistent with the existing SWB literature (see Dolan et al., 2008). We find a U-shaped relationship between age and SWB with the minimum occurring around the ages 40—45, females have higher SWB than males while those who have more dependents in the family have lower SWB. Those who are

---

<sup>24</sup> For a \$1 per gallon increase in the price of petrol, our estimates equate to a 0.4133-0.4304 decline in SWB on a 1-10 scale. Boyd-Swan and Herbst (2012) measure SWB on a 1-6 scale. For a \$1 per gallon increase in the price of petrol, our estimates equate to a 0.2474-0.2577 decline in SWB on a 1-6 scale. Hence, our estimates for the effect of petrol prices on SWB are considerably higher than those in Boyd-Swan and Herbst (2012).

married and have higher income have higher SWB, while those individuals with a long—term illness have lower SWB.

#### **4.5.2 Addressing endogeneity**

In Table 4.3, we present the 2SLS results for the same specifications as reported in Table 4.2, in which we instrument for petrol prices using the NYSE Arca Oil Stocks price index. The first stage results suggest that the NYSE Arca Oil Stocks price index is positively correlated with petrol prices. This implies that an increase in oil stock prices have a significant and positive effect on the city—level petrol price. The first stage F-statistics are greater than 10 and R-squared from the first stage regression is relatively high in each case, suggesting that our instrument is relevant.

The results in Table 4.3 suggests that there is substantial downward bias in our baseline estimates due to endogeneity as the 2SLS estimates are relatively larger in size than both the POLS and panel fixed effects estimates. Our preferred POLS estimate in column 7 suggests that a one standard deviation increase in the petrol price leads to a 0.0245 standard deviation decline in SWB. After controlling for individual fixed effects, our preferred panel fixed effects estimate in column 8 suggest a slightly smaller effect, whereby a one standard deviation increase in the petrol price is associated with a decline in SWB of 0.0157 standard deviations. We present the full results for columns 7 and 8 in Table A4.3 in the appendix. The coefficients on all other variables in the 2SLS and panel fixed effects-IV models are similar to the baseline.

#### **4.5.3 Potential channels through which petrol prices influence SWB**

We next present the potential channel analysis focusing on the role of social networks and consumption choices, proxied by eating out. A large body of literature emphasises the importance of social networks in promoting SWB (see for e.g., Ateca-Amestoy, Aguilar & Moro-Egido, 2014; Awaworyi Churchill & Mishra, 2017; Duckitt, 1982; Elgar et al., 2011; Portela, Neira & Salinas-Jiménez, 2013). This literature shows that good social relationships and networks are valuable and can make people happy, thus increasing their overall wellbeing. Such networks can avert conflict, avoid psychological deprivation and improve one’s ability to cope with stress, thus promoting wellbeing (Biswas-Diener & Diener, 2006). Hence, we expect an increase

**Table 4.2 Petrol prices and subjective wellbeing, using city-level monthly ULP price data (baseline results)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Pooled OLS	Panel FE	Pooled OLS	Panel FE	Pooled OLS	Panel FE	Pooled OLS	Panel FE
Petrol price	-0.0797*** (0.0263) [-0.0084]	-0.0542*** (0.0233) [-0.0057]	-0.0827*** (0.0263) [-0.0087]	-0.0575*** (0.0234) [-0.0061]	-0.0964*** (0.0261) [-0.0102]	-0.0644*** (0.0236) [-0.0068]	-0.1092*** (0.0365) [-0.0115]	-0.1137*** (0.0414) [-0.0120]
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-level controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
City FE	No	No	No	No	Yes	Yes	Yes	Yes
Monthly FE	No	No	No	No	No	No	Yes	Yes
Yearly FE	No	No	No	No	No	No	Yes	Yes
Observations	118,342	118,342	118,342	118,342	118,342	118,342	118,342	118,342
R-squared	0.0823	0.0135	0.0825	0.0135	0.0838	0.0137	0.0842	0.0142
Number of Individuals		14,953		14,953		14,953		14,953

**Notes:** The dependent variable is life satisfaction which is measured on a scale of 0-10, where 0 is totally dissatisfied and 10 is totally satisfied. Demographic control variables consist of gender (only included in pooled OLS specification as it is time-invariant), age, age-squared, marital status (never married or de-facto, widowed, divorced, separated, de-facto, legally married), income, employment status (employed, unemployed including those not in the labour force), level of education (year 12 & below, certificate, diploma, bachelor or honours, graduate diploma, postgraduate), health status (long term health issues, no long term health issues) and number of dependents. State-level control variables include population density and real GDP per capita by state. Panel FE regressions also control for individual fixed-effects. Robust standard errors are in parentheses. Individual clustered standard errors are reported for FE models. Standardised coefficients in brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10

**Table 4.3 Petrol prices and subjective wellbeing, using city-level monthly ULP price data (IV results)**

Variables	(1) 2SLS	(2) Panel FE-IV	(3) 2SLS	(4) Panel FE-IV	(5) 2SLS	(6) Panel FE-IV	(7) 2SLS	(8) Panel FE-IV
Petrol price	-0.3570*** (0.0525) [-0.0376]	-0.1353*** (0.0443) [-0.0083]	-0.3608*** (0.0505) [-0.0380]	-0.1276*** (0.0408) [-0.0083]	-0.2365*** (0.0400) [-0.0249]	-0.1185*** (0.0353) [-0.0086]	-0.2324*** (0.0617) [-0.0245]	-0.1566*** (0.0517) [-0.0157]
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-level controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
City FE	No	No	No	No	Yes	Yes	Yes	Yes
Monthly FE	No	No	No	No	No	No	Yes	Yes
Yearly FE	No	No	No	No	No	No	Yes	Yes
Observations	118,342	118,342	118,342	118,342	118,342	118,342	118,342	118,342
R-squared	0.0814	0.0135	0.0816	0.0136	0.0835	0.0137	0.0844	0.0143
Number of Individuals		14,953		14,953		14,953		14,953
<i>First stage</i>								
Instrument:	0.0003***	0.0003***	0.0003***	0.0003***	0.0004***	0.0004***	0.0005***	0.0005***
NYSE Arca Oil Stock price index	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-squared	0.3391	0.3391	0.3764	0.3764	0.4607	0.4607	0.5840	0.5840
F-Statistics	>10	>10	>10	>10	>10	>10	>10	>10

**Notes:** see notes to Table 4.2.



in petrol prices to have a negative effect on maintaining social networks and that the negative effect on maintaining social networks to be reflected in lower SWB.

Another strand of studies examines the role of eating behaviour and consumption choices on SWB (see for e.g. Blachflower, Oswald & Stewart-Brown, 2013; Holder, 2019; Huffman & Rizov, 2017; Legyel, Tate & Blatz, 2009; Schnettler, Lobos et al., 2017; Schnettler, Miranda et al., 2015; Schnettler, Pena et al., 2013). We expect an increase in petrol prices to have a negative effect on propensity to eat out, but the effect of eating out less on SWB is ambiguous. Eating out less could have a positive effect on SWB (avoiding calorie foods and eating homemade healthy foods promotes SWB) or a negative effect on SWB (to the extent that eating out has a social dimension, eating out less reduces social connections, adversely affecting SWB).

**Table 4.4 Estimated indirect and direct effects of petrol prices on subjective wellbeing**

Mediating variables	Petrol price
<i>Social networks outside the home</i>	
Community participation: See members of extended family	-0.0063*** (0.0024)
Community participation: Keep in touch with friends	-0.0072*** (0.0033)
<i>Eating out</i>	
Log of household expenditure on meals eaten out	0.0001 (0.0003)
Total indirect effect	-0.0134*** (0.0048)
Direct effect	0.0289 (0.0239)
Combined effect (total indirect effect + direct effect)	0.0155 (0.0246)
Observations	11,208

**Notes:** The coefficients are standardised coefficients. Bootstrapped standard errors (200) replications are in parenthesis. \*\*\* p<0.01, \*\* p<0.05, \* p<0.10. The model includes demographic controls and includes fixed effects at city and monthly levels. *Community participation: See members of extended family* is the individual's response to the question 'In general, how often do you do the following things: See members of your extended family (or relatives not living with you) in person. This questionnaire was asked in wave 6, 10 and 14 only. *Community participation: Keep in touch with friends* is the individual's response to the question 'In general, how often do you do the following things: Make time to keep in touch with friends. This questionnaire was asked in wave 6, 10 and 14 only. *Log of household expenditure on meals eaten out* is the log of monthly household expenditure on meals eaten out. This information was collected from waves 6—17. Hence, to include the three potential mediators together, the SEM specification is based on waves 6, 10 and 14 only.

A summary of the indirect effects of petrol prices through the three potential channels are reported in Table 4.4. We find that an increase in petrol price is negatively associated with both measures of social networks, while the effects on household expenditure on meals eaten out is statistically insignificant.<sup>25</sup> The total indirect effect of petrol price is negative and significant. The results also show that with the inclusion of the potential channel variables, the direct effect of petrol price on SWB becomes statistically insignificant. These results suggest that the social network variables mediate the relationship between petrol prices and SWB.

#### **4.5.4 Extension and robustness checks**

In this section, we conduct a series of checks and extensions to examine the robustness of our results. We first extend our analysis to examine the heterogenous effects of petrol price across various sub-groups. We then examine how petrol price volatility effects the hypothesised relationship between petrol prices and SWB. We also examine the short- and long-run dynamics of petrol prices and the economic significance of this association. Third, we examine the robustness of our results to using Dated Brent an alternative instrument, as well as the Lewbel (2012) 2SLS approach. Finally, we examine the sensitivity of our results to alternative ways of measuring SWB and fuel prices as well as perform other sensitivity checks.

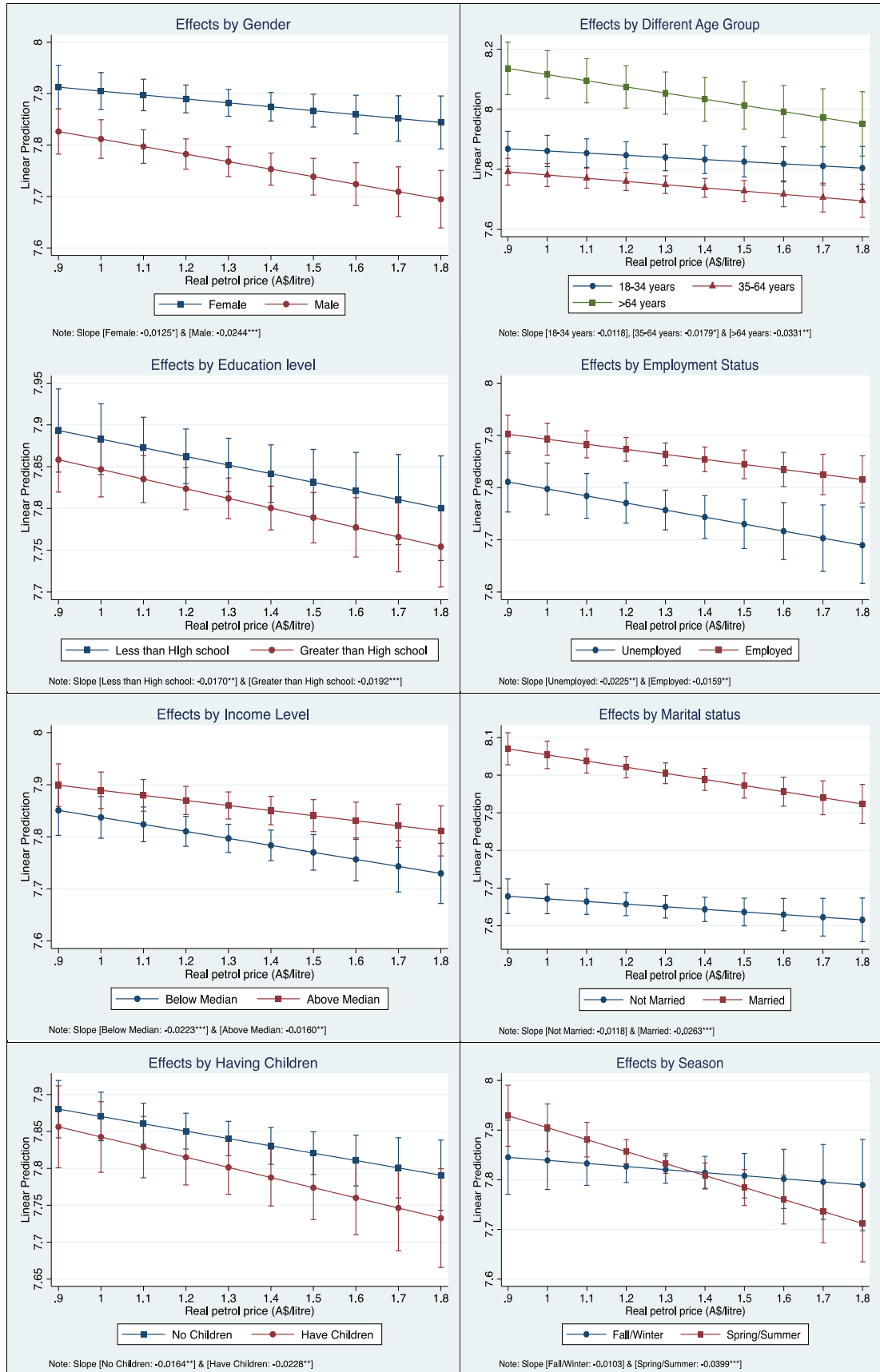
##### **4.5.4.1 Heterogenous effects across sub-groups**

In Figure 4.2, we show the relationship between petrol prices and SWB for sub-samples of males, females, age groups, education level, employment status, income level, marital status, having children and the season in which the respondent was interviewed. The estimates are the predictive margins of petrol prices at an increment of every \$0.10 between the lowest and highest recorded real petrol prices over the sample period for each sub-group. The results suggest that an increase in petrol prices is associated with lower SWB for all subgroups.

---

<sup>25</sup> Traditionally women have shouldered the responsibility for preparing food at home. According to the 2016 Australian census, the average Australian woman spends up to 14 hours a week cooking and cleaning, while the average man does fewer than five hours and 26 percent of men do no cooking at all (ABS, 2016). This means that there are real time and labor costs associated with eating meals prepared at home, especially for women. If meals are increasingly prepared at home, women bear the brunt of this labor and, therefore, may be disproportionately influenced in terms of decreased SWB. To examine if this is the case we performed the mediation analysis reported in Table 4.4 separately for each gender (results not reported). The indirect effect of eating out on SWB is insignificant for both men and women.

**Figure 4.2 Heterogeneous effects of petrol price on life satisfaction by sub-groups**



**Note:** All figures reported here are based on regression estimates using the same model specification in Column 7 of Table 4.2 but accounting for the different sub-groups.

While the effect of petrol prices on the SWB of both males and females is negative, the effect is stronger for males than females. This finding is consistent with a higher proportion of men than women have driver licenses in Australia (Loader, 2015) and, as result, being more likely to be the ones filling up at the pump. That male labour force participation rates are higher than female labour force participation rates in Australia (Australia Bureau of Statistics, 2018), combined with the fact that many households are located in the outer suburbs, mean that males are also more likely than females to be making long daily commutes in the car to go to work. These results are consistent with Boyd-Swan and Herbst (2012) who find that women's wellbeing is not sensitive to gasoline price changes in the US.

In terms of age groupings, petrol prices have the strongest association with SWB for those over the 64 years of age followed by those in the mid-age category (between 35 and 64 years). The findings for those aged over 64 likely reflect that most people in this category are no longer working and are living on a relatively low, fixed income, that makes them particularly sensitive to price increases. These people are not excessively engaged in commuter behaviour and their response to rising petrol prices is likely to be to simply drive less and to condense errands into single trips, which reduces their SWB. This is consistent with Harrison and Ragland (2003) who find that reduced driving activities has adverse consequences on individuals' life satisfaction. Those in the 35—64 age group form the bulk of families living in the outer suburbs of the large cities that make long commutes to work each day. Meanwhile, those in the relatively young age group (between 18 and 34 years) appear to be least affected by rising petrol prices as the impact on their SWB is very small in magnitude. The results for those aged 18—34 are consistent with a recent study of car use in Melbourne by Jain, Rose and Johnson (2018), who find that those aged in their twenties and thirties have become habituated to having ready car access and heavily discount the costs associated with maintaining and owning a car.

The impact of petrol prices on life satisfaction by employment status, income level, marital status and having children differs among categories in these groups. Those who are unemployed, have income below median income levels, are married and have children experience a greater decline in SWB, in response to rising petrol prices. Each of these groups of people have a relatively lower income and/or face a higher

opportunity cost of driving when petrol prices increase, which can be expected to make them particularly sensitive to price increases. As discussed above, urban sprawl, combined with poor public transport options, in most Australian cities, creates a problem of ‘forced car ownership’<sup>26</sup> (Currie et al., 2018). This phenomenon lends support to our findings that the adverse effect of petrol prices on the SWB of those below the median income is stronger than those otherwise.

However, there appears to be no significant difference in the effect of petrol prices on the SWB of individuals with different level of education attainment. In a study identifying factors influencing the adoption of vehicle sharing systems in Greece, Efthymiou, Antoniou and Waddell (2013) find that one’s level of education was not an important consideration. This is likely to be true in our context as well given the strong car ownership culture in Australia (Kent, 2018), which implies most people own a car, irrespective of their education level.

Following Welsch and Biermann (2017), at the bottom of Figure 4.2, we examine if there is a difference in the effect of petrol prices on SWB across different seasons. To do this, we group the months from September to February as hot months, reflecting the spring and summer season and the months from March to August as the cooler months, reflecting the fall and winter months in Australia. The estimates show that individuals interviewed in the hotter months are significantly negatively affected by increase in petrol prices. Those effects on wellbeing for those interviewed in the cooler months are negative, but insignificant. These results are not surprising as in the summer months most families in Australia take holidays which often involve long road trips and it is common for petrol stations to increase prices.

#### **4.5.4.2 Role of volatility and lagged effects of petrol price on SWB**

Numerous studies have identified that economic activity responds differently to absolute levels and variations in real oil prices (see for e.g. Blanchard & Gali, 2007; Cunado & Gracia, 2005; Kilian, 2009; Mohaddes & Pesaran, 2017). There are also a few studies that have analysed individual behavioural changes due to fuel price volatility. Studies, largely for the United States (see for e.g. Lane, 2010; Smart, 2014),

---

<sup>26</sup> ‘Forced car ownership’ is a term used to describe the situation, in which low income households have little choice, but to own and use cars for mobility because there are few alternatives available.

find that fuel price variations are a meaningful driver of consumer behavioural change. Smart (2014) argues that individuals are likely to respond to price changes largely by using some reference price established through repetitive purchasing against which they judge price fluctuations. In Table 4.5 we examine how fluctuations in petrol prices are associated with individual's assessment of their SWB.<sup>27</sup>

In panel A and B of Table 4.5, we evaluate how individuals respond to the petrol price they faced in the month of their interview, conditional on the petrol price in the month prior to the interview in a given year. In panel A, the 2SLS and panel FE-IV results suggest that petrol prices have a significant adverse effect on the SWB of those who faced a higher petrol price in their month of interview, compared to the month prior to the interview. In panel B, however, petrol prices have an insignificant effect on SWB for those for whom petrol prices in their month of interview were lower than in the month immediately prior to the interview.

In panel C of Table 4.5 we use a simple GARCH(1,1) process to obtain monthly conditional standard deviation, in order to examine the effect of monthly petrol price volatility on SWB. We use this volatility measure instead of petrol prices in the 2SLS and panel FE-IV specifications and find that petrol price volatility has a negative and significant effect on SWB. The estimates suggest that a one standard deviation increase in petrol price volatility leads to a decline in SWB between 0.0377 and 0.0582 standard deviations. In particular, these effects are almost three times the magnitude of an increase in absolute petrol prices which suggests that volatility in petrol prices has an important adverse effect on SWB. This result is consistent with Smart (2014) who argues that consumers view fuel price volatility as an indication of things to come and that rapid fuel price fluctuations have greater emotional impact on consumers.

In panel D and E of Table 4.5, we separate our sample into those facing upward volatility and those facing downward volatility in petrol prices during the month in which they were interviewed in the given year of the survey, based on the volatility variable used in panel C. In panel D, the 2SLS and panel FE-IV results suggest that

---

<sup>27</sup> An alternative approach to examine the differences across difference sub-samples is to use interaction terms, however, such interaction terms are likely to be endogenous. Thus, we split our sample and instrument for petrol prices in each sub-sample regression.

**Table 4.5 Lagged petrol prices, petrol price volatility and subjective wellbeing**

<b>Variables</b>	<b>2SLS</b>	<b>Panel FE-IV</b>
<b>Panel A: Current month price <math>\geq</math> Last month price</b>		
Petrol price	-0.4122*** (0.0995) [-0.0431]	-0.2721*** (0.0773) [-0.0300]
Observations	55,759	55,759
<b>Panel B: Current month price <math>&lt;</math> Last month price</b>		
Petrol price	-0.0667 (0.1144) [-0.0065]	-0.0625 (0.0423) [-0.0058]
Observations	62,583	62,583
<b>Panel C: Impact of monthly price volatility</b>		
Petrol price volatility	-1.2543*** (0.3334) [-0.0582]	-0.8873*** (0.2962) [-0.0377]
Observations	118,342	118,342
<b>Panel D: Impact of monthly price volatility: Upward volatility</b>		
Petrol price volatility	-0.2632*** (0.0960) [-0.0288]	-0.3004*** (0.0936) [-0.0300]
Observations	55,949	55,949
<b>Panel E: Impact of monthly price volatility: Downward volatility</b>		
Petrol price volatility	-0.0642 (0.1406) [-0.0065]	0.0521 (0.0432) [0.0049]
Observations	62,393	62,393
<b>Panel F: Impact of lagged monthly prices</b>		
Petrol prices: contemporaneous	-0.3076*** (0.0713) [-0.0332]	-0.1559*** (0.0592) (-0.0161]
Petrol prices: 1-month lag	0.1967* (0.1029) [0.0206]	-0.0094 (0.0455) [-0.0010]
Petrol prices: 2-month lag	0.0029 (0.1017) [0.0003]	-0.0222 (0.0449) [-0.0021]
Observations	89,357	89,357
<b>Panel G: Current month price <math>\geq</math> Average yearly city-level price</b>		
Petrol price	-0.4588*** (0.0849) [-0.0496]	-0.2848*** (0.0710) [-0.0300]
Observations	60,468	60,468
<b>Panel H: Current month price <math>&lt;</math> Average yearly city-level price</b>		
Petrol price	-0.0857 (0.0833) [-0.0080]	-0.0353 (0.0866) [-0.0030]

Observations	57,874	57,874
<b>Panel I: Impact of yearly city-level price volatility</b>		
Petrol price volatility	-0.6094*** (0.2350) [-0.0135]	-0.2982* (0.1705) [-0.0058]
Observations	118,342	118,342

**Notes:** All models include demographic and state-level controls and includes fixed effects at city, monthly and yearly levels. In Panel C, a simple GARCH (1,1) process is used to obtain the conditional standard deviation as the measure of monthly volatility in petrol prices. This monthly petrol price volatility variable is then instrumented using the NYSE Arca Oil Stock prices index as the IV. In Panels D and E, the monthly volatility variable, as used in Panel C, is used to create a dummy variable denoting 1 if the volatility is higher than last month's volatility and 0 otherwise. This dummy variable is then used to separate the sample into those facing upward volatility and downward volatility during their month of interview in the given year of survey. In Panel I, volatility for each year is calculated based on the standard deviation of the petrol price over the 12-month period in that year. This yearly petrol price volatility variable is then instrumented using the NYSE Arca Oil Stock prices index as IV. The NYSE Arca Oil Stock prices index is used as the IV in all model specifications.

upward volatility in petrol prices has a significant adverse effect on SWB. The estimates show that a one standard deviation increase in petrol price volatility for those who face higher price volatility leads to decline in SWB between 0.0288 and 0.0300 standard deviations. However, the results for downward volatility are insignificant.

In panel F of Table 4.5 we present results in which we incorporate two-month lags in petrol prices in equation (4.1). The two-month lags allows us to capture the effect of petrol price cycles, given that price cycles in Australian capital cities typically range from a low of two weeks to a high of about two months (ACCC, 2019). The 2SLS estimates suggest that although a contemporaneous increase in petrol prices significantly reduces SWB, the losses are mildly offset by an increase in SWB after one-month. However, the panel FE-IV estimates suggest that only current month petrol prices have a significant adverse effect on SWB. The coefficient on the two-month lag in both specifications are small in magnitude and statistically insignificant. Together, the lags in the panel FE-IV estimates suggest that after two months, a sustained \$1 per litre increase in petrol prices leads to 0.1875 points lower life satisfaction on a 0–10 scale, an estimate that is about a fifth larger than the estimate in column 8 of Table 4.3.

In panel G and H of Table 4.5, we perform a similar exercise to what we did in panel A and B, but instead we use average yearly city-level prices to account for the possibility that individuals might use average yearly prices as a reference price to



respond to petrol price changes. In this exercise, we match current monthly-level petrol prices to average petrol price faced by individuals in their city. In panel G, the 2SLS and panel FE-IV results suggest that the petrol price has a significant adverse effect on the SWB of those individuals who faced higher petrol price in their month of interview, compared to the annual average petrol price in their city. Conversely, results in panel H suggest that for those individuals who faced lower petrol prices in their month of interview, relative to the average annual price, petrol prices have an insignificant effect on their SWB. These results indicate that irrespective of the reference price used, petrol prices have a significant adverse effect on the SWB of those who faced a higher petrol price in their month of interview, compared to the month prior to the interview.

Finally, in panel I of Table 4.5 we calculate the standard deviation of petrol prices over the 12-month period to obtain an alternative measure of price volatility. We find that petrol price volatility has a negative and significant effect on SWB in both the 2SLS and panel FE-IV results. The estimates suggest that a one standard deviation increase in petrol price volatility leads to a decline in SWB of between 0.0058 and 0.0135 standard deviations.

#### **4.5.4.3 Economic significance of petrol price effects**

We estimate the economic significance of the effects of petrol price changes by calculating the income equivalence of the drop in SWB due to an increase in petrol prices. To do so, we first calculate how much monthly income the median family would need in order to offset the reduction in SWB from rising petrol prices and then compare this amount to the effect of an increase in unemployment on SWB. In Table 4.6, we present the income equivalence of a one standard deviation increase in petrol prices in the first panel followed by a one standard deviation increase in the unemployment rate in the second panel. A one standard deviation increase in petrol prices equate to \$0.1547 per litre over the 2001–2017 period, while a one standard deviation increase in the unemployment rate is a 0.92 percentage points over the same period.

A \$0.1547 per litre increase in petrol prices produces a reduction in SWB which is equivalent to a loss of \$AUD538 in monthly household income. When compared to

the reported household income in the HILDA survey, this corresponds to 7.3 percent of household income. With regard to state-level increase in unemployment rates, we find that over the sample period, a 0.92 percentage point increase in the unemployment rate leads to a reduction in SWB equivalent to a loss of \$379 in monthly household income, corresponding to 5.15 percent of household income. These estimates suggest that wellbeing losses due to an increase in petrol prices are as important as wellbeing losses created by weakening labour market conditions in the local economy.

**Table 4.6 The income equivalence of rising petrol prices**

	Results in Australian dollars per litre	Results in USD based on increase per gallon
<b><i>Increase in petrol prices (\$0.1547)</i></b>		<b>US \$0.4496</b>
Monthly income equivalence	\$538	US \$1,536
Yearly income equivalence	\$6,455	US \$18,758
Percent of average household income	7.3%	27.6%
<b><i>Increase in unemployment (0.92 ppts)</i></b>		
Monthly income equivalence	\$379	US \$1,102
Yearly income equivalence	\$4,550	US \$13,222
Percent of average household income	5.15%	19.5%

**Notes:** The income equivalence for petrol price is based on a \$0.1547 per litre increase in prices (the standard deviation during the analysis period). To produce the calculations in the table, we first ran regressions comparable to those in column (7) of Table 4.2, removing the petrol price variable and replacing it with total monthly real household income and income squared. We then calculated the change in life satisfaction due to a \$1.00 increase in household income from the median (i.e., the marginal effect). The median monthly household income for the overall sample is \$6,487. The marginal effects for monthly household income were then compared to the marginal effects for the petrol price for the overall model. For example, to produce the monthly income equivalent of a \$0.1547 per litre increase in petrol prices, the following was calculated:  $\$0.1547 \times (-0.1095 / 0.0000315) = \$538$ . The same set of procedures were followed to obtain the income equivalence for state-level unemployment rates. The average US:AUD exchange rate over 2001–2017 (1US:AUD1.3026) is used to convert amounts in Australian dollars to US dollars.

How do these results compare with those in Boyd-Swan and Herbst (2012) who perform a similar income equivalence exercise in the context of the United States? To compare with Boyd-Swan and Herbst (2012) we use the average Australian-US dollar exchange rate over the period 2001 to 2017 and convert our estimates from litres to gallons. The results from doing this are also reported in Table 4.6. Our estimates per litre are similar to Boyd-Swan and Herbst’s (2012) estimates per gallon. When we

convert from litres to gallons, the income equivalence of petrol price rises in our study are considerably higher than in Boyd-Swan and Herbst (2012).

#### **4.5.4.4 Employing alternative IVs**

We use Dated Brent crude oil prices as an alternative instrument in Panel A of Table 4.7. The first stage result suggests that the crude oil price is positively correlated with petrol price. The F-statistics ( $>10$ ) and R-squared from the first stage regression, indicates that the instrument is relevant. A one standard deviation increase in petrol prices is associated with a 0.0234 standard deviation decrease in SWB in the 2SLS estimates and a 0.0157 standard deviation decrease in SWB in the panel FE-IV estimates. The estimates using this alternative IV are similar to those produced using the NYSE Arca Oil Stock price index as the IV.

We next adopt the Lewbel (2012) approach which uses the presence of heteroskedasticity as a precondition for identification to construct internally generated instruments based on a heteroskedastic covariance restriction. Panel B reports findings from Lewbel 2SLS regressions that use internally generated instruments only while Panel C reports results for Lewbel 2SLS estimates that combine internally generated instruments with our main external instrument (the NYSE Arca Oil Stock prices). The heteroskedasticity assumption for Lewbel (2012) is fulfilled as the Breusch and Pagan test for heteroskedasticity is significant indicating presence of heteroskedasticity. All other tests for relevance and validity of the instruments are satisfied.

The estimates based on the Lewbel (2012) approach are higher than our baseline estimates which lends support to our earlier claims that endogeneity generates downward bias in our baseline estimates. However, these estimates are slightly lower than those obtained using external instruments. Specifically, we find that a one standard deviation increase in petrol prices lead to 0.0159 standard deviation decline in SWB in panel B while in panel C, a one standard deviation increase in petrol prices is associated with a decline of 0.0165 standard deviations in SWB. Each of the results in Table 4.7 using alternative instruments support our conclusion that petrol price increases have an adverse effect on SWB.

**Table 4.7 Robustness checks: employing alternative IVs**

<b>Dependent variable (life satisfaction as a proxy for subjective wellbeing)</b>		
<b>Variables</b>	<b>2SLS</b>	<b>Panel FE-IV</b>
<b>Panel A: IV is Dated Brent crude oil price</b>		
Petrol price	-0.2218*** (0.0564) [-0.0234]	-0.1566*** (0.0506) [-0.0157]
Observations	118,342	118,342
<i>First stage</i>		
Instrument: Brent crude oil price	0.0136*** (0.0000)	0.0136*** (0.0000)
R-squared	0.6290	0.6290
F-Statistics	>10	>10
<b>Panel B: IV (Lewbel internal generated instruments)</b>		
Petrol price	-0.1509*** (0.0540) [-0.0159]	
Observations	118,342	
<i>First stage</i>		
R-squared	0.7876	
F-Statistics	>10	
<b>Panel C: Using Lewbel internal generated and external (NYSE Arca oil index) IVs</b>		
Petrol price	-0.1568*** (0.0537) [-0.0165]	
Observations	118,342	
<i>First stage</i>		
Instrument: NYSE Arca Oil Stock prices index	0.0001*** (0.0000)	
R-squared	0.7931	
F-Statistics	>10	

**Notes:** All models include demographic and state-level controls and includes fixed effects at city, monthly and yearly levels. For other notes see Table 4.2.

#### 4.5.4.5 Alternative measures of wellbeing

As a further robustness check on our results, we use alternative ways of viewing and measuring SWB in Table 4.8. In panel A, we treat SWB as ordinal and estimate equation (4.1) using an ordered logit model. The estimates are consistent with our baseline results.

In panel B, we follow the approach in Welsch and Biermann (2017) and measure life satisfaction as a dummy variable in which we code the responses of participants that report life satisfaction scores of 6—10 as ‘satisfied’ denoted by 1 and scores between

0 and 5 as ‘not satisfied’, denoted by 0. In panel C, instead of treating the mid-point as the cut-off, for the purposes of constructing the dummy variable we treat those who report life satisfaction above the mean value of 7.829 as ‘satisfied’ and below the mean as ‘not satisfied’ in panel C. The results in panels B and C estimated using a logit model are consistent with our baseline results.

Second, as an alternative, we use a measure of mental health to measure SWB. The HILDA survey collects annual data on the SF-36 general health survey, which is used to create the five-item Mental Health Inventory (MHI-5) scale. MHI-5 scale is a measure of mental health intended to capture mood and emotion on a 0—100 scale. The scale is based on the following items in which respondents were asked about how often in the past four weeks they have: 1) been nervous; 2) felt so down in the dumps, such that nothing could cheer them up; 3) felt calm and peaceful; 4) felt down; and 5) been happy. Since it is hypothesised that rising petrol prices may cause a reduction in happiness enhancing leisure travel activities, along with anxiety and stress due to the perceived associated deterioration in the macroeconomic state of the economy, higher petrol prices are likely to be associated with increased psychological distress. While life satisfaction provides a cognitive appraisal of overall wellbeing and the MHI-5 is designed to capture affective reactions to life circumstances, employing HILDA data Wooden and Li (2014) show that the two are quite strongly correlated. Panel D of Table 4.8 reports results for the association between petrol price and the MHI-5 scale. We find that there is a significant negative relationship between petrol prices and mental health, suggesting that rising petrol prices are associated with increased psychological distress.

As an alternative to the MHI-5 scale, we use the Kessler Psychological Distress Scale (K10) score and K10 score risk categories to measure psychological health. The K10 is based on a 10-item response measuring psychological distress, based on questions about peoples’ level of nervousness, agitation, psychological fatigue and depression in the past four weeks. By way of construction, lower scores indicate low levels of psychological distress and high scores indicate high levels of psychological distress.

In panels E and F, we find that there is a significant positive association between petrol prices and these alternative ways of constructing the K10 scale, reinforcing the

**Table 4.8 Robustness checks: alternative measures of wellbeing**

<b>Variables</b>	
<b>Panel A (Ordered Logit): Ordinal treatment of dependent variable</b>	
Petrol price	-0.1569*** (0.0462) [-0.0165]
Observations	118,342
<b>Panel B (Logit): DV is Life Satisfaction Dummy Using Welsch and Biermann cut-offs</b>	
Petrol price	-0.2206** (0.1024) [-0.1343]
Observations	118,342
<b>Panel C (Logit): DV is Life Satisfaction Dummy Using Mean Value as cut-off point</b>	
Petrol price	-0.1945*** (0.0560) [-0.0636]
Observations	118,342
<b>Panel D (Panel FE-IV): DV is (MHI-5 Mental Health Scale)</b>	
Petrol price	-2.8713* (1.7238) [-0.0246]
Observations	105,696
<b>Panel E (Panel FE-IV): DV is K10 Distress Scale score</b>	
Petrol price	1.1702** (0.4872) [0.0260]
Observations	39,906
<b>Panel F (Panel FE-IV): DV is K10 Distress Scale score risk categories</b>	
Petrol price	0.1611* (0.0864) [0.0237]
Observations	39,906

**Notes:** All models include demographic and state-level controls and include fixed effects at city, monthly and yearly levels. Individual fixed effects are also controlled for in Panel D, E and F. All models are 2SLS, employing the NYSE Arca Oil Stock prices index as the IV. For other notes see Table 4.2.

conclusion from the MHI-5 scale findings in panel D that rising petrol prices are associated with increased psychological distress.

The checks using K10 are based on waves 7, 9, 11, 13, 15 and 17 of the HILDA survey. For completeness, instead of using K10, we re-estimated the FE-IV model for SWB, restricting the sample to waves 7, 9, 11, 13, 15 and 17. When we do this, the coefficient on SWB is positive, and significant. Alternatively, we also re-estimated the FE-IV model for SWB, restricting the sample to all even years (2002, 2004, 2006, 2008, 2010, 2012, 2014 and 2016) and all odd years (2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015 and 2017). In both cases, the coefficient on SWB was positive and statistically significant, consistent with the results in Table 4.8. Results from this exercise are presented in appendix Table A4.4.

#### **4.5.4.6 Robustness to alternative fuel data and other sensitivity checks**

Next, we examine the robustness of our findings to employing alternative fuel price datasets. In Table 4.9, instead of monthly city—level unleaded petrol prices, we use monthly city—level diesel prices. We adopt the same approach as in Table 4.3, where we use the NYSE Arca Oil Stock prices as the instrument and progressively add more controls to the 2SLS and panel FE-IV estimates. Our preferred POLS estimate in column 7 suggests that a one standard deviation increase in diesel prices leads to a 0.0291 standard deviation decline in SWB, while the panel fixed effects estimates in column 8 suggests that a one standard deviation increase in diesel prices lead to a reduction in SWB by 0.0191 standard deviations.

We next examine if our results remain robust when we consider all participants in HILDA, not just those who live in the cities. To do so, we use state—level data. At the state-level, the only petrol price data is average annual petrol prices, which is available from the Australian Institute of Petroleum website for 2002—2017. Because we are considering all participants, and not just those who live in the cities, our sample size is increased to 25,197 individuals with 217,654 observations who participated in at least two waves of the survey. We match the state—level petrol price data to the annual SWB scores of these participants. Results are presented in Table A4.5. The state—level baseline, 2SLS and panel FE-IV estimates suggest a significant negative association between petrol prices and SWB, consistent with our main results.

To complement the analysis in Table A4.5, we examine the impact of petrol prices on SWB of those living in urban and rural areas based on vehicle ownership. These

**Table 4.9 Robustness check: Petrol prices and subjective wellbeing using city-level monthly diesel price data (IV results)**

Variables	(1) 2SLS	(2) Panel FE-IV	(3) 2SLS	(4) Panel FE-IV	(5) 2SLS	(6) Panel FE-IV	(7) 2SLS	(8) Panel FE-IV
Diesel price	-0.2973*** (0.0437) [-0.0393]	-0.1127*** (0.0369) [-0.0083]	-0.2913*** (0.0408) [-0.0386]	-0.1030*** (0.0330) [-0.0085]	-0.1856*** (0.0314) [-0.0246]	-0.0930*** (0.0277) [-0.0087]	-0.2201*** (0.0584) [-0.0291]	-0.1479*** (0.0488) [-0.0191]
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-level controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
City FE	No	No	No	No	Yes	Yes	Yes	Yes
Monthly FE	No	No	No	No	No	No	Yes	Yes
Yearly FE	No	No	No	No	No	No	Yes	Yes
Observations	118,342	118,342	118,342	118,342	118,342	118,342	118,342	118,342
R-squared	0.0827	0.0135	0.0829	0.0136	0.0839	0.0137	0.0844	0.0143
Number of Individuals		14,953		14,953		14,953		14,953
<b>First stage</b>								
Instrument:	0.0004***	0.0004***	0.0004***	0.0004***	0.0005***	0.0005***	0.0005***	0.0005***
NYSE Arca Oil Stock prices index	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-squared	0.3100	0.3100	0.3720	0.3720	0.4822	0.4822	0.6402	0.6402
F-Statistics	>10	>10	>10	>10	>10	>10	>10	>10

Notes: See notes to Table 4.2.



results, which are presented in Table A4.6, suggest that for those who own a vehicle, petrol price increases have a significant adverse effect on their SWB, but for those who do not own a vehicle, the effect of petrol price increases on SWB are insignificant. More specifically, for a one deviation increase in petrol prices, those who own a vehicle in rural areas experience a 0.0276 standard deviation decline in SWB, while those who own a vehicle in urban areas experience a smaller 0.0151 standard deviation decline in SWB. These results reflect that people living in rural areas are more reliant on their vehicles to travel for work and leisure, given that rural areas are sparsely populated with often long distances between towns that have few, or no, public transport options. Our results are consistent with Dodsden and Sipe (2007) who argue that car dependence in rural areas in Australia makes people vulnerable to increased fuel costs as they heavily rely on cheap petrol prices. However, those in city and inner suburban areas with much easier access to public transportation system will be less disadvantaged by higher petrol prices.

In Table A4.7 we consider if our main results are robust to using a range of alternative fuel price datasets at different frequencies and for geographical areas. In panel A and panel B, we use annual data obtained at the city-level from the Australian Institute of Petroleum website for petrol and diesel for the period 2004—2017, respectively. The estimates in both panels suggest a negative association between both petrol and diesel prices and SWB. In panel C, we match state-level diesel price data from the Australian Institute of Petroleum website to the annual SWB scores of participants over the 2004—2017 period and find a negative relationship. Finally, we match petrol and diesel price data from the Western Australia Fuel Watch website for Western Australian regions with SWB data for Western Australian participants in HILDA for the period 2001-2017. The relationship between petrol prices and SWB are again negative.

Our baseline estimates in Table 4.2 are estimated with cluster-robust standard errors at the individual level. As a check, we re-estimated the baseline results with a full set of controls (Column 8 of Table 4.2), clustering the standard errors at the city-level. We find that the results, which are presented in appendix Table A4.8, are robust to clustering at the city-level.

While some studies use disposable income in SWB regressions (see for e.g. Anwar, Astell-Burt & Feng, 2019; Bernardelli, Kortt & Michellon, 2019; Johnston, Shields & Suziedelyte, 2018; Lorenz, 2018), others use equivalized income (see for e.g. Aitken, Simpson, Gurrin, Bentley & Kavanagh, 2018; Huang, Frijters, Dalziel & Clarke, 2018; Kristoffersen, 2018; Wooden & Li, 2014). In our main results, we present estimates for regressions that control for the log of real household disposable total income measured in dollars. In Table A4.9, we examine the sensitivity of our results to the use of equivalized income,<sup>28</sup> and thus we used equivalized income instead of disposable income and the results are qualitatively the same.

In our main results, we include year and month fixed effects, but one might be concerned that there are seasonal variations that influence changes in SWB and petrol prices which may not be captured with time fixed effects. In particular, as a result in climate change, hotter weather may decrease SWB but increase petrol prices. This would be consistent with the heterogeneity analysis presented in Figure 4.2. To examine this issue, we included average monthly temperature in the full model specification in the baseline and IV results. The results are reported in Table A4.10. The coefficient on petrol prices continues to be negative and significant with very similar magnitudes to columns 7 and 8 in Table 4.2 and Table 4.3. The coefficient on ‘temperature’ is insignificant in the 2SLS and Panel FE-IV specifications.

#### **4.6 Conclusion**

We have examined the relationship between petrol prices and SWB for Australia using the nationally representative longitudinal HILDA dataset over the period 2001—2017. We find that there is a significant negative association between petrol prices and SWB. This finding is robust to a number of checks for endogeneity, employing alternative ways of defining wellbeing and the use of a range of alternative datasets covering different geographical areas and measures of fuel prices at alternative frequencies. We also examine the role of consumption choices and maintaining social networks as channels through which petrol prices affect SWB and find that maintaining contact with family and friends are important channels.

---

<sup>28</sup> Equivalized household income is calculated using the formula: household disposable total income / [1 (first adult in the household) + 0.5 \* (second and each subsequent person aged 14 and over in the household) + 0.3 \* (each child aged under 14 in the household)].

Our results suggest that rising petrol prices have direct significant adverse effects on the benefits realized via travel. This is particularly important in Australia given that many people are reliant on cars for travel and poor public transport options in many Australian cities, particularly in the outer suburbs of major metropolitan areas in which most people live, mean that there are few realistic alternatives to travelling by car when petrol prices rise. Overall, 80 percent of urban passenger travel is via cars, with a little more than 10 percent done by mass transit (Bureau of Infrastructure, Transport and Regional Economics, 2016). The increased availability, and affordability, of cars in Australia has brought with it benefits such as the ability to obtain employment further afield, take longer trips to see family and friends and engage in cultural and social activities (Australia Bureau of Statistics, 2013); however, our estimates suggest that increases in petrol prices limits engagement in these happiness-enhancing activities, thereby having an adverse effect on the individual life satisfaction.

Given that we find adverse effects of both diesel and petrol prices, as well as their volatility, on the wellbeing of individuals, an important policy implication of our finding is to subsidise alternatives to fuel cars, such as electric cars.<sup>29</sup> Increased prevalence of electric cars would not only reduce the susceptibility of people's SWB to movements in fuel prices, but also be more environmentally friendly, which is relevant as Australia is a signatory of the Paris agreement to achieve net zero carbon emissions by 2050. In Australia, there are currently very limited incentives for individuals to switch to electric vehicles. In one recent news report, Chang (2019) documents that electric vehicles represent just 0.2 percent of automobiles in the country. However, research by Australian Automotive Aftermarket Association (2019) finds that about 54 percent of Australians would be likely to buy an electric vehicle if given attractive government incentives, such as tax credits and discounts on vehicle fees. Our results also support Currie, Delbosc and Pavkova's (2018) call for greater investment in public transport services in Australia, especially in outer suburban areas, together with policies to promote safe cycling and walking

---

<sup>29</sup> This suggestion relies on the assumption that dependence on electricity prices is better than dependence on petrol prices, which, in turn, relies on the assumption that electricity is produced with low carbon emitting technologies.

infrastructure. Improved public transport options would provide alternatives to travel by car and reduce the sensitivity of SWB to petrol prices.

## References

- Aitken, Z., Simpson, J., Gurrin, L., Bentley, R., & Kavanagh, A. (2018). Do material, psychosocial and behavioural factors mediate the relationship between disability acquisition and mental health? A sequential causal mediation analysis. *International Journal of Epidemiology*, *47*(3), 829-840.
- Alesina, A., & Zhuravskaya, E. (2011). Segregation and the quality of government in a cross section of countries. *American Economic Review*, *101*(5), 1872-1911.
- Allen, D., & MacDonald, G. (1995). The long-run gains from international equity diversification: Australian evidence from cointegration tests. *Applied Financial Economics*, *5* (1), 33-42.
- Amadeo, K. (2019). How crude oil prices affect gas prices. The Balance, January 25. Retrieved May 18, 2019 from <https://www.thebalance.com/how-crude-oil-prices-affect-gas-prices-3306230>.
- Ambrey, C., & Fleming, C. (2014). Life satisfaction in Australia: Evidence from ten years of the HILDA survey. *Social Indicators Research*, *115* (2), 691-714.
- Anwar, A., Astell-Burt, T., & Feng, X. (2019). Does social capital and a healthier lifestyle increase mental health resilience to disability acquisition? Group-based discrete trajectory mixture models of pre-post longitudinal data. *Social Science & Medicine*, *235*. 112143.
- Armstrong, B., Davison, G., de Vos Malan, J., Gleeson, B., & Godfrey, B. (2015). *Delivering sustainable urban mobility*. Melbourne, VIC, Australia: Australia Council of Learned Academies (ACOLA).
- Ateca-Amestoy, V., Aguilar, A. C., & Moro-Egido, A. I. (2014). Social interactions and life satisfaction: Evidence from Latin America. *Journal of Happiness Studies*, *15*(3), 527-554.
- Australian Automotive Aftermarket Association. (2019). *Why Australians won't be plugging into electric cars any time soon*. Retrieved August 30, 2019, from <https://www.aaaa.com.au/news/automotive-industry-news/why-australians-wont-be-plugging-into-electric-cars-any-time-soon/>.
- Australian Bureau of Statistics. (2013). *Australian Social Trends, July 2013* (No.4102.0). Retrieved May 29, 2019, from <https://www.abs.gov.au/AUSSTAS/abs@.nsf/Lookup/4102.0Main+Features40July+2013>.

- Australian Bureau of Statistics (2016). *Census Data*. Retrieved April 19, 2020 from <https://www.abs.gov.au/websitedbs/D3310114.nsf/home/2016+Census+National>
- Australian Bureau of Statistics. (2018). *Gender Indicators, Australia, September 2018* (No. 4125.0). Retrieved August 5, 2019, from <https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4125.0Sep%202018?OpenDocument..>
- Australian Bureau of Statistics. (2019). *Motor vehicle census, Australia, 31 Jan 2019* (No. 9309.0). Retrieved May 19, 2019, from <https://www.abs.gov.au/ausstats/abs@.nsf/mf/9309.0>.
- Australian Competition and Consumer Commission (ACCC). (2019). *Petrol price cycles in capital cities*. Retrieved May 31, 2019, from <https://www.accc.gov.au/consumers/petrol-diesel-lpg/petrol-price-cycles#petrol-price-cycles-in-capital-cities>.
- Awaworyi Churchill, S., Appau, S., & Farrell, L. (2019). Religiosity, income and wellbeing in developing countries. *Empirical Economics*, 56 (3), 959-985.
- Awaworyi Churchill, S., & Mishra, V. (2017). Trust, social networks and subjective wellbeing in China. *Social Indicators Research*, 132(1), 313-339. doi:10.1007/s11205-015-1220-2
- Awaworyi Churchill, S., & Smyth, R. (2019). Transport poverty and subjective wellbeing. *Transportation Research Part A*, 124, 40-54.
- Bachmeier, L., & Griffin, J. (2003). New evidence on asymmetric gasoline price responses. *The Review of Economics and Statistics*, 85(3), 772-776.
- Bacon, R. (1991). Rockets and feathers: the asymmetric speed of adjustment of U.K. retail gasoline prices to cost changes. *Energy Economics*, 13(3), 211-218.
- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173.
- Barrington-Leigh, C., & Escande, A. (2018). Measuring progress and well-being: A comparative review of indicators. *Social Indicators Research*, 135(3), 893-925.
- Bernardelli, L., Kortt, M., & Michellon, E. (2019). Religion, health, and life satisfaction: Evidence from Australia. *Journal of Religion and Health*, 1-17.
- Biswas-Diener, R., & Diener, E. (2006). The subjective well-being of the homeless, and lessons for happiness. *Social Indicators Research*, 76(2), 185-205. doi:10.1007/s11205-005-8671-9

- Blanchard, O., & Gali, J. (2007). The macroeconomic effects of oil shocks: Why are the 2000s so different from the 1970s? *NBER Working Paper No. 13368*, Retrieved January 27, 2019, from <https://www.nber.org/papers/w13368>.
- Blanchflower, D., Oswald, A., & Stewart-Brown, S. (2013). Is psychological well-being linked to the consumption of fruits and vegetables? *Social Indicators Research, 114* (3), 785-801.
- Borenstein, S., Cameron, A., & Gilbert, R. (1997). Do gasoline prices respond asymmetrically to crude oil price changes? *The Quarterly Journal of Economics, 112*(1), 305-339.
- Boyd-Swan, C., & Herbst, C. (2012). Pain at the pump: Gasoline prices and subjective well-being. *Journal of Urban Economics, 72*, 160-175.
- Bureau of Infrastructure, Transport and Regional Economics. (2016). *A dozen facts about transport in Australia*. Retrieved May 29, 2019, from [https://www.bitre.gov.au/publications/2016/files/is\\_075.pdf](https://www.bitre.gov.au/publications/2016/files/is_075.pdf).
- Catalano, R., & Dooley, D. (1983). Health effects of economic instability: A test of the economic stress hypothesis. *Journal of Health and Social Behavior, 24*, 46-60.
- Chang, C. (2019). The reality of electric cars in Australia. News Corp Australia Network, April 6. Retrieved August 30, 2019 from <https://www.news.com.au/national/federal-election/the-reality-of-electric-cars-in-australia/newsstory/ebc70930d49758db0ad0f6b5a91df0c6>.
- Chen, L., Finney, M., & Lai, K. (2005). A threshold cointegration analysis of asymmetric price transmission from crude oil to gasoline prices. *Economics Letters, 89*(2), 233-239.
- Cheng, Z., Mishra, V., Nielsen, I., Smyth, R., & Wang, B. (2017). Wellbeing in China. *Social Indicators Research, 132*(1), 1-10.
- Chua, C., De Silva, C., & Suardi, S. (2017). Do petrol prices increase faster than they fall on market disequilibria. *Energy Economics, 61*, 135-146.
- Commonwealth of Australia. (2019). Liquid Fuel Security Review – Interim Report. *Commonwealth of Australia, Canberra*. Retrieved September 5, 2019, from <https://www.environment.gov.au/system/files/consultations/7cf6f8e2-fef0-479e-b2dd-3c1d87efb637/files/liquid-fuel-security-review-interim-report.pdf>.
- Courtemanche, C. (2011). A silver lining? The connection between gasoline prices and obesity. *Economic Inquiry, 49*(3), 935-957.

- Cummins, R. (2018). Subjective wellbeing as a social indicator. *Social Indicators Research, 135*(3), 879-891.
- Cunado, J., & Garcia, P. (2005). Oil prices, economic activity and inflation: Evidence for some Asian countries. *The Quarterly Review of Economics and Finance, 45*, 65-83.
- Currie, G., Delbosc, A., & Pavkova, K. (2018). *Alarming trends in the growth of forced car ownership in Melbourne*. Paper presented at the 40<sup>th</sup> Australasian Transport Research Forum, Darwin. Retrieved from [https://www.atrf.info/papers/2018/files/ATRF2018\\_paper\\_8.pdf](https://www.atrf.info/papers/2018/files/ATRF2018_paper_8.pdf).
- Davey, A. (2010). Deregulation of wholesale petrol prices: What happened to capital city petrol prices. *The Australian Journal of Agricultural and Resource Economics, 54*(1), 81-98.
- Deloitte Access Economics. (2017). ASX Australian Investor Study. *Deloitte Access Economics*, Sydney. Retrieved March 5, 2019, from <https://www.asx.com.au/documents/resources/2017-asx-investor-study.pdf>.
- Diener, E., & Suh, E. (1997). Measuring quality of life: Economic, social, and subjective indicators. *Social Indicators Research, 40*(1-2), 189-216.
- DiMaria, C., Peroni, C., & Sarracino, F. (2019). Happiness matters: Productivity gains from subjective well-being. *Journal of Happiness Studies, 1-22*.
- Dodson, J., & Sipe, N. (2007). Oil vulnerability in the Australian city: Assessing socioeconomic risks from higher urban fuel prices. *Urban Studies, 44*(1), 37-62.
- Dolan, P., Peasgood, T., & White, M. (2008). Do we really know what makes us happy? A review of economic literature on the factors associated with subjective wellbeing. *Journal of Economic Psychology, 29*, 94-122.
- Drew, A. (2018). Thousands boycott petrol stations in protest of high fuel prices. Retrieved February 5, 2019, from <https://www.triplem.com.au/story/thousands-boycott-petrol-stations-in-protest-of-high-fuel-prices-115707>.
- Duckitt, J. H. (1982). Social interaction and psychological well-being: A study of elderly persons living in the inner-city area of Pretoria. *Humanitas: Journal for Research in the Human Sciences, 8*(2), 121-129.
- Duffy-Deno, K. (1996). Retail price asymmetries in local gasoline markets. *Energy Economics, 18*(1-2), 81-92.
- Efthymiou, D., Antoniou, C., & Waddell, P. (2013). Factors affecting the adoption of vehicle sharing systems by young drivers. *Transport Policy, 29*, 64-73.



- Elgar, F. J., Davis, C. G., Wohl, M. J., Trites, S. J., Zelenski, J. M., & Martin, M. S. (2011). Social capital, health and life satisfaction in 50 countries. *Health & Place, 17*(5), 1044-1053.
- Fernandez-Blanco, V., Orea, L., & Prieto-Rodriguez, J. (2013). Endogeneity and measurement errors when estimating demand functions with average prices: An example from the movie market. *Empirical Economics, 44*(3), 1477-1496.
- Ferrer-i-Carbonell, A., & Frijters, P. (2004). How important is methodology for the estimates of the determinants of happiness? *The Economic Journal, 114*(497), 641-659.
- Frijters, P., Johnson, D., Shields, M., & Sinha, K. (2015). A lifecycle perspective of stock market performance and wellbeing. *Journal of Economic Behavior and Organization, 112*, 237-250.
- Galeotti, M., Lanza, A., & Manera, M. (2003). Rockets and feathers revisited: An international comparison on European gasoline markets. *Energy Economics, 25*(2), 175-190.
- Graham, C., & Chattopadhyay, S. (2010). (Un?) Happiness and gasoline prices in the United States. Retrieved May 5, 2019, from <https://www.brookings.edu/research/unhappiness-and-gasoline-prices-in-the-united-states/>.
- Grover, S., & Helliwell, J. (2019). How's life at home? New evidence on marriage and the set point for happiness. *Journal of Happiness Studies, 20*(2), 373-390.
- Harrison, A., & Ragland, D. (2003). Consequences of driving reduction or cessation for older adults. *Transportation Research Record: Journal of the Transportation Research Board, 1843*(1), 96-104.
- Headey, B., & Yong, J. (2019). Happiness and longevity: Unhappy people die young, otherwise happiness probably makes no difference. *Social Indicators Research, 142*(2), 713-732.
- Holder, M. (2019). The contribution of food consumption to well-being. *Annals of Nutrition & Metabolism, 74* (2), 44-51.
- Honarvar, A. (2009). Asymmetry in retail gasoline and crude oil price movements in the United States: an application of hidden cointegration technique. *Energy Economics, 31*(3), 395-402.
- Hou, N., Popkin, B., Jacobs, D., Song, Y., Guilkey, K., He, K., ... Gordon-Larsen, P. (2011). Longitudinal trends in gasoline price and physical activity: The CARDIA study. *Preventive Medicine, 52*(5), 365-369.

- Huang, L., Frijters, P., Dalziel, K., & Clarke, P. (2018). Life satisfaction, QALYs, and the monetary value of health. *Social Science & Medicine*, *211*, 131-136.
- Huffman, S., & Rizoy, M. (2017). Life satisfaction and diet: Evidence from the Russian longitudinal monitoring survey. *Economics Working Papers: 17021*. Retrieved October 4, 2019, from [https://lib.dr.iastate.edu/econ\\_workingpapers/22](https://lib.dr.iastate.edu/econ_workingpapers/22).
- Inoguchi, T. (2018). Leisure satisfaction in relation to quality of life using the AsiaBarometer survey data. In L. Rodriguez de la Vega & W.Toscano (Eds.), *Handbook of leisure, physical activity, sports, recreation and quality of life* (pp. 19-30). Switzerland: Springer.
- International Wellbeing Group. (2013). *Personal Wellbeing Index - Adult Manual*. Deakin University. Melbourne: Australian Centre on Quality of Life. Retrieved April 6, 2019 <http://www.acqol.com.au/uploads/pwi-a/pwi-a-english.pdf>.
- Jain, T., Rose, G., & Johnson, M. (2018). *Unpacking impacts of car sharing: Insights from a qualitative research study in Melbourne, Australia*. Paper presented at the 40<sup>th</sup> Australiasian Transport Research Forum, Darwin. Retrieved from [https://www.atrf.info/papers/2018/files/ATRF2018\\_Abridged\\_Paper\\_85.pdf](https://www.atrf.info/papers/2018/files/ATRF2018_Abridged_Paper_85.pdf).
- Johnston, D., Shields, M., & Suziedelyte, A. (2018). Victimization, well-being and compensation: Using panel data to estimate the costs of violent crime. *The Economic Journal*, *128*(611), 1545-1569.
- Jones, A., Steinbach, R., Roberts, H., Goodman, A., & Green, J. (2012). Rethinking passive transport: Bus fare exemptions and young people's wellbeing. *Health & Place*, *18*(3), 605-612.
- Kent, J. (2018). Why car sharing had a slow start in Australia – and how that's changing. *The Conversation*, October 29. Retrieved August 20, 2019 from <https://theconversation.com/why-car-sharing-had-a-slow-start-in-australia-and-how-thats-changing-104389>.
- Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review*, *99*(3), 1053-10694.
- Kristoffersen, I. (2018). Great expectations: Education and subjective wellbeing. *Journal of Economic Psychology*, *66*, 64-78.
- Kubiszewski, I., Zakariyya, N., & Costanza, R. (2018). Objective and subjective indicators of life satisfaction in Australia: How well do people perceive what supports a good life? *Ecological Economics*, *154*, 361-372.

- Kuykendall, L., Tay, L., & Ng, V. (2015). Leisure engagement and subjective well-being: A meta analysis. *Psychological Bulletin*, *141*(2), 364-403.
- Lane, B. (2010). The relationship between recent gasoline price fluctuations and transit ridership in major US cities. *Journal of Transport Geography*, *18*(2), 214-225.
- Lengyel, C., Tate, R., & Blatz, A. (2009). The relationship between food group consumption, self-rated health, and life satisfaction of community-dwelling Canadian older men: The Manitoba follow-up study. *Journal of Nutrition for the Elderly*, *28* (2), 158-173.
- Lewbel, A. (2012). Using heteroscedasticity to identify and estimate mismeasured and endogenous regressor models. *Journal of Business & Economic Statistics*, *30*(1), 67-80.
- Liu, H., & Yu, B. (2015). Serious leisure, leisure satisfaction and subjective well-being of Chinese university students. *Social Indicators Research*, *122*(1), 159-174.
- Liu, M., Margaritis, D., & Tourani-Rad, A. (2010). Is there an asymmetry in the response of diesel and petrol prices to crude oil price changes? Evidence from New Zealand. *Energy Economics*, *32*(4), 926-932.
- Loader, C. (2015, March 9). Trends in driver's license ownership in Australia [Blog post]. Retrieved June 3, 2019 from <https://chartingtransport.com/2015/03/09/trends-in-drivers-license-ownership-in-australia/>.
- Lorenz, O. (2018). Does commuting matter to subjective well-being. *Journal of Transport Geography*, *66*, 180-199.
- Ma, L., Zhang, X., Ding, X., & Wang, G. (2018). Bike sharing and user's subjective well-being: an empirical study in China. *Transportation Research Part A*, *118*, 14-24.
- Mishra, V., & Smyth, R. (2015). Estimating returns to schooling in urban China using conventional and heteroskedasticity-based instruments. *Economic Modelling*, *47*, 166-173.
- Mohaddes, K., & Pesaran, M. (2017). Oil prices and the global economy: Is it different this time around? *Energy Economics*, *65*, 315-325.
- Morris, E. (2015). Should we all just stay home? Travel, out-of-home activities, and life satisfaction. *Transportation Research Part A*, *78*, 519-536.
- Narayan, P., & Smyth, R. (2004). Modeling the linkages between the Australian and G7 stock markets: common stochastic trends and regime shifts. *Applied Financial Economics*, *14*(14), 991-1004.

- Newman, D., Tay, L., & Diener, E. (2014). Leisure and subjective well-being: A model of psychological mechanisms as mediating factors. *Journal of Happiness Studies, 15*(3), 555-578.
- Norman, J. (2018). Americans expect more gas price hikes. GALLUP.COM, May 30. Retrieved October 18, 2019 from <https://news.gallup.com/poll/235142/americans-expect-gas-price-hikes.aspx>
- Nguyen, J., Fleming, C., & Su, J. (2015). Does income inequality make us less happy?. *The Australian Economic Review, 48*(1), 15-32.
- Portela, M., Neira, I., & Salinas-Jiménez, M. d. M. (2013). Social capital and subjective wellbeing in Europe: A new approach on social capital. *Social Indicators Research, 114*(2), 493-511.
- Powdthavee, N., & Wooden, M. (2015). Life satisfaction and sexual minorities: Evidence from Australia and the United Kingdom. *Journal of Economic Behavior & Organization, 116*, 107-126.
- Reynolds, F., & Lim, K. (2007). Contribution of visual art-making to the subjective well-being of women living with cancer: A quantitative study. *The Arts in Psychotherapy, 34*(1), 1-10.
- Roca, E. (1999). Short-term and long-term price linkages between the equity markets of Australia and its major trading partners. *Applied Financial Economics, 9*(5), 501-511.
- Sachs, J., Becchetti, L., & Annett, A. (2016). World Happiness Report 2016 (Vol.2). New York: UN Sustainable Development Solutions Network.
- Schnettler, B., Lobos, G., Miranda-Zapata, E., Denegri, M., Ares, G., Hueche, C. (2017). Diet quality and satisfaction with life, family life, and food-related life across families: A cross sectional pilot study with mother-father-adolescent triads. *International Journal of Environmental Research and Public Health, 14* (11), 1-24.
- Schnettler, B., Miranda, H., Lobos, G., Orellana, L., Sepulveda, J., Denegri, M.,...Grunert, G. (2015). Eating habits and subjective well-being. A typology of students in Chilean state universities. *Appetite, 89*, 203-214.
- Schnettler, B., Pena, J., Mora, M., Miranda, H., Sepulveda, J., Denegri, M., Lobos, G. (2013). Food related lifestyles and eating habits inside and outside the home in the metropolitan region of Santiago, Chile. *Nutricion Hospitalaria, 28* (3), 1266-1273.

- Sen, B. (2012). Is there an association gasoline prices and physical activity? Evidence from American time use data. *Journal of Policy Analysis and Management*, 31(2), 338-366.
- Shaw, C., Hales, S., Edwards, R., Howden-Chapman, P., & Stanley, J. (2018). What can fuel price increases tell us about the air pollution health co-benefits of a carbon price? *Journal of Transport and Health*, 8, 81-90.
- Sirgy, M., Uysal, M., & Kruger, S. (2017). Towards a benefits theory of leisure well-being. *Applied Research in Quality of Life*, 12(1), 205-228.
- Smart, M. (2014). A volatile relationship: the effect of changing gasoline prices on public support for mass transit. *Transportation Research Part A*, 61, 178-185.
- Solé-Auró, A., & Lozano, M. (2019). Inequalities in longevity by education level in Spain: A life satisfaction approach. *Social Indicators Research*, 144(2), 729-744.
- Stanley, J., & Vella-Brodrick, D. (2009). The usefulness of social exclusion to inform social policy in transport. *Transportation Policy*, 16(3), 90-96.
- Stiglitz, J., Sen, A., & Fitoussi, J. (2009). *Report by the commission on the measurement of economic performance and social progress*. Paris: Commission on the measurement of economic performance and social progress. Retrieved May 2, 2019, from [http://www.stiglitz-sen-fitoussi.fr/documentsrapprt\\_anglais.pdf](http://www.stiglitz-sen-fitoussi.fr/documentsrapprt_anglais.pdf).
- Summerfield, M., Bevitt, A., Fok, Y., Hahn, M., La, N., Macalalad, N., ... Wooden, M. (2018). HILDA User Manual – Release 17. Melbourne Institute: Applied Economic and Social Research, University of Melbourne. Retrieved June 2, 2019, from [https://melbourneinstitute.unimelb.edu.au/\\_\\_data/assets/pdf\\_file/0004/2939053/HILDA-User-Manual-Release-17.1.pdf](https://melbourneinstitute.unimelb.edu.au/__data/assets/pdf_file/0004/2939053/HILDA-User-Manual-Release-17.1.pdf).
- Valadkhani, A. (2013a). Do petrol prices rise faster than they fall when the market shows significant disequilibria? *Energy Economics*, 39, 66-80.
- Valadkhani, A. (2013b). Modelling the terminal gate prices of unleaded petrol in Australia. *Energy Economics*, 33, 233-243.
- Valadkhani, A., & Chen, G. (2014). An empirical analysis of the US stock market and output growth volatility spillover effects on three Anglo-Saxon countries. *International Review of Applied Economics*, 28(3), 323-335.
- Valadkhani, A. & Smyth, R. (2018). Asymmetric responses in the timing, and magnitude, of changes in Australian monthly petrol prices to daily oil price changes. *Energy Economics*, 69, 89-100.

- Wang, Z. (2008). Collusive communication and pricing coordination in a retail gasoline market. *Review of Industrial Organization*, 32(1), 35-52.
- Wang, Z. (2009). (Mixed) strategies in oligopoly pricing: Evidence from gasoline price cycles before and under a timing regulation. *Journal of Political Economy*, 117(6), 987-1030.
- Welsch, H., & Biermann, P. (2017). Energy affordability and subjective wellbeing: Evidence for European countries. *The Energy Journal*, 38(3), 159-176.
- Wooden, M., & Li, N. (2014). Panel conditioning and subjective well-being. *Social Indicators Research*, 117(1), 235-255.
- Yatchew, A., & No, J. (2001). Household gasoline demand in Canada. *Econometrica*, 69(6), 1697–1709.
- Zhu, Z., Li, Z., Chen, H., Liu, Y., & Zeng, J. (2019). Subjective well-being in China: How much does commuting matter? *Transportation*, 46(4), 1505-1524.

## APPENDICES

**Table A4.1 Description and Summary Statistics of variables**

Variables	Descriptions	Mean	SD
Subjective wellbeing (life satisfaction)	How satisfied are you with your life? On a scale of 0—10, where 0 is labelled as totally dissatisfied and 10 is totally satisfied	7.8287	1.4681
Petrol prices	Real ULP prices measured in Australian dollars per litre	1.2987	0.1547
Age	Age of the survey respondents measured in years.	44.9931	17.7427
Age squared	Square of age/100	23.3918	17.6631
Male	Dummy variable if respondent is male	0.4683	0.4990
Female	Dummy variable if respondent is female	0.5317	0.4990
Dependants	Number of dependents in household aged 0—24	0.6375	1.0467
Separated	Dummy variable if respondent is separated	0.0261	0.1593
Divorced	Dummy variable if respondent is divorced	0.0647	0.2460
Widowed	Dummy variable if respondent is widowed	0.0488	0.2155
Single	Dummy variable if respondent is single	0.2180	0.4129
Income	Log of real household disposable total income measured in dollars	11.0945	0.7866
Employed	Dummy variable if respondent is employed	0.6711	0.4698
Unemployed	Dummy variable if respondent is unemployed or not in labour force	0.3289	0.4698
Postgraduate	Dummy variable if respondent's highest education level achieved is masters or doctorate	0.0623	0.2417
Graduate Diploma	Dummy variable if respondent's highest education level achieved is graduate diploma or certificate	0.0643	0.2452
Bachelor	Dummy variable if respondent's highest education level achieved is bachelor or honors	0.1782	0.3827
Diploma	Dummy variable if respondent's highest education level achieved is advanced diploma or diploma	0.0970	0.2959
Certificate	Dummy variable if respondent's highest education level achieved is certificate I, II, III or IV	0.1842	0.3877
Year 12	Dummy variable if respondent's highest education level achieved is year 12 or below	0.4141	0.4926

Illness	Dummy variable if respondent is disabled or has a long-term illness	0.2231	0.4163
Population density by state	Persons per square kilometer by state	10.0161	9.5667
Gross state product per capita	Log of real gross state domestic product per capita measured in thousands	4.1892	0.1351
Mental health	Five-item Mental Health Inventory (MHI-5) scale	73.8619	17.0829
K10 Distress Scale	Kessler Psychological Distress Scale (K10)	15.8724	6.3905
K10 Risk Categories	Kessler Psychological Distress Scale (K10) risk categories. 1 represents low risk, 2 moderate risk, 3 high risk and 4 very high risk	1.5791	0.8753
Diesel prices	Real diesel prices measured in Australian dollars per litre	1.3580	0.1943
Community participation: See members of extended family	In general, how often do you see members of your extended family (or relatives not living with you) in person? On a scale of 1—6, where 1 is labelled as 'never' and 6 is 'very often'	3.9518	1.3024
Community participation: Keep in touch with friends	In general, how often do you make time to keep in touch with friends? On a scale of 1—6, where 1 is labelled as 'never' and 6 is 'very often'	4.4512	1.0832
Household expenditure on meals eaten out	Log of household expenditure on meals eaten out measured in dollars	5.3528	0.7962
City	City is defined by area postcodes that are in the seven major metropolitan areas in Australia: Adelaide (5000—5199), Brisbane (4000—4207, 4300—4305, 4500—4519), Darwin (800-832), Hobart (7000—7004), Melbourne (3000—3207), Perth (6000—6109), Sydney (2000—2234). Numbers in parenthesis are Australian area postcodes		
State	8 states in Australia: New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Northern Territory, Australian Capital Territory.		



**Table A4.2 Test on the validity of IV**

<b>Variables</b>	<b>Pooled OLS</b>	<b>Panel FE</b>
<b>Dependent variable: Maximum monthly</b>		
NYSE Arca Oil Stock prices index	0.0000 (0.0001) [0.0018]	0.0000 (0.0000) [0.0002]
Demographic controls	Yes	Yes
State-level controls	Yes	Yes
City FE	Yes	Yes
Monthly FE	Yes	Yes
Yearly FE	Yes	Yes
Observations	118,342	118,342
R-squared	0.8516	0.6584
Number of Individuals		14,953

**Notes:** The maximum monthly temperature data is sourced from The Bureau of Meteorology - Australia website (<http://www.bom.gov.au/climate/data/index.shtml>). Daily maximum temperature is obtained from various existing weather stations to calculate monthly average maximum temperature by city. For other notes see Table 4.2

**Table A4.3 Petrol prices and Life satisfaction, full baseline and 2SLS results**

Variables	Baseline		2SLS	
	Pooled OLS	Panel FE	Pooled OLS	Panel FE
Petrol price	-0.1092*** (0.03650) [-0.0115]	-0.1137*** (0.0414) [-0.0120]	-0.2324*** (0.0617) [-0.0245]	-0.1566*** (0.0517) [-0.0157]
Female	0.1141*** (0.0202) [0.0388]		0.1143*** (0.0202) [0.0389]	
Age	-0.0586*** (0.0034) [-0.7082]	-0.0144*** (0.0049) [-0.1744]	-0.0588*** (0.0034) [-0.7102]	-0.0158*** (0.0050) [-0.1905]
Age squared	0.0720*** (0.0036) [0.8661]	0.0121*** (0.0043) [0.1457]	0.0722*** (0.0036) [0.8686]	0.0122*** (0.0043) [0.1474]
Dependants	-0.0492*** (0.0093) [-0.0351]	-0.0583*** (0.0092) [-0.0416]	-0.0493*** (0.0093) [-0.0352]	-0.0585*** (0.0092) [-0.0417]
Separated	-0.8526*** (0.0570) [-0.0925]	-0.6417*** (0.0464) [-0.0696]	-0.8511*** (0.0571) [-0.0924]	-0.6418*** (0.0464) [-0.0697]
Divorced	-0.4584*** (0.0467) [-0.0768]	-0.3705*** (0.0466) [-0.0621]	-0.4567*** (0.0467) [-0.0765]	-0.3702*** (0.0466) [-0.0620]
Widowed	-0.2930*** (0.0537) [-0.0430]	-0.4196*** (0.0642) [-0.0616]	-0.2919*** (0.0537) [-0.0428]	-0.4189*** (0.0642) [-0.0615]
Single	-0.3679*** (0.0268) [-0.1035]	-0.2592*** (0.0230) [-0.0729]	-0.3667*** (0.0268) [-0.1031]	-0.2591*** (0.0230) [-0.0729]
Income	0.1803*** (0.0123) [0.0966]	0.0392*** (0.0093) [0.0210]	0.1840*** (0.0125) [0.0986]	0.0398*** (0.0093) [0.0213]
Employed	0.1064*** (0.0225) [0.0341]	0.0508*** (0.0164) [0.0163]	0.1055*** (0.0225) [0.0338]	0.0508*** (0.0164) [0.0163]
Postgrad	-0.0830** (0.0397) [-0.0137]	-0.0360 (0.0504) [-0.0059]	-0.0820** (0.0396) [-0.0135]	-0.0364 (0.0505) [-0.0060]
Graduate Diploma	-0.0534 (0.0404) [-0.0089]	-0.1002** (0.0499) [-0.0167]	-0.0529 (0.0404) [-0.0088]	-0.1003** (0.0499) [-0.0167]

Bachelor	-0.0855*** (0.0270) [-0.0223]	-0.1375*** (0.0317) [-0.0359]	-0.0849*** (0.0270) [-0.0221]	-0.1377*** (0.0317) [-0.0359]
Diploma	-0.0195 (0.0336) [-0.0039]	-0.0944* (0.0492) [-0.0190]	-0.0192 (0.0336) [-0.0039]	-0.0947* (0.0492) [-0.0191]
Certificate	-0.0240 (0.0275) [-0.0063]	-0.0681* (0.0356) [-0.0180]	-0.0227 (0.0275) [-0.0060]	-0.0681* (0.0356) [-0.0180]
Long-term illness	-0.6009*** (0.0221) [-0.1704]	-0.1959*** (0.0130) [-0.0555]	-0.6008*** (0.0221) [-0.1704]	-0.1959*** (0.0130) [-0.0555]
Population Density	-0.0017 (0.0075) [-0.0110]	-0.0180** (0.0070) [-0.1172]	-0.0032 (0.0075) [-0.0206]	-0.0186*** (0.0070) [-0.1215]
Gross state product per capita	0.2804* (0.1508) [0.0258]	-0.0130 (0.1758) [-0.0012]	-0.0830 (0.1977) [-0.0076]	-0.0176 (0.1758) [-0.0016]
City FE	Yes	Yes	Yes	Yes
Monthly FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	118,342	118,342	118,342	118,342
R-squared	0.0842	0.0142	0.0844	0.0143
Number of Individuals		14,953		14,953

**Notes:** See notes to Table 4.2. Reference category for marital status are those married or in a de facto relationship, for educational status it is those whose highest education level is year 12 or below, and for employment status it is those unemployed or not in the labour force.

**Table A4.4 Petrol prices and subjective wellbeing, alternating years**

Variables	(2) Panel FE-IV
<b>Panel A: restricting SWB sample over same years as K10 variable</b>	
Petrol price	-0.1914* (0.1050) [-0.0152]
Observations	45,198
<b>Panel B: restricting SWB sample to odd years of the survey</b>	
Petrol price	-0.2133*** (0.0653) [-0.0190]
Observations	63,221
<b>Panel C: restricting SWB sample to even years of the survey</b>	
Petrol price	-0.0968* (0.0572) [-0.0091]
Observations	55,121

**Notes:** All models include demographic and state-level controls and includes fixed effects at state and yearly levels. For other notes see Table 4.2.

**Table A4.5 Petrol prices and subjective wellbeing, using state-level yearly petrol prices**

Variables	(1) Pooled OLS	(2) Panel FE
<b>Panel A: Baseline Results</b>		
Petrol price	-0.1154*** (0.0307) [-0.0109]	-0.2592*** (0.0413) [-0.0244]
Observations	217,654	217,654
R-squared	0.0792	0.0137
Number of Individuals		25,197
<hr/>		
<b>Panel B: IV Results</b>	<b>2SLS</b>	<b>Panel FE-IV</b>
Petrol price	-0.3789*** (0.0568) [-0.0357]	-0.1638*** (0.0286) [-0.0147]
Observations	217,654	217,654
Number of Individuals		25,197
<i>First stage</i>		
Instrument:	0.0004***	0.0004***
NYSE Arca Oil Stock prices index	(0.0000)	(0.0000)
R-squared	0.5183	0.5183
F-Statistics	>10	>10

**Notes:** All models include demographic and state-level controls and includes fixed effects at state and yearly levels. The data for state level petrol price is for the period 2002—2017. For other notes see Table 4.2.

**Table A4.6 Petrol prices and subjective wellbeing, heterogeneous effects by geographical location and vehicle ownership using state-level yearly petrol prices**

<b>Panel A: Urban</b>		
<b>Variables</b>	<b>Own a vehicle Panel FE-IV</b>	<b>Do not own a vehicle Panel FE-IV</b>
Petrol price	-0.1664** (0.0791) [-0.0151]	-0.3247 (0.2118) [-0.0227]
Observations	119,002	33,788
<b>Panel B: Rural</b>		
<b>Variables</b>	<b>Own a vehicle Panel FE-IV</b>	<b>Do not own a vehicle Panel FE-IV</b>
Petrol price	-0.3004** (0.1474) [-0.0276]	-0.4465 (0.5090) [-0.0306]
Observations	14,390	3,341

**Notes:** All models include demographic and state-level controls and includes fixed effects at state and yearly levels. The NYSE Arca Oil Stock prices index is used as instrument in all the specifications. For other notes see Table 4.2.

**Table A4.7 Petrol prices and subjective wellbeing using alternative yearly fuel prices (IV results)**

<b>Variables</b>	<b>2SLS</b>	<b>Panel FE-IV</b>
<b>Panel A: City-level yearly ULP prices</b>		
Petrol price	-0.3385*** (0.0773) [-0.0326]	-0.1901*** (0.0482) [-0.0172]
Observations	100,138	100,138
<b>Panel B: City-level yearly Diesel prices</b>		
Diesel price	-0.3222*** (0.0736) [-0.0401]	-0.1670*** (0.0429) [-0.0197]
Observations	100,138	100,138
<b>Panel C: State-level yearly Diesel prices</b>		
Diesel price	-1.6267** (0.8111) [-0.2059]	-0.0901* (0.0481) [-0.0114]
Observations	159,697	159,697
<b>Panel D: Western Australia – yearly ULP prices</b>		
Petrol price	-0.4158*** (0.1522) [-0.0372]	-0.2065* (0.1150) [-0.0184]
Observations	21,733	21,733
<b>Panel E: Western Australia – yearly Diesel prices</b>		
Diesel prices	-0.2686*** (0.0983) [-0.0299]	-0.1842* (0.1017) [-0.0205]
Observations	21,733	21,733

**Notes:** All models include demographic and state-level controls and includes fixed effects at state/city/region and yearly levels. In Panel A and B, the data for city level petrol and diesel price is sourced from Australian Institute of Petroleum website for the period 2004—2017. In Panel C, the data for state level diesel price is sourced from Australian Institute of Petroleum website for the period 2007—2017. In Panel D and E, the data for petrol and diesel price for Western Australia regions is sourced from Western Australia Fuel Watch website for the period 2001—2017. The NYSE Arca Oil Stock prices index is used as the instrument in all specifications. For other notes see Table 4.2.

**Table A4.8 Petrol prices and subjective wellbeing, clustering at city-level**

<b>Variables</b>	<b>Panel FE</b>
Petrol price	-0.0486*** (0.0120) [-0.0051]
Demographic controls	Yes
State-level controls	Yes
City FE	Yes
Monthly FE	Yes
Yearly FE	Yes
Observations	118,342
R-squared	0.5791
Number of Individuals	14,953

**Notes:** See notes to Table 4.2.



**Table A4.9 Petrol prices and subjective wellbeing, using equivalized income**

Variables	Baseline		2SLS	
	Pooled OLS	Panel FE	Pooled OLS	Panel FE
Petrol price	-0.1113*** (0.0366) [-0.0117]	-0.1134*** (0.0519) [-0.0119]	-0.2390*** (-0.0617) [-0.0252]	-0.1573*** (-0.0517) [-0.0158]
Equivalized Income	0.2077*** (0.0142) [0.0944]	0.0474*** (0.0105) [0.0215]	0.2129*** (0.0145) [0.0967]	0.0482*** (0.0105) [0.0219]
Demographic controls	Yes	Yes	Yes	Yes
State-level controls	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Monthly FE	Yes	Yes	Yes	Yes
Yearly FE	Yes	Yes	Yes	Yes
Observations	118,314	118,314	118,314	118,314
R-squared	0.0841	0.0142	0.0842	0.0144
Number of Individuals		14,950		14,950

**Notes:** See notes to Table 4.2.

**Table A4.10 Baseline and 2SLS results, using average monthly temperature as an additional control variable**

Variables	Baseline		2SLS	
	Pooled OLS	Panel FE	Pooled OLS	Panel FE
Petrol price	-0.0863*** (0.0386) [-0.0091]	-0.1101*** (0.0414) [-0.0065]	-0.2339*** (0.0616) (-0.0247)]	-0.1600*** (0.0521) (-0.0160]
Temperature	-0.0047** (0.0024) [-0.0135]	-0.0034* (0.0020) [-0.0096]	-0.0033 (0.0024) [-0.0093]	-0.0029 (0.0020) [-0.0083]
Demographic controls	Yes	Yes	Yes	Yes
State-level controls	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Monthly FE	Yes	Yes	Yes	Yes
Yearly FE	Yes	Yes	Yes	Yes
Observations	118,342	118,342	118,342	118,342
R-squared	0.0843	0.0142	0.0842	0.0143
Number of Individuals		14,953		14,953

**Notes:** Temperature is variable capturing average monthly temperature at the city level. For other details, see notes to Table 4.2.

## **CHAPTER 5**

## **CONCLUSION**

There is now a rapidly growing literature in economics investigating what influences wellbeing and the challenges that these empirical findings pose for policy. In the last decade, the advancement in data gathering, advanced statistical techniques and increased computing power has led to significant increases in the study of the correlates with SWB. Despite the growing popularity of wellbeing measures in the academic and policy debate, significant gaps remain in the literature. Advancing the understanding on the dynamics and determinants of SWB was my focus in this dissertation with three papers on SWB.

The first paper of this dissertation focussed on the effect of one of the important objectives for many people in their life, that is to own one's home. The focus in this paper was on the effect of parental homeownership status on the SWB of children. In presenting the first study to examine in depth the relationship between homeownership and SWB of children, I find that parental homeownership status has a positive and significant effect on the SWB of their children using longitudinal data from China. Using different model specifications and addressing endogeneity of homeownership, the welfare effects of homeownership on children remain robust. Given rising homeownership rates in China, this finding suggests that government policies should promote full homeownership with residential property rights over renting in order to realize higher SWB of children. This result also calls for greater regulation of the real estate market in urban China and policies to remove discrimination in the housing market, to ensure that the benefits of homeownership are not illegally denied to minority children. The findings are important for parents wanting to improve the SWB of their children. They suggest that homeownership provides an important antecedent to doing this.

Further results from the mediation analysis finds that parental inputs into their children's education, investment in home maintenance, the quality of the neighbourhood and parents' emotional support for their children are important pathways that enhance the child's SWB. This analysis suggests that government policies to invest in improving the quality of neighbourhoods and to invest in better-quality non-owner-occupied housing might enhance these pathways that would bring about similar positive effects to homeownership per se. While these findings are informative, future research should expand on this work by examining the relationship

between homeownership and SWB of children in other countries, perhaps where homeownership rates are lower. Other directions for future research include examining various heterogeneous effects of homeownership on SWB of children or examining the relationship between homeownership and objective outcomes of children, such as performance in school, for which there are few studies. There is also potential scope in the future to explore the role of various different housing characteristics, such as neighbourhood conditions, dwelling size, sanitation and internet connections as moderators or mediators of the relationship between homeownership and child outcomes. This would provide a richer framework for designing appropriately targeted homeownership policies.

In the second paper of this thesis, I examined the issue of rising global wealth inequality, inspired by the work of Piketty (2014). Given rising homeownership rates in China, as discussed in the first paper, China represented an ideal case to study the effects of rising housing wealth inequality on individual wellbeing. In presenting the first in-depth study on how housing wealth and inequality in housing wealth is associated with happiness, either for China or other countries, I find that housing wealth is positively associated with happiness in urban China and that this is particularly true for the in-group comparison and when city is the reference point. I find that a general increase in housing wealth inequality at the province level lowers happiness. I explain this result by arguing that there exists a jealousy effect as individuals are unable to relate to those at the top end of the distribution and, hence, feel unable to replicate their success. On the contrary, I find that an increase in housing wealth inequality within a narrowly defined reference group – those of the same gender, similar age and education living in the same city – up to a certain point increases happiness. This represents a signalling effect, in which individuals feel empowered by the success of others with very similar characteristics to them and, as a result, feel that they are well placed to replicate their success. Nonetheless, beyond a certain point this ceases to be the case because the success of those at the top end of the distribution appears out of reach. In additional analysis, I also find that there are diminishing returns to happiness from owning more than one house.

An important policy implication of findings from the second paper is that the government should take steps to reduce general inequality in housing wealth and to

create more opportunities for those without housing wealth to build at least modest levels of housing wealth. I suggest, in the context of Chinese economy, that this can be done by the government taking steps to subsidise low-income housing and possibly by introducing economy wide fixed asset taxes to curb housing wealth at the top of the distribution. These interventions have the potential to reduce housing wealth inequality in order to make happy communities.

In the third paper of this dissertation, I examined the effect of petrol prices and its volatility on individual SWB. Using the HILDA dataset for Australia, I find that there is significant adverse effects of petrol prices and its volatility on individual SWB. These findings remained robust to a number of checks for endogeneity, employing alternative definitions of wellbeing and to the use of alternative datasets and fuel prices at alternative frequencies.

Mediation analysis showed that maintaining social networks is an important channel through which petrol prices affect SWB. Given Australia's heavy reliance on cars for travel, the findings from this paper has important policy implications. To mitigate the negative consequences of petrol prices on wellbeing, my results suggest the need for increased government investment in public transport services, safe cycling, and walking infrastructure and for subsidies to promote alternatives to fuel cars. With improved options, these would provide alternatives to travel by car and reduce the sensitivity of individual SWB to petrol prices.

Research into the dynamics and determinants of SWB is growing rapidly. Given the increasing relevance of using wellbeing measures in public policy, there is increasing interest in knowing which factors cause happiness and the channels through which this occurs, along with ways to achieve optimal levels of happiness for individuals and societies. This dissertation contributes to furthering efforts in understanding the dynamics of SWB.