ESSAYS ON POPULATION ECONOMICS, THE ECONOMICS OF POPULATION AGING AND HEALTH ECONOMICS

ESSAYS ON POPULATION ECONOMICS, THE ECONOMICS OF POPULATION AGING AND HEALTH ECONOMICS

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Lay Abstract

In Chapter 1, Prof. Michel Grignon and I investigate the relationship between the interprovincial migration of physicians within Canada and different tax rules across Canadian provinces. These changes can substantially increase the income of physicians and we found that the net migration of physicians (entrants minus exits) increased after the rule changes were implemented. Chapter 2 details the costs and benefits of the Covid-19 lockdowns/restrictions put in place by the Canadian government and estimates how these vary across the electorate. According to my estimates, for the majority of voting age Canadians the benefits of the lockdowns exceeded costs. Finally, in Chapter 3 I estimate the relationship between the median age of households and the share of consumption these households spend on services. Consumer preferences evolve as people age. The supply side of the economy will adapt to these changes as well which may have consequences for long term economic growth.

Abstract

The three chapters of this dissertation analyze topics within the realm of population economics, the economics of population aging and health economics.

Chapter 1: Between 1990 and 2019 Manitoba, Newfoundland and Labrador, Nova Scotia, Ontario, Quebec, and Saskatchewan passed or amended legislation allowing physicians to split income with family members via Canadian-Controlled Private Corporations; three provinces (Alberta, British Columbia and New Brunswick) allowed for this before 1990 (we exclude Prince Edward Island and the three territories). For some, there are large financial benefits from income splitting which can exceed $50,000 CAD per year. We use a difference-in-differences model to estimate the effect of not allowing physicians to split income on the net interprovincial migration of physicians to provinces that enacted income splitting rules after 1990. The annual net migration flow to these provinces increases on average by 21% lower when they allow for income splitting compared to when they did not. This equates to nearly 0.3% of the average physician workforce per year. Our results have implications for economic policy and provide information about the utility functions of physicians: it is suboptimal if Canadian provinces design legislation/policy with the intention of poaching physicians from one another; and physicians impose a large cost onto their former healthcare systems and patients when they migrate. Presumably, for those who move as a result of the policy (the increase in the flow), the utility derived from income splitting's financial benefit outweighs the value of such costs in the physicians' utility function.

Chapter 2: I contribute to the political economy and cost-benefit analysis literatures pertaining to Covid-19 public health measures (PHMs). Specifically, I address how individuals' net-

present-value (NPV) of these policies varies with age across the Canadian population, and how that variation influences the political economy of the PHMs. Deaths per 100k persons from Covid-19 vary markedly across jurisdictions within the USA and Canada, as well as between these two countries. The USA had nearly three times more deaths per capita than Canada – partially due to stricter and better respected PHMs in most Canadian provinces than in most American states. Significant economic costs are associated with these PHMs; and a broad body of literature exists to measure the macro and microeconomic implications of these policies. It is also clear that mortality due to Covid-19 strongly depends on age. Bergstrom and Hartman's (2008) framework, which employs population projections and lifetables to estimate the political support for public pension reform, is adapted to this context. Assuming individuals' support for PHMs depends on their expected personal NPV, then the benefits of PHMs are the expected value of life-years saved from not contracting the Covid-19 virus and the costs account for the expected lost income due to the unemployment caused by the PHMs as well as the value of forgone consumption/leisure. From an individualistic perspective, the results indicate the majority of Canadians should support the Covid-19 PHMs.

Chapter 3: I explore the possibility that population aging is contributing to slower economic growth through changes in household consumption decisions. I estimate, empirically, the relationship between the basket of goods consumed by aggregate households and their median age. Recently, Cravino, Levchenko and Rojas (2022) analyzed data from the United States and found a positive relationship between the age of households and the share of consumption they dedicate to services. Using household consumption data on 12 countries - which includes both developing and developed nations - the relationship between the fraction of household consumption attributed to services and the Old Age Dependency Ratio (OADR) is estimated. Conditional on GDP per capita, I observed that households consume a larger share of services as the population OADR increases. The additional expenditure is concentrated on hospitality and restaurants, and to a lesser extent, transportation and privately obtained health care.

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Firstly, I would like to thank Michel Grignon for his unwavering support and mentorship- without either of which I would not have been able to complete this dissertation; Arthur Sweetman enlightened me with some, but not all, of the invaluable knowledge and wisdom he has accumulated throughout his career as an academic economist; and Young Ki Shin never once declined to assist me with my research no matter how large or small the request.

Other faculty members deserve recognition for their contributions to my accomplishments: Michael Veall was kind enough to support me financially through the Productivity Partnership Grant while also helping with the development of Chapters 1 and 2. Professor Chris Muris assisted with the empirical analysis of Chapter 1. Professors Bettina Bruggeman, Johnathan Zhang and Bradley Ruffle coached me on my job market pitch. Finally, Prof. Seungjin Han essentially supervised me through the first two years of my studies at McMaster University.

My classmates are an amazing group of people who worked with each other, resisting the pressure to bitterly compete against one another. Alex Sam, and his wife Gifty, welcomed me into their home on numerous occasions to break bread. Rabiul Islam and Farzana Alamgir never hesitated to collaborate with me on coursework or research. Andrew Leal read an early draft of the manuscript for Chapter 2 and offered his insightful comments. Thomas Palmer was always there when I need him.

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This work is dedicated to the loving memory of my departed friend Adriel Shworob.

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Declaration of Academic Achievement

Chapter 1 of this dissertation began as a term paper and was then submitted to the 2021 Justice Emmet Hall Essay Contest-which it subsequently won. It has since been heavily revised and is now coauthored with my supervisor Michel Grignon. Chapters 2 and 3 are the result of my individual research and writing – though both have benefitted greatly from comments and suggestions made by third-parties. The remaining sections of this dissertation are the result of my individual effort and did not benefit from any external support (be that human or an automated AI chat system, such as Chat GTP).

Introduction

Health Economics, broadly defined, analyzes the behaviours and interactions of a variety of entities and individuals, from both the aggregate and microeconomic perspectives. These entities include: healthcare systems; the individual public and private sector institutions which makeup these systems; the, publicly and privately employed, individuals administering these institutions; the individuals delivering the healthcare (physicians, surgeons, pharmacists, nurses, medical researchers, medical technicians, and other types of support staff); and, of course, the individuals consuming the healthcare provided by the health and healthcare systems (patients) as well as the numerous explicit and implicit decisions these individuals make which affect their health- the decisions being made both within and without the health system. Questions addressed within this field of research include the production and distribution of resources (both internally and externally produced) that are used within the aggregate health systems; the efficacy of said systems and institutions at providing health care and how the structure of the system/institutions influences the behaviour of health care providers and patients alike.

Much attention in Health Economics has been allocated to the supply of physicians practicing in each of the Canadian provinces – with less attention to the Territories. This topic is of importance because health and health care systems need physicians to administer care, yet many Canadian provinces struggle to maintain a stable supply thereof. Specifically, Manitoba, Newfoundland and Labrador, Nova Scotia and Saskatchewan are the traditional source provinces of Canada, meaning they experience a large annual net outflow of physicians migrating within Canada while British Columbia, Alberta and Ontario are the primary recipients of the migratory physicians. There is a body of literature on this topic which is thoroughly discussed in the literature review section of Chapter 1 (see Grant and Oertel (1997), Benarroch and Grant (2004), Basu and Rajbhandry (2006a and 2006b) and McDonald and Worswick (2012)). Chapter 1 has been submitted for peer review and presented internally at McMaster University. Chapter 2 has been presented at McMaster University, the 2022 Canadian Economics Association Conference and the 2022 Consortium of Data Driven Decision Making keynote address at McGill University.

Chapter 1, coauthored with Professor Michel Grignon, seeks to establish a causal link between the provincial tax rules regarding physician owned private corporations and the interprovincial migration of physicians within Canada. Prior to 1990 several provinces allowed physicians to designate their privately owned practices as Canadian Controlled Private Corporations (CCPCs), and one by one the remaining provinces that did not allow for this changed their rules to allow for it. There is a large financial incentive for some physicians to incorporate: income splitting. This entails shifting income from one family member to another, from a higher tax bracket to a lower one, thus increasing the after-tax income of the household. Financially speaking, provinces that allow for incorporation are more attractive destinations for migratory physicians who can take advantage of the income splitting rules than provinces that do not. Since there are provinces that allowed physicians to incorporate for the entirety of the sample period and provinces that changed their rules between 1990 and 2019, we are able to estimate a difference-in-differences model (DiD) to determine the effect of restricting physicians' ability to incorporate on the interprovincial migration of physicians to provinces that changed the incorporation rules to allow the establishment of physician owned CCPCs. Our results indicate that the annual net interprovincial migration, defined as entrants minus exits, was 21% lower than the national average over our sample period when provinces did not allow for incorporation compared to when they did. This equates to roughly 0.3% of the physician workforce forgone per annum. The results of Chapter 1 illuminate the fragility of Canada's national healthcare system- which can be impacted by seemingly innocuous provincial tax rules- and the motivations of physicians- many of whom knowingly left provinces which struggle to retain physicians and probably did so for pecuniary reasons.

Chapter 2 and Chapter 3 of this dissertation fall within the domain of Population Economics. Population Economics was at the forefront of 18th century Economics and could be considered a cornerstone of the discipline, along with political philosophy. Reverend Thomas Robert Malthus's 1798 ***Essays on the Principles of Population*** – which postdates Adam Smith's ***The Wealth of Nations*** by 22 years - laid the foundation for generations of research on Population Economics. Ironically, Reverend Malthus and his contemporaries were concerned with the problem of overpopulation, fearing that the population will increase in direct proportion to output, consuming away any additional surplus created by innovations in productive capacity. Whereas underpopulation in the developed world, and more specifically, population aging is the new topic of interest and debate amongst population economists.

The Great Demographic Transition, the contemporaneous decline in birth rates towards, or below, replacement levels and the secular increase in life expectancy, has substantially reduced the support ratio (ratio of working age adults 15 – 64 per persons aged 65 +) to historically low levels. This is a global phenomenon which countries experience as they develop economically (Lee, 2002). There is debate regarding the net effect of the decreasing support ratios on economic growth and prosperity. Optimists argue the economy can adapt to the decreased support ratio while maintaining living standards and normal levels of economic growth. The contrarians argue that the nominal decline and aging of the workforce, plus the increase in the relative size of the elderly population, will dominate any reforms implemented to offset these developments and ultimately reduce societal welfare and future growth rates. This dissertation does not attempt to determine what the net effect of population aging on the global economy will be. Instead, Chapter 2 explores the political economy aspect of population aging by introducing a framework for estimating, by age, the individual costs and benefits of Covid-19 public health measures and Chapter 3 investigates the relationship between population aging and the consumption choices of aggregate households.

Chapter 2 is titled the Political Economy of Covid-19 Public Health Measures because these measures had a disparate effect on younger Canadians compared to older Canadians and so did the Covid-19 virus (before vaccination, it was life threatening to the elderly but statistically inconsequential to younger Canadians and even with full vaccination, it can still be serious for older individuals). The latter (effect of Covid-19 on mortality) is happenstance, as not all viruses hit the elderly more than the young (the Spanish Flu was more lethal to the young than the old), while the former (public health measures) is due to a combination of necessity and choice. Necessity because the government had to minimize the spread of the Covid-19 virus by limiting in-person interactions; and choice because there was not, nor is there not, an obvious method to optimally do so. Certain methods are, however, more palatable to the voting age population than others. Thus, when faced with the choice of imposing restrictions unto younger Canadians to whom Covid-19 is very low-risk, in order to protect the high-risk elderly, the age distribution of the electorate was surely taken into consideration- albeit a Machiavellian one. Chapter 2 estimates how the impact of the Covid-19 related public health measures varies across voting age Canadian. It was found that for very young Canadians, under 30 years old, the costs of the measures exceeded the benefits, and for the remainder of the voting age population the benefits exceeded the costs. The Canadian Emergency Response Benefit (CERB) was very generous to those most impacted by the measures and disproportionately claimed by younger Canadians –

who were most likely to be unemployed after restrictions were introduced. The CERB could be perceived as a compensating differential paid to the young in exchange for their compliance to the public health measures which ultimately did not benefit them, from a selfish perspective.

Chapter 3 contributes to the debate over the economic implications of population aging by establishing an empirical connection between aggregate demand and the median age of the population. This was accomplished through the use of panel data from 12 countries, at different stages of economic development, to estimate the statistical relationship between the Old Age Dependency Ratio (OADR) and the share of aggregate household consumption that is dedicated to various goods and services classifications. The intuition is that aggregate demand will skew towards services as households age and the relative size of the service sector will then increase as a result. This may be one of the channels through which population aging will affect economic growth. Historically speaking, productivity growth is slower in the service industry than other sectors of the economy (Clarke, 2016) and an inverted U-shaped relationship has been observed between the concentration of R&D investments allocated to the service industry and real GDP growth (Kim, 2020). There is evidence that households in the USA spend an increasing share of their consumption on services (Cravino, Levchenko and Rojas, 2022). The results of Chapter 3 corroborate the findings of the latter and suggest that that the trend may be true for the broader set of countries analyzed within that chapter.

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Chapter 1 Income Splitting and Interprovincial Migration of Physicians in Canada

1.1 Introduction

Canada is a federation and its constitution states that health care is a provincial jurisdiction. As a result, health care is funded and delivered differently across Canadian provinces. Importantly for this study, physicians can be compensated differently (in level as well as structure) in different provinces. Moreover, even though the training of physicians is the responsibility of provincially-funded and administered medical schools, licensing is largely portable and practicing physicians are not bound to their province of residence in the same manner as lawyers: law students are trained to pass the bar in their respected provinces, whereas medical students are accredited by provincial medical colleges and these accreditations are more easily transferred between jurisdictions. Therefore, beyond the costs incurred by successfully obtaining employment and moving to a different province, there is little in the way of physicians who wish to migrate interprovincially.

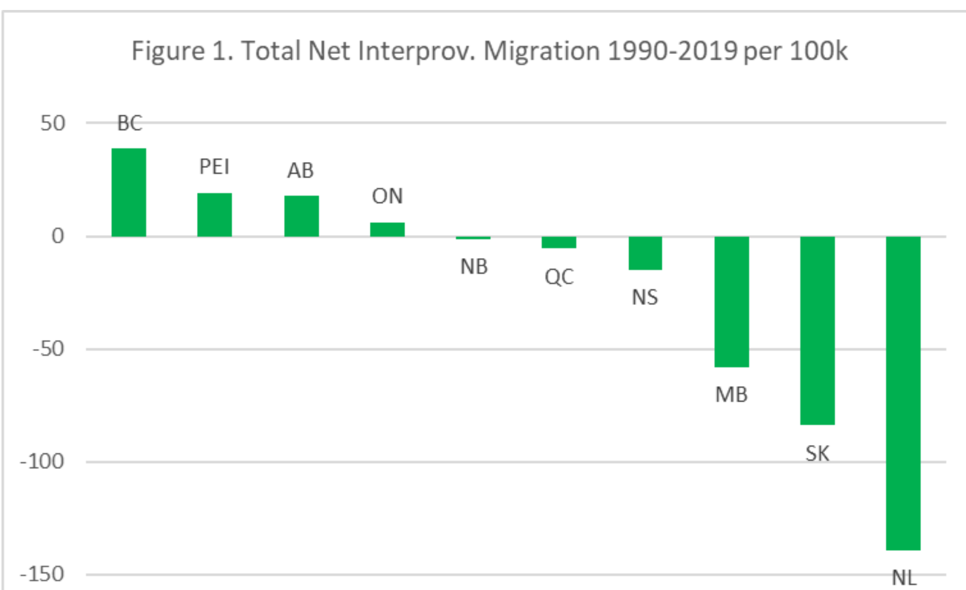

Figure 1. Total Net Interprov. Migration 1990-2019 per 100k

It is clear that physicians do indeed move across provinces. Figure 1 is constructed using data between 1990 and 2019 from the Scott's Medical Database (SMDB) which is provided by the Canadian Institute for Health Information (CIHI). The SMDB contains information on the net interprovincial migration of physicians to and from each province. For example, in any given year the net migration to Ontario is the number of practicing physicians who leave one province and enter Ontario minus the number of physicians who leave Ontario to practice in another Canadian province (residency students who leave the province of their residency to practice in another province are excluded from this measure). In Figure 1, we report these flows as the total net migration over the period (30 years) per 100,000 population. In the figure, as well as in the rest of the paper, we do not include the flows of international migration (foreign-based physicians coming to Canada or Canadian-based physicians leaving for another country). Between 1990 and 2019 (inclusive) total international migration has been roughly 36% of interprovincial migration. We also exclude the territories from our analysis, mostly because their very small populations means that migration rates are extremely volatile and also because none of them hosts a medical school.

There is a clear divide across the provinces: British Columbia (BC), Alberta (AB), Prince Edward Island (PEI) and Ontario (ON) are destination provinces on average over the period (and most the time, not shown on the figure but clear in the data) while New Brunswick (NB), Quebec (QC), and Nova Scotia (NS) are close to neutrality (they lost less than 10 physicians per year per 100,000 inhabitants between 1990 and 2019), and Manitoba (MB), Saskatchewan (SK) and Newfoundland and Labrador (NL), are source provinces. PEI is a special case: not only is it much smaller than any other province, it does not train physicians and therefore has a mechanically stronger inflow of physicians than outflow. In the remainder of the analysis, we drop PEI and therefore focus on nine provinces only. The relatively large migration rates of physicians out of MB, SK, and NL to the rest of Canada as well as the attractiveness of BC, AB and ON are well documented phenomena, see Grant and Oertel (1997), Benarroch and Grant (2004), Basu and Rajbhandry (2006a and 2006b) and McDonald and Worswick (2012).

The loss of physicians from these source provinces can be problematic because physicians are perceived as a scarce resource in Canada; whether there is a shortage or not is hard to tell, but it is true that there are fewer physicians per population in Canada than in most OECD countries (OECD health database). Moreover, the general public has become sensitive to the issue. In NS a Liberal provincial government that had received good grades for its management of the Covid19 pandemic was defeated in 2021 after a campaign that revolved mostly around the issue of physician retention and attraction (Tutton, 2018).

The conventional approach to explain the interprovincial migration of physicians in Canada is to analyze discrepancies between the economies and healthcare systems thereof Benarroch and Grant (2004) or study the personal characteristics of migrating physicians to see who moves and where Basu and Rajbhandry (2006a and 2006b) and McDonald and Worswick (2012). We use the insights developed by the aforementioned literature and exploit differences in the provincial tax legislation and rules regarding physician owned Canadian-Controlled Private Corporations (CCPCs) to make a novel contribution to the understanding of the interprovincial migration trends of Canadian physicians. Specifically, we are interested in the effect of after-tax income on the decision to relocate: for the same before tax income, provincial tax legislation can make a substantial difference on the after-tax, disposable income of physicians. We want to explore the effect that these differences in tax rules can have on the migration flows of physicians across provinces. This is of interest from a health policy perspective, as that would suggest ways to avoid the race to the bottom and better coordinate human health resources policies across provinces. Moreover, understanding the role of net income in the decision to migrate can shed light on a core and disputed issue of health economics: how much weight do physicians put on the well-being of their patients versus their own income? When a practicing physician leaves a province, they leave behind patients who have invested in them and their patient-physician relationship; for patients with chronic conditions, switching physicians induces a real cost in quality of care. Therefore, the decision to leave to increase their income comes at a cost to their current patients.

Provincial tax legislation can influence after-tax incomes of physicians in many different ways, including actual tax rates for the provincial share of income tax (that provinces are free to set), but here we focus on a non-strictly fiscal mechanism that affects both federal and provincial income tax: the ability to privately incorporate a practice and distribute dividends to family members. The legal classification of private medical practices is determined by Canadian provincial legislatures, not the federal government. Prior to 1990 three provinces, BC, AB, and NB, allowed physicians to register their private practices as Canadian-Controlled Private Corporations (CCPCs), while the remaining six did not. Between 1990 and 2019 one by one these provinces passed legislation allowing for physicians to incorporate their practices: NS in 1995; MB in 1999; SK in 2000; NL in 2001; ON in 2005 and QC in 2011 (the law was enacted in 2007 in QC but it took four years for it to be implemented in the code of professions of the province, the only province with such a delay between enactment and implementation; we take this into account by running two versions of the model, one with QC changing rules in 2011 and one with QC changing rules in 2007, finding similar results). Establishing CCPCs has significant financial benefits, for every type of establishment not just private physician practices. Of course, provinces did many other things during those years to alter the legal framework under which physicians and their practices were treated fiscally, but allowing physicians to incorporate their practice was the change with the greatest implication on physicians' net income by far and was eventually implemented by all of the provinces, whereas other minor changes may have been unique to one or a minority of provinces.

The primary benefit of CCPCs is within household income splitting; the other benefits of registering as a CCPC will be discussed in Section 2 (Background section). Income splitting is the transfer of income from a higher earning family member with a high marginal tax rate to a lower earning family member (often zero earnings one) with a low or even 0 marginal tax rate, thereby reducing the annual tax payments of the household as a whole. The annual savings from income splitting can be as high as $50,000 per year (for a physician with a spouse who is not working and two children) and has been estimated to be between $12,000 and $18,000 per year on average in the post-"Kiddie tax" era Nielsen and Sweetman (2018). A single person without a family cannot split income, yet, as we will outline in Section 2, they can still benefit from incorporating. While a married person whose spouse earns less than they do, and/or who has adult children, can split income between all members of their household, thus drastically lowering their annual tax liabilities. Assuming that income splitting is allowed indefinitely, after-tax lifetime earnings for physicians that can take advantage of incorporating is substantially higher than it would be if they practiced in a province that does not allow for incorporation. The difference can be in the hundreds of thousands of dollars. Naturally, from a financial perspective, provinces which allow physicians to incorporate are more attractive regions to practice in than those which do not.

Public data on migrations of physicians from the SMDB was supplemented with non-publicly available data provided by CIHI on annual net interprovincial migrations of male and female physicians (separately) for each province for the same years. The public access data do not contain information at the level of gender, and certain years are missing observations (which CIHI was able to provide to us). Using the difference-in-difference framework we estimate the effect of not allowing physicians to register their private practices as CCPCs on the net interprovincial migration of physicians to provinces that passed the incorporation laws after the year 1990. The control provinces are BC, AB, and NB, as they allowed for incorporation for the entirety of our period, while the remaining provinces only did so for a portion of the time. After controlling for confounding variables (provincial tax rates, unemployment rates, healthcare expenditure per capita, expenditure on physicians per physician, and the provincial house price index as a proxy for cost of living), we estimate that annual per capita net in-migration rates for our treated provinces are approximately 21% lower when they did not allow for physicians to incorporate their private practices compared to when they did. This equates to nearly 0.3% of the physician workforce forgone per annum – which may sound innocuous, but for provinces such as ON and QC that did not allow for incorporation until the mid 2000's their total losses are near 3% of their total physician workforce. We abstain from estimating the direct impact of lower migration rates on provincial healthcare systems or patients, while outlining briefly what these may be in the discussion section. Within that section we also explore the implications for the utility functions of physicians – which balance personal wellbeing with that of their patients. Though we remain agnostic with respect to the legislation and rule changes that allowed physicians to split income via CCPCs, as the purpose of this paper is to estimate how these changes influence the interprovincial migration of physicians in Canada, our general impression of said changes are negative. In the long run neither provinces nor the federal health system will benefit from the former enacting legislation or rule changes that attempt to steal physicians from the rest of Canada.

The remainder of this paper is organized as follows: Section 2 is the background section where we discuss the specifics of CCPCs and the history of income splitting in Canada. Section 3 is the literature review, Section 4 outlines the data used in our analysis. Section 5 and 6 are the methodology and results sections. In Section 7 we discuss the implications of our findings.

1.2 Background

Canadian-Controlled Private Corporations

CCPCs are privately owned companies, registered to Canadian citizens and are not listed publicly in Canada or abroad. Incorporation is essentially a means to protect personal assets invested in the firm as it opens the possibility to claim bankruptcy; but it also has some fiscal benefits as it allows owners to smooth revenue over time to minimize tax payments as well as to minimize inheritance and capital gains tax.

Another tax implication of incorporating a firm, which is what interests us here, is known as income splitting. Income splitting can be done outside of incorporation, by paying income to family members for ‘services provided’; but it is much easier to pay dividends to household members, as this only requires a family member to own shares in the CCPC. The dividends received need not be proportionate to the value or shares owned. Shares in the CCPC can be purchased for as little as $1 and then receive dividend payments of any value agreed upon by the owners of the CCPC. This allows for dividend sprinkling: each year the CCPC can pay out dividends to shareholders so that their tax liabilities are minimized, distributing more dividends to household members with lower marginal tax rates and, more importantly, less to household members with higher marginal tax rates. Thus, converting income into dividends allows to spread income across household members and lower the average income tax rate of the household. Until 2000, children under the age of 18 could own shares in the CCPC and receive dividends and income that was taxed in accordance with their marginal tax rates. The federal "Kiddie Tax" provision to the 1999 federal budget Dept. of Finance, Budget Plan (1999) changed the rules so that children had to pay the highest federal tax rate on income and dividend payments received from a CCPC. Households could still benefit from income splitting among adults.

Unsurprisingly, after the implementation of the "Kiddie Tax" amendment there was a substantial decrease in dividend payments made to those aged 19 and under. Total payments received by that age group declined by 86%, compared to the pre–"Kiddie Tax" years (Bauer, Macnaughtan and Sen, 2015). Other confounding variables such as population changes were insufficient to explain the decline in payments and there was no such decline in the value of dividends paid to persons aged 20 and over. Bauer, Macnaughtan and Sen (2015) concluded that these dividend payments were indeed distributed to split income and reduce tax liabilities of households.

In late 2017, the federal government implemented several amendments to the present rules for Tax on Split Income (TOSI), including extending the "Kiddie Tax" to those aged 25 and under; and limiting the types of income paid by CCPC that are exempt from being taxed at the highest tax rate (Budget Implementation Act, 2018). This essentially made income splitting much less attractive from a fiscal perspective. The introduction of the 'Kiddie Tax' during our treatment period is believed to bias our estimate of *NoSplit* downward. The reasoning is that before the ‘Kiddie Tax’, 1990-99, the financial benefits from incorporation are higher, thus the effect of allowing physicians to incorporate is expected to be higher during this period as well. Post ‘Kiddie Tax’ the financial benefits are still substantial but less than they previously were. So, for provinces such as ON and QC – which did not allow for incorporation for 4 and 11 years after the ‘Kiddie Tax’, respectively- we are averaging the treatment effect over those two eras. In a different world where the ‘Kiddie Tax’ was never enacted theory suggests the estimate of *NoSplit* would be larger than what we observed, ceteris paribus.

Income Splitting in Canada

The concept of income splitting, at the federal level, was first suggested by Kenneth Carter in the 1966 Royal Commission on Taxation (Macdonald, 2006). The commission concluded that the system in place at that time was comprised of loopholes that high-income households could use to lower annual tax payments, and that lower income households were paying a disproportionate amount of taxes compared to higher earning households. One suggestion to make income tax more egalitarian was to tax income of the household rather than that of the individual. It was seen as egalitarian across family types, mostly dual earner versus single earner couples. Under individual taxation, the latter pays more tax than the former for the same level of household income. Krzepkowski and Mintz (2013) argued that income splitting would allow stay-at-home parents with children to be compensated for their contribution to society, which is not fully recognized under individual taxation.

Of course, not everybody agrees on the social benefit or ethical justification of taxation at the household level or income splitting. For instance, simulations conducted by Laurin and Kesselman (2011) have shown that a plausible version of such a scheme would disproportionately benefit high income households and would also come at a large fiscal cost (or, if it were to be done at constant fiscal revenue, it would cost low income households to benefit high income ones): according to their simulations, 85% of households would gain nothing at all and 40% of the gains would accrue to households earning $125,000 or more. The fiscal cost would amount to $2.7 billion per annum.

In 2014 the Conservative government introduced their "Family Tax Cut" which allowed families to transfer up to $50,000 within the household and receive a non-refundable tax credit worth $2000 (Canada Revenue Agency Archives, 2015). This policy was reversed by the federal Liberal government in 2016 (Canada Revenue Agency Archives, 2016). Prior to the change in 2014, Canada never formally introduced joint household taxation of employment income, and the only option was therefore income splitting and dividend sprinkling via CCPC – which is exclusive to professionals able to establish such entities.

There are differences between provincial income taxes in Canada. QC has the highest income tax rates and BC, AB and ON have the lowest. The remaining provinces are clumped above the latter three provinces and below the former. There have not been drastic changes in mean effective income tax rate paid by the 85^{th}-95^{th} income percentile of households for any of the provinces from 1992-2018 (see Figure 2, in Appendices A6).

1.3 Relevant Literature

The supply and geographic distribution of physicians in Canada has been studied extensively, in part because Canada is one of the OECD countries with the lowest number of physicians per population. Grant and Oertel (1997) highlighted the ability of immigrant physicians to meet the shortfall of physicians during the 1990's. They also detailed the migration patterns of physicians interprovincially and to the US between 1970 and 1995. They found that ON and BC were generally destination provinces, while MB, SK, and the Atlantic provinces (NB, NL, NS and PEI) were the primary sources of migrating physicians. QC did experience an outflow, but in smaller magnitude than MB/SK and the Atlantic provinces, probably due to language barriers. AB, on the other hand, was initially a destination province, however, in the 90's the Klein government introduced large cuts to healthcare expenditure that led to a massive out flow of physicians. Overall, Grant and Oertel (1997) argued that real income differences between provinces and the migration rates were strongly correlated.

Bennarroch and Grant (2004) further investigated the role of income in determining physician interprovincial migration from 1976 to 1992. Their results indicate that income differential between provinces is an important determinant of migration, but so are the quality of health care provided in the province (proxied as the number of hospital beds per capita) and payment schemes. They found that the provinces with higher fee-for-service rates and expenditure per physician also had the higher net in-migration rates of any province. To measure quality of care, they used number of hospital beds and provincial expenditure per person, each of which were positively correlated with the inflow of physicians. Demographics mattered too, the ratio of rural to urban populations (rural population per urban), was negatively correlated with net migration flows and so was the average distance between major cities.

Worswick and MacDonald (2012) researched the movement of immigrant (born and trained outside of Canada) physicians between provinces and found that rural physicians are most likely to migrate, moving to urban areas and mostly to ON. Ryan and Steward (2007) focused on where family physicians chose to live after their residency and found that approximately 50% of them moved to a different province than the one where they completed their residency to start their practice, including ON trained physicians. On net, there was a positive inflow of physicians from residency positions to ON, while other regions, the Prairies (AB, MB, and SK) and the Atlantic faced an outflow of physicians. Rajbhandray and Basu (2006b) produced similar results: a majority of physicians preferred to stay in the province they were trained in and those who did move were most likely to chose BC or ON.

Finally, Rajbhandray and Basu (2006a) estimated the characteristics of physicians who did move. Those aged under 45 were substantially more likely to move compared to the reference group (over 45 to under 50), while those in the age category of 55 to 60 and older were less likely to move. Foreign-trained status (MD received outside of Canada or USA) mattered as well, this group was also more likely to move than non-immigrant physicians; and specialists were more mobile that generalists.

1.4 Data

a. CIHI Public Access Data

The Canadian Institute for Health Information (CIHI) publishes compilations from the Scott's Medical Database (SMDB) which contains information at the national, provincial, and regional levels on the total supply of physicians and the interprovincial migration thereof for the years 1968 to 2019.

CIHI also publishes the annual healthcare expenditure and the expenditure on physicians for each province and inflation indexes for the costs of health care services. Data for the years 1990 – 2019 were obtained. Using this information and population statistics from Statistics Canada, we calculate provincial health care expenditure per one hundred thousand persons. Expenditure on physicians is weighted by the number of physicians practicing in that province so that we have expenditure per physician - which is a rough measure of renumeration. Data on total and average fee-for-service payments is not publicly available and was obtained by request from CIHI.

The SMDB dataset is missing values for interprovincial migration from the years 2007 & 2008 for BC; 2007, 2008 and 2009 for AB and 2008 & 2009 for the rest of Canada. In addition, it does not provide data on the net migration of physicians by gender.

b. CIHI Graduate Student Data Access Program

To obtain the missing values discussed above and information at the level of gender and specialty we requested data through the Graduate Student Data Access Program (GSDAP). CIHI does not allow us to share the accessed data with those interested, however, for the purposes of replicability they will consider direct requests for the same dataset we use on a case-by-case basis. Furthermore, we have made the cleaned-public access SMBD dataset, R code and a table of the results available online for those interested in replication. Note this is a different dataset and model (missing certain annual observations and there is no information on gender), therefore the results are slightly different from what is presented in this text.

Data on the average and total fee-for-service payments made by provincial governments was accessed through the GSDAP. Information from Quebec was not available, thus we had to drop that province from the regressions when we used fee-for-service payments as an explanatory variable of net population adjusted migration flows.

c. Incorporation Laws

The information on provincial legislation regarding the classification of physician owned private practices was obtained by contacting the respective medical associations and provincial legislative libraries of BC, AB, SK, MB NS, NB, and QC via email. For the case of NL, the provincial legislatures library provided all of the necessary information. The decision to allow physicians to establish CCPCs in ON was thoroughly discussed by Michael Wolfson in a 2017 Globe and Mail article Wolfson (2017).

d. Statistics Canada

Statistics Canada tables were used to obtain annual estimates, at the provincial level, of the population and the average unemployment rates. A house-price-index (HPI) is also maintained by Statistics Canada, covering the same years as the physician migration data 1990-2019. All the aforementioned data from Statistics Canada is publicly available, the links to the specific datasets used can be found in the references section.

Statistics Canada estimates the **effective** marginal income tax rates in each province at the mean for different income percentiles. We estimated our regression models using the approximate marginal tax rates for high earners 86^{th} to 95^{th} percentile but the variable was highly insignificant and dropped from our final specifications.

The descriptive statistics are for the data in our primary analysis. There are 8 provinces, NL and PEI are excluded, which is why the mean of net interprovincial migration (entrants minus exits) by gender, specialty, province, and time NetMig(g,s,p,t) is less than zero. In the second, third, and fourth row we first pool by gender and then we report separate means for each. Rows five through eight present statistics for the absolute values of the interprovincial migration variables. It is clear men are more mobile than women. Note that men are slightly more mobile than women. U.Emp is the average unemployment rate for each province; adjHCexp is the adjusted per capita provincial expenditure on health care; adjPHYexp is the adjust per physician provincial expenditure on physicians; and House.P.Index is the provincial house price index reported by Statistics Canada.

Table 1: Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
NetMig(g,s,p,t)	1,440	−0.100	0.595	−4.390	2.018
NetMig(s,p,t)	720	−0.201	1.010	−8.091	3.066
Fem.NetMig(s,p,t)	720	−0.041	0.442	−3.701	1.497
Male.NetMig(s,p,t)	720	−0.160	0.712	−4.390	2.018
Abs[NetMig(g,s,p,t)]	1,440	0.371	0.477	0.000	4.390
Abs[NetMig(s,p,t)]	720	0.621	0.821	0.000	8.091
Abs[Fem.NetMig(s,p,t)]	720	0.284	0.342	0.000	3.701
Abs[Male.NetMig(s,p,t)]	720	0.457	0.568	0.000	4.390
U.Emp	240	7.679	2.345	3.500	14.300
adjHCexp	240	4.448	1.748	2.051	7.700
adjPHYexp	240	0.290	0.103	0.112	0.488
House.P.Index	240	75.198	22.324	32.400	108.700

1.5 Methods

The effect of allowing physicians to incorporate their private practice on the annual, population adjusted, net interprovincial migration of physicians is estimated using a difference-in-difference framework[1]. Our aggregate data, from CIHI were specified as: $Y_{g,s,p,t}$, which they calculate using the number of physicians entering ($e_{g,s,t,p}$) as well as the numbers of physicians departing ($d_{g,s,t,p}$) each province, p, in each year, t (from 1990 to 2019), and by specialty, s (general

[3] We are aware of recent developments in the Difference-in-Differences literature, specifically Callaway and Sant' Anna (2021). Due to privacy concerns CIHI does not release data on interprovincial migration by health regions, thus our dataset has a very large number of time periods (30) relative to treatment/control groups (8) which restricts us to estimating the average treatment effect across all treated units and treated years.

practitioner, medical specialist, surgeon) and gender, g (male or female). We calculated the net flow (entries minus departures) relative to the total provincial population ($P_{p,t}$):

$$y_{g,s,p,t} = \frac{Y_{g,s,p,t}}{P_{p,t}} = \frac{e_{g,s,p,t} - d_{g,s,p,t}}{P_{p,t}}$$

We employ two specifications of the same model. Equation (1), uses observations at the level of gender, specialty, province, and time, whereas equation (2) does not use the distinction between male and female physicians, collapsing the two separate series into one.[2]

$$y_{g,s,t,p} = \beta_0 + \beta_1 NoSplit_{t,p} + \beta_j X_{t,p} + \kappa_g + \lambda_s + \delta_t + \gamma_p + \epsilon_{g,s,t,p} \quad (1)$$

$$y_{s,t,p} = \beta_0 + \beta_1 NoSplit_{t,p} + \beta_j X_{t,p} + \lambda_s + \delta_t + \gamma_p + \epsilon_{s,t,p} \quad (2)$$

Equation (1) is estimated on 1,440 observations (8 provinces times 30 years times 3 specialties times 2 genders) and equation (2) on half that number. 8 provinces are used instead of 10 because PEI and NL are dropped. The former does not produce any physicians while the latter is a clear outlier (see Figure 1). Furthermore, NL is the only province in Canada to experience population decline between the years 1990-2019 (Statistics Canada Population Tables) and our results are robust to including NL (Table 9, the regression results when NL is included can be found in the appendix).

The indicator variable $NoSplitt_{t,p}$ is set to 1 when the province p in time t does not allow for income splitting via incorporation and 0 when it does allow for income splitting via incorporation. This may appear somewhat counterintuitive, as the decision to allow for incorporation (which allows physicians to split income with spouses and children) could be seen

[4] Two physicians' genders were not recorded, and they were not included when we use migration flows by gender, we do not lose any time periods for any province by omitting these unknown observations.

as the real political choice (and no incorporation as the default). However, three provinces have always allowed incorporation, making it a sort of default option, and we are interested in the effect of a province **preventing** physicians from taking advantage of income splitting. In that sense, the policy decision is truly to prevent physicians from incorporating. It must also be noted that, from an econometric perspective, the two options are equivalent (interpretations are simply in opposite directions). By choosing this definition of $NoSplit_{t,p}$ our hypothesis is that:

$$\beta_1 < 0$$

meaning that when provinces did not allow physicians to incorporate, the post-tax annual income of physicians who could potentially benefit from income splitting is lower, ceteris paribus, than it would be if they were allowed to incorporate. As a result, the province that does not allow for incorporation is less attractive, from a financial standpoint, than other provinces that do allow for incorporation. The treated years are: 1990-94 for NS, 1990-98 for MB, 1990-99 for SK, 1990-2004 for ON and 1990-2010 for QC. The remaining provinces, excluding PEI and NL, are the control provinces.

The vector of covariates $X_{t,p}$, does not contain information on specialty or gender, only province and time. The rationale for including these variables is that they might influence inter-provincial migrations and vary across provinces and over time concomitantly with the change in incorporation policy. We therefore wanted to control for the variations in known determinants of inter-provincial migrations of physicians. We included the following controls:

- The provincial unemployment rate, as an indicator of the economic health of the province (physicians are more likely to migrate to a booming province and leaving a struggling one)

- The level of provincial expenditures on physicians per physician, as a proxy for physician earnings in each province in that year (again, assuming that physicians are more likely to practice where they are better paid)
- The level of provincial expenditures on health care per 100,000 population, to control for the general quality of the health care provided in the province and the means physicians have at their disposal to practice (a proxy of working conditions and job satisfaction for physicians)
- We sought to include the marginal effective tax rate for top 15% of earners in each province was included but decided to drop it as it never reached any meaningful level of significance and the data from Statistics Canada is from 1992-2018, removing three years from our dataset.
- Finally, $\kappa_g, \lambda_s, \delta_t$ and γ_p are fixed effects for the gender g, 1 for male 0 otherwise; specialty s, family doctor, medical or surgical specialist; time t and province p. $\epsilon_{g,s,t,p}$ is our error term.

Heterogeneity by Specialty

To estimate the heterogeneity in treatment effects across specialties, family doctor, medical specialists, and surgical specialist we take equation (1) and run the regressions separately for each specialty. The models are identical except that we remove the specialty fixed effect λ_s, and in doing so sacrifice 2/3 of our observations. See equation 3 below.

$$y_{g,t,p} = \beta_0 + \beta_1 NoSplit_{g,t,p} + \beta_j X_{g,t,p} + \kappa_g + \delta_t + \gamma_p + \epsilon_{g,t,p} \quad (3)$$

Heterogeneity by Gender

To estimate heterogeneity in treatment effects across gender we introduce a binary variable for male physicians, $Male_{t,p}$ and interact it with $NoSplit_{t,p}$, thus augmenting equation (1) as shown below in equation 4. The results from this regression can be found in appendix A6.

$$y_{g,s,t,p} = \beta_0 + \beta_1 NoSplit_{t,p} + \beta_2 Male_{t,p} * NoSplit_{t,p} + \beta_j X_{t,p} + \kappa_g + \lambda_s + \delta_t + \gamma_p + \epsilon_{g,s,t,p} \quad (4)$$

Parallel Trends Assumption

Given our choice of the treatment variable (not allowing incorporation), treated provinces are treated at the beginning of the period and all provinces become not treated by the end of it. As a result, and contrary to standard practice, parallel trends have to be tested in the final period (when all provinces allow for incorporation, i.e., after 2011). To test the parallel trends assumption, we group the provinces that enacted income splitting laws after 1990 into one group, $Treated_{t,p}$ and the remaining provinces (controls) in the other. MB, ON, NS, SK and QC are in the treated group, while BC, AB, and NB are in the control group. The details of this exercise and the corresponding regression table can be found in the appendix. The results satisfy the necessary condition: when all of the provinces allow for physicians to split income using CCPC their corresponding trends of interprovincial migration are not statistically different from one another.

Anticipation and Common Support

Another necessary condition for estimating treatment effects is that individuals do not anticipate too much, otherwise behaviours are affected by the change at a time different from the time of the policy change. In our case, this means physicians would anticipate the end of the treatment (because our treatment happens first). We altered the treatment variable so that treatment ended one, two or three years before provinces passed legislation allowing physicians to incorporate their private practices. The coefficient on NoSplit is highly statistically insignificant when we do this for all three years (see appendix). This suggests that physicians did not move in anticipation of provinces allowing incorporation. On the other hand, when we extend treatment for one, two or three years the coefficient of NoSplit is significant at the 1% level for one and two years and significant at the 5% level for three years.

Intuitively these results are sensible: physician practicing in other provinces would require advanced knowledge of forthcoming legislation that allows for private incorporation of practices and also trust the legitimacy of that information. A very risky gamble since moving costs are high for physicians (they need to regain provincial licensing and, for specialists, hospital privileges, on top of standard moving expenses). It is plausible that physicians already practicing in a province which eventually allows for incorporation were aware of this information and chose to alter plans to leave the province in response, however, our results suggest this had an insignificant effect on net interprovincial migration and therefore must not have been common.

The significance of the lag treatment variable, the addition of one or two years to NoSplit, is conceivable. After the information on the newly passed incorporation legislation is disseminated there will be a brief adjustment period. Moving is quite expensive and will take several months if not a year or more to complete. This is especially true for cross-Canada migration which entails moving large geographical distances.

Finally, another condition for estimating DID is common support – sufficient overlap between the characteristics of treated and non treated units. We believe this condition is satisfied based on the diversity of both treated and control provinces. There are treated provinces from the prairies and the Atlantic's, MB, SK, and NS; and control provinces from the same regions, AB, and NB. BC , though not quite as populous as ON, does have a large, expensive, and growing metropolitan area, the Greater Vancouver Area. This compares reasonably well to the Greater Toronto Area – which is admittingly an outlier within Canada. QC is also comparable to AB and BC, though it too is somewhat of an outlier given the majority Francophone population, making migration for Francophone physicians less of an option than for anglophone physicians in the rest of Canada.

1.6 Results

Below are the results from the DiD models starting with the 4-way analysis where the dependent variable, net physician migration per 100,000 population is measured by physician gender, specialty (family physician, medical specialist, and surgical specialist), province, and year. The results with NL can be found in the appendix. The 3-way analysis, when observations by gender are added together, follows, and the final three tables present the results from the 3-way panel model when we run separate regressions for each specialty, with the dependent variable measured by gender, province, and year.

Tables 2 to 6 are organized to show what happens as we use different expenditure measures (health care expenditure or physician services expenditures and both) as controls and then account for cost of living using the provincial house price index. All models include the provincial unemployment rate as a control representing the health of the provincial economy in any given year. The coefficients of NoSplit are largest and most significant when we only account for health care expenditure but are robust to including both physician expenditure and house price index. The latter actually removes the significance of the former since higher cost of living provinces do pay higher salaries and also tend to have positive net migration. Interestingly, none of the expenditure are statistically significant when we include the house price index as a regressor.

In Table 2, on the next page, the coefficient for NoSplit ranges from -0.08 to -0.15, depending on the expenditure measures used and whether the house price index variable is included. The negative sign on NoSplit implies that in any given year when a treated province did not allow physicians to incorporate and thus split income within the household, the net per capita interprovincial migration of physicians was lower compared to when it did allow for incorporation- using the provinces that have always allowed for incorporation as the control group.

	1	2	3	4	5
NoSplit	-0.15 (0.04)***	-0.11 (0.05)*	-0.08 (0.05)$^{\circ}$	-0.09 (0.04)*	-0.09 (0.04)*
UR	-0.05 (0.02)**	-0.06 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)*	-0.04 (0.01)**
HCexp	0.09 (0.06)	0.04 (0.07)	-0.03 (0.06)		
PHYexp		1.10 (0.66)	0.25 (0.61)	0.13 (0.50)	
HPidx			0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***
Num. obs.	1440	1440	1440	1440	1440
R^2 (full model)	0.55	0.55	0.56	0.56	0.56
R^2 (proj model)	0.02	0.02	0.03	0.03	0.03
Adj. R^2 (full model)	0.53	0.53	0.53	0.53	0.53
Adj. R^2 (proj model)	-0.04	-0.04	-0.02	-0.02	-0.02
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	48	48	48	48	48

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province, Specialty and Gender. Standard errors, shown in the parenthesis, are clustered by Province, Specialty and Gender.

Table 2: 4-way Gender Specialty Province Time

In column 1, we use HCexp alone, the latter is insignificant at the 10% level of confidence and the coefficient is equal to 0.09. UR is significant at the 1% level of confidence and has a negative coefficient equal to -0.05. These results match economic intuition: all else equal, physicians should be more/less attracted to a province that has more/less resources distributed to the health care sector and lower/higher unemployment rates. The coefficient of NoSplit is -0.15 and significant at the 0.1% level of confidence.

In column 2 we keep HCexp in the model and add in PHYexp; UR is still negative and significant while the coefficient of NoSplit is now -0.11 and significant at the 5% level of confidence. Note the standard errors of NoSplit are consistently between (0.4,0.5) through columns 1 to 5, while the coefficient fluctuates more substantially. The coefficient for HCexp is no longer significant and almost 1/3rd of its original estimate. While PHYexp has a positive coefficient with a p-value equal to 0.103.

Moving to column 3 we control for annual cost of living in each province using the HPidx. Now neither HCexp or PHYexp are anywhere close to statistically significant, and both of their coefficients shrink in size compared to column 2; for HCexp columns 1 and 2. HPidx is significant at the .1% level of confidence with the coefficient equal to .01. Referring to Figure 1 in the introduction section, we can see that the provinces with positive net migration have a much higher cost of living than the provinces with negative net migration, suggesting that the housing price index is determined by population migrations rather than the other way around. BC, AB and ON experienced positive net migration between 1990-2019, while NS, MB, and SK experience substantial negative migration over the same three decades. House prices in BC, AB and ON during that time period increased at a much higher rate than they did in NS, MB, and SK. With respect to the expenditure measures, this means that provinces that were spending more on the health care sector and physicians directly were only doing so in nominal terms, and once cost of living is accounted for these additional payments had no effect on the migration flows to provinces. As for the treatment effect of allowing physicians to incorporate in a province, adjusting for cost of living reduces the coefficient from -0.11 to -0.08, while leaving the significance level below the 10% threshold (p-value is 0.069).

In columns 4 and 5 we first remove HCexp, because it is highly insignificant and then we removed PHYexp because it too is insignificant. When we do this the estimate of the average treatment effect on the treated, NoSplit, increases in absolute value from -0.08 to -0.09, and is significant at the 5% level of confidence (p-values of 0.046 and 0.017, respectively). Overall, the results in Table 2 are quite clear: Physicians appear to be responsive to the financial incentives provided by altering the rules of incorporation to allow for within-household income splitting.

	1	2	3	4	5
NoSplit	-0.31 (0.11)**	-0.21 (0.12)$^{\circ}$	-0.17 (0.10)	-0.18 (0.11)	-0.19 (0.10)$^{\circ}$
UR	-0.09 (0.04)*	-0.11 (0.05)*	-0.09 (0.04)*	-0.09 (0.04)*	-0.09 (0.04)*
HCexp	0.18 (0.12)	0.08 (0.15)	-0.06 (0.13)		
PHYexp		2.19 (1.56)	0.50 (1.40)	0.27 (1.16)	
HPidx			0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***
Num. obs.	720	720	720	720	720
R^2 (full model)	0.64	0.64	0.64	0.64	0.64
R^2 (proj model)	0.03	0.04	0.06	0.06	0.06
Adj. R^2 (full model)	0.60	0.61	0.61	0.61	0.62
Adj. R^2 (proj model)	-0.05	-0.05	-0.02	-0.02	-0.02
Num. groups: Time.	30	30	30	30	30
Num. groups: i.ProvField	24	24	24	24	24

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province and Specialty. Standard errors, shown in the parenthesis, are clustered by Province and Specialty.

Table 3: 3-way Gender Pooled

We repeat the same exercise in Table 3, above, where we are now pooling observations by gender and standard errors are clustered by specialty and province. The results do not change substantively from what we find using the 4-way panel model, the most significant differences being the reduction in our sample size by exactly ½, the mean of the dependent variable is doubled since we are adding male and female observations together (see Table 1 descriptive statistics) and consequently a slightly larger than twofold increase in our standard errors. The dependent variable is now larger in absolute value, the mean is -0.39 versus -0.19 for the 4-way panel model. The coefficients for UR, HCexp, PHYexp and HPidx have the same sign and are roughly twice as large as they are in Table 2. The same is true for NoSplit, it is just over double the value of what it is in Table 2, ranging between -0.17 to -0.31. NoSplit is below 1% statistical significance in column 1 and then oscillates between borderline significant (columns 3 at 0.123 and 4 at 0.106) and highly significant (columns 2 at 0.0770 and 5 at 0.0508). As with Table 2, PHYexp has more explanatory power than HCexp, however, neither retain any significance when we control for the cost of living.

To estimate treatment heterogeneity across specialties we run separate regressions of model 1 for family physicians, medical specialists, and surgical specialists respectively, clustering standard errors by gender and province. In doing so we are reducing our sample size to 1/3 the original, a more substantial penalty than when we pool our observations by gender. There are noticeable differences between Tables 4 - 6 and the first two. UR is still negative and significant, HCexp does not have any significance when it is the only measure of expenditure in Tables 4 and 6. PHYexp still has a positive and weakly significant coefficient in Table 4, below,

	1	2	3	4	5
NoSplit	$-0.26\ (0.09)^{**}$	$-0.19\ (0.11)$	$-0.15\ (0.09)$	$-0.17\ (0.09)^{\circ}$	$-0.17\ (0.07)^{*}$
UR	$-0.08\ (0.04)^{*}$	$-0.10\ (0.04)^{*}$	$-0.08\ (0.03)^{*}$	$-0.08\ (0.04)^{*}$	$-0.08\ (0.03)^{*}$
HCexp	0.09 (0.13)	0.01 (0.13)	-0.10 (0.12)		
PHYexp		1.68 (1.32)	0.34 (1.24)	-0.07 (1.20)	
HPidx			$0.01\ (0.00)^{**}$	$0.01\ (0.00)^{**}$	$0.01\ (0.00)^{***}$
Num. obs.	480	480	480	480	480
R^2 (full model)	0.67	0.67	0.67	0.67	0.67
R^2 (proj model)	0.03	0.04	0.06	0.06	0.06
Adj. R^2 (full model)	0.63	0.63	0.64	0.64	0.64
Adj. R^2 (proj model)	-0.07	-0.07	-0.05	-0.05	-0.04
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	16	16	16	16	16

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province and Gender. Standard errors, shown in the parenthesis, are clustered by Province and Gender.

Table 4: 3-way Family Doctors

until we account for cost of living, however in Tables 5 and 6 is far less significant compared to Tables 2 and 3.

The treatment effect for family physicians now ranges from -0.15 to -0.26. As with Tables 2 and 3 the coefficient of NoSPlit shrinks and is less significant after we control for

	1	2	3	4	5
NoSplit	−0.12 (0.08)	−0.09 (0.08)	−0.06 (0.07)	−0.04 (0.07)	−0.05 (0.06)
UR	−0.05 (0.03)°	−0.06 (0.03)	−0.04 (0.03)	−0.04 (0.03)	−0.04 (0.02)°
HCexp	0.19 (0.09)°	0.15 (0.11)	0.07 (0.09)		
PHYexp		0.82 (1.27)	−0.19 (1.06)	0.09 (0.86)	
HPidx			0.01 (0.00)*	0.01 (0.00)*	0.01 (0.00)*
Num. obs.	480	480	480	480	480
R^2 (full model)	0.29	0.29	0.30	0.30	0.30
R^2 (proj model)	0.02	0.02	0.04	0.04	0.04
Adj. R^2 (full model)	0.21	0.21	0.23	0.23	0.23
Adj. R^2 (proj model)	−0.08	−0.08	−0.07	−0.06	−0.06
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	16	16	16	16	16

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province and Gender. Standard errors, shown in the parenthesis, are clustered by Province and Gender.

Table 5: 3-way Medical Specialists

PHYexp. However, HPidx eliminates any significance of both expenditure measures and the coefficient of NoSplit increases in absolute value after we control for this variable. In column 5 the coefficient of NoSplit is again below the 5% level of significance.

As shown in Table 5, above, the model for medical specialists has generated results quite different from family physicians. The sign of UR is negative and less significant, never below the 5% level of confidence. Contrary to what we observe in Tables 1-3 PHYexp eliminates less of the significance of HCexp when it is included, and it itself does not have a significant relationship with net per capita migration flows. HPidx is positively correlated with migration flows as it was in the first three tables. As for the treatment effect, it appears to be weaker for medical specialists. The t-values of NoSplit range from 0.57 to 1.5 (the p-values are 0.414 and

0.141, respectively). This is a much wider interval than observed in the previous three regressions. Medical specialists are the least migratory of the three groups and also are most connected to hospital systems. It is less common for them to own their private practices which is required to benefit from the provincial incorporation laws. Thus, it is unsurprising they appear less responsive to the CCPC rule changes than family physicians.

Surgical specialists, the results of which are presented in Table 6, below, are somewhat of an outlier. There is a moderate treatment effect for this group- though less significant than we observe for family physicians and the covariates do not exhibit the same relationship with the dependent variable as they did the first four specifications (4-way panel, gender pooled, family physicians and medical specialists). UR has a negative sign but never dips below the 25% significance threshold and exceeds the 45% threshold in column 1. HCexp never has any significance, PHYexp is more significant than it is for medical specialists, before we control for the cost of living, and the latter does not have any significance at all. Throughout the first four regression tables HPidx was consistently significant at 5% level and in most cases significant at the 0.1% level. Migration flows of surgical specialists appear to follow their own process, quite different from medical specialists and family physicians.

	1	2	3	4	5	6
NoSplit	−0.08 (0.04)*	−0.05 (0.04)	−0.04 (0.05)	−0.06 (0.05)	−0.07 (0.04)	−0.08 (0.04)°
UR	−0.01 (0.01)	−0.02 (0.01)	−0.02 (0.01)	−0.01 (0.01)	−0.01 (0.01)	
HCexp	−0.00 (0.07)	−0.04 (0.06)	−0.05 (0.05)			
PHYexp		0.79 (0.72)	0.60 (0.53)	0.37 (0.54)		
HPidx			0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	
Num. obs.	480	480	480	480	480	480
R^2 (full model)	0.22	0.23	0.23	0.23	0.23	0.22
R^2 (proj model)	0.01	0.01	0.01	0.01	0.01	0.01
Adj. R^2 (full model)	0.14	0.14	0.14	0.14	0.14	0.14
Adj. R^2 (proj model)	−0.10	−0.10	−0.10	−0.10	−0.10	−0.10
Num. groups: Time	30	30	30	30	30	30
Num. groups: i.ProvFieldGender	16	16	16	16	16	16

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province and Gender. Standard errors, shown in the parenthesis, are clustered by Province and Gender.

Table 6: 3-way Surgical Specialists

The coefficient of NoSplit has a p-value of 0.046 in column 1, 0.374 in column 2, 0.304 in column 3, 0.28 in column 4, 0.122 in column 5 and 0.056 in column 6. We ran a sixth regression for surgical specialists that only included NoSplit and the gender, province, and time fixed effects. Though we have less confidence in these results than we do in Tables 2-4 there is still a modest treatment effect for surgical specialists. These estimates are more precise than what we observed from the medical specialist's regressions. Surgical specialists are somewhere in between medical specialists and family physicians with regards to their ability to practice income splitting: a portion of them own their practice, or are a partner in private practice, while plenty also operate within a hospital network and are then compensated directly by that institution.

Overall, separate regressions by specialty show that family physicians are the most reactive to the possibility to incorporate their practice and medical specialists are not. Surgical specialists may be somewhat reactive, but the effect is not robust to model specifications (control variables entered). It is safe to conclude that the effect of incorporation is mostly driven by the migration of family physicians. Finally, the separate regressions by gender in the appendix demonstrate that the treatment effect is not statistically different for male and female physicians.

1.7 Discussion

This empirical analysis shows there exists a substantial effect of provincial policies regarding the incorporation of physician practices on the flows of physicians across provinces: provinces that do not allow their physicians to incorporate their practice lose more or attract fewer physicians than they would if they allowed incorporation. Moreover, the effect is driven mostly by family physicians. We do not have direct evidence of the mechanism explaining the effect, but it is likely related to the financial incentives that comes from privately incorporating a practice. The ability to split income across household members, thus reducing the income tax due on the income of the practice substantially. In the pre 'Kiddie Tax' era this figure could be as high as $50,000 per annum, for a physician whose spouse is in a lower tax bracket and has children under the age of 18 who earn nothing. Post 'Kidde Tax' the tax savings are estimated to be somewhere between $12,000 - $18,000 at the mean, while still in excess of $20,000 CAD for the highest earning physicians (Nielsen and Sweetman, 2018).

Such a finding is of interest for two reasons: firstly, it has welfare and policy consequences for Canadian provinces and Canadian patients or their family; secondly, it tells us something about physicians' preferences, the extent to which some of them (there is heterogeneity in the effect) trade-off the well-being of their patients for their own financial benefit.

The welfare and policy consequences of the effect of provincial incorporation rules on physicians' decisions to relocate to another province are specific to Canada and the federal nature of its health care system. In Canada, physicians are free to move and relocate across provinces; but, at the same time, physicians training and health human resources management are provincial responsibilities. As a result, provinces must make decisions on how many physicians they will train, how much they will pay them and what work conditions they will offer, all this under the constraint that these physicians can easily vote with their feet and move to another province. Of course, this is true to some extent of any health care system, as the examples of physicians moving out of the UK at the time of the creation of the NHS, or the current exodus of physicians out of poorer countries to work in OECD countries, including Canada. The implications of these trends are clear: if physicians perceive they are not well treated or will be better treated elsewhere, some of them will leave, possibly affecting health human resources management policies and the well-being of their patients.

What makes the case of Canada unique are two things: as already mentioned, it is a federation and physicians are free to move and relocate, making inter-provincial migration much less onerous and therefore more of an option than international migration; moreover, all Canadian provinces are characterized by a low density of physicians per population, compared to other OECD health care systems. It is of course impossible to tell how many physicians there should be in a given health care system, as it depends heavily on the way the system is organized. However, it is clear that Canadian provinces have been rationing the number of physicians as a way to contain health care costs and that it translates into low densities of physician per population and perceived shortages of physicians in many areas of the country (Allin, Marchildon and Merkur, 2020). This latter characteristic is why Canada differs from other federations such as the US (where physicians shortages are less of an issue) or the European Union (where physicians migrate less across countries because of the natural language barriers that exist between member states).

Our finding is that not allowing physicians to incorporate their practice costs a province, on average, 0.3% of its physician workforce each year, which can have a sizeable impact if the province refuses to let physicians incorporate their practice for ten years. Of course, if all provinces had allowed physicians to incorporate and split income, the effect on inter-provincial migration would have been eliminated.

Not all provinces did allow incorporation, though, and this for at least two reasons: a matter of principles, first, since allowing professional, often solo practice, to incorporate for the sake of reducing their tax bill is dubious or at least disputable. For example, in the early 1990s a senior CRA official regarded the use of family trusts with professional corporations (CCPCs) as follows: "Our view is that these arrangements are extremely offensive. In fact, this is arguably the most abusive scheme which I have ever seen." (Wolfson and Legree, 2015). That all provinces would have to abandon their moral principle and align their fiscal policy with that of other provinces in order to protect their health care system can be described as a race to the bottom, which is not something a federation should be wishing for. The second reason has to do with the financial cost of incorporation: it is true that most of the cost is shouldered by the federal government, and this was a great motivation for many provinces who allowed physicians to incorporate. But it remains that income splitting is also costly to the province since it affects the taxable income on which provincial taxes are calculated. The reasoning behind allowing incorporating for most provincial governments was that it would cost them much less than a fee raise and that it could be seen as a windfall for physicians shouldered mostly by the federal budget. Physicians could be convinced to reduce their ask during a negotiation in exchange for the right to incorporate – which is what happened in ON. Because of this, a substantial proportion of physicians in provinces that went from no incorporation to incorporation benefited from a larger increase in their after-tax income than they could have extracted from a fee raise, and this caught the attention of physicians and policy makers in provinces that still did not allow incorporation, possibly because they could not afford the minimal tax cost it would mean for provincial income tax revenue. As a result, have-not provinces (NS and MB), which could not really afford to allow income splitting on their portion of the income tax, had to see some of their physicians (0.3% each year) leave to move to have provinces (B.C and Alberta) who were attracting these physicians to a relatively low fiscal cost. In a sense, the have-nots could have benefited from a greater price effect (the federal level subsidizing the policy) than the haves but the weaker tax base of the have-nots was likely to have prevented them from taking advantage of the windfall and forced them to allow more physicians to leave their health care system than would have been the case without incorporation in the have provinces. This (admittedly oversimplified) mechanism generated a "beggar thy neighbour" effect that penalized residents of poorer provinces already suffering from a perceived shortage of physicians. Estimating the welfare cost of such an effect is beyond the scope of this paper and would require heroic assumptions on the optimal level of physicians per population in the Canadian health care system, but it is clear that provincial governments and populations in the Atlantic and prairies provinces had to do with a health human resource issue that was entirely manufactured by provincial legislators making decisions in the area of corporate law. Thus far, the 2018 changes to income splitting rules in Canada have remained intact, however, any discussion of re-allowing professionals to incorporate and benefit from income splitting should keep in mind the unintended consequences regarding the provincial health care systems and their management of health human resources.

The substantial effect of rules pertaining to the income tax on the decision of physicians to migrate across provinces sheds a light on the utility function of physicians. It is a well-established idea in health economics that physicians differ from other businesses in their objective function: while a firm is supposed to maximize its profit, a doctor is supposed to maximize a utility function the arguments of which are their own consumption (hence, income) and the well-being of their patients. Evans (1984) summarized this by saying that physicians are "not-only-for-profit" and Arrow (1963) showed that physicians must convince their patients that they are not standard businesses, profit-motivated, in order to build a relationship of trust with their patients (due to the asymmetry of information, patients must trust their doctor). If the latter weighs more than the former, a doctor would not prescribe a return visit that has marginal (or even negative) effect on the patient just for the sake of increasing their income. In the opposite case, the doctor might do this, something called "supplier-induced demand." The theoretical model is sound, but the problem in health economics is that we do not really have reliable estimates of the weights physicians give to their own income versus the well-being of their patients. The present experiment allows us to shed a qualitative light on this issue and at the very least shows that some physicians (mostly family physicians and surgical specialists) care prioritize their finances, even though that can be detrimental to their patients. When a practicing doctor (this is not true to the same extent of medical residents who go to another province to set up their first practice) leaves a province, they leave behind their patients, who have invested in them and in whom they have invested (knowledge, information). Granted this may be less consequential for physicians who are members of group practices, as opposed to solo practicing physicians, since their colleagues should be somewhat familiar with their patients. The same is true for surgical and medical specialists who, generally, have less personal relationships with their patients than family physicians (the treatment effect was largest and most significant for family physicians). The move entails an obvious welfare loss for the health care system, in particular for patients with chronic conditions, who are the most vulnerable and we believe this loss in sending provinces is not necessarily compensated for by the gain of patients in receiving provinces: the loss for a patient with a chronic condition is that, switching physician as a result of the move will mean the loss of years of relationship with their former doctor and the knowledge that goes with it; in the receiving province, patients will have easier access to a physician and physicians will have more time to spend with each patient but this does not offset the loss in quality suffered by patients in the source province. Furthermore, a profound time-gap in optimal provision of care will exist between the date a physician leaves their province and when they complete their adjustment to their new province. Specifically, this gap begins when the physician leaves their patients behind and ends once they become equally familiar with their new patients – which may take years. Thus, even if the additional knowledge obtained by the migrating physician equally offsets the forgone knowledge they have abandoned, the amount of time they spend practicing optimally, with complete knowledge of their patients, has decreased and is hence a welfare loss. This is especially true in places that suffer from perceived shortages of physicians. This is not to say that physicians should never move, and they have many reasons to do so (to be closer to aging parents or because they want their children to grow up in a big city and have access to education facilities etc.), but here the reason is purely financial and allows us to qualitatively weigh own income versus patients' well-being.

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Appendices

A1.1. Parallel Trends Assumption

To test the parallel trends assumption, we group the provinces that enacted income splitting laws after 1990 into one group, $Treated_{t,p}$ and the remaining provinces (controls) in the other. MB, ON, NS, SK and QC are in the treated group, while BC, AB, and NB are in the control group. The 30-year time periods over which we have data are also grouped into six 5-year time periods, 1990-'94, '95-'99, 2000-'04, '04-'09,'10-'14 and '15-'19.

$$y_{t,p} = \beta_0 + \beta_1 \mathrm{Treated}_{t,p} + \sum_{h=2}^{6} \beta_h X_{t,p} + \sum_{i=7}^{11} \beta_i \mathrm{Time}_{t,p} + \sum_{j=12}^{16} \beta_j \mathrm{Time}_{t,p} * \mathrm{Treat}_{t,p} + \epsilon_{t,p} \quad (4)$$

We then interact the time periods with the treated group indicator variable, dropping the years 1990-1994. $X_{t,p}$ and $Time_{t,p}$ are vectors for the covariates (UR, hCexp, PHYexp and hPidx) and the time indicator variables listed above. The coefficients β_j, of the interaction term, **should not be statistically different from zero when all of the provinces allow for incorporation**. Quebec was the last province to allow for incorporation in the year 2011. This means β_{15} and β_{16} cannot be statistically different from zero. The results presented in Table 7 show that these conditions are satisfied, was also not different from zero, implying that when all the provinces allow for incorporation there is not a significant difference in migration flows between the control and treated provinces – which enables us to employ the difference-in-differences framework.

	4-way	3-way
Intercpet	0.22 (0.14)	0.43 (0.34)
UR	−0.01 (0.01)	−0.02 (0.02)
PHYexp	0.29 (0.39)	0.59 (0.93)
HCexp	−0.21 (0.04)***	−0.42 (0.10)***
HPidx	0.01 (0.00)***	0.02 (0.00)***
95-99	0.03 (0.06)	0.05 (0.15)
00-04	0.18 (0.08)*	0.36 (0.19)
05-09	0.22 (0.12)	0.44 (0.28)
10-14	0.32 (0.15)*	0.64 (0.35)
15-19	0.45 (0.17)**	0.90 (0.41)*
Treated	−0.33 (0.07)***	−0.65 (0.18)***
95-99*Treated	0.13 (0.09)	0.26 (0.22)
00-04*Treated	−0.01 (0.10)	−0.02 (0.24)
05-09*Treated	0.12 (0.09)	0.24 (0.22)
10-14*Treated	0.17 (0.09)	0.34 (0.21)
15-19*Treated	−0.02 (0.11)	−0.04 (0.28)
R^2	0.13	0.18
Adj. R^2	0.12	0.16
Num. obs.	1440	720
RMSE	0.56	0.93

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 7: Parallel Trends Test

A1.2. Lags and Leads of Treatment Variable

	1	2	3	4	5	6
UR	−0.05 (0.02)**	−0.05 (0.02)**	−0.05 (0.02)**	−0.04 (0.02)*	−0.04 (0.02)*	−0.05 (0.02)**
HCexp	0.76 (0.68)	0.65 (0.60)	0.65 (0.58)	−0.09 (0.56)	0.06 (0.53)	0.28 (0.56)
PHYexp	−0.06 (0.06)	−0.05 (0.06)	−0.04 (0.06)	−0.02 (0.06)	−0.03 (0.06)	−0.05 (0.06)
HPidx	0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***
Lag1	−0.01 (0.05)					
Lag2		−0.03 (0.05)				
Lag3			−0.04 (0.04)			
Lead1				−0.13 (0.04)**		
Lead2					−0.11 (0.03)**	
Lead3						−0.08 (0.03)*
Num. obs.	1440	1440	1440	1440	1440	1440
R^2 (full model)	0.56	0.56	0.56	0.56	0.56	0.56
R^2 (proj model)	0.03	0.03	0.03	0.04	0.04	0.03
Adj. R^2 (full model)	0.53	0.53	0.53	0.53	0.53	0.53
Adj. R^2 (proj model)	−0.03	−0.03	−0.03	−0.02	−0.02	−0.02
Num. groups: Time	30	30	30	30	30	30
Num. groups: i.ProvFieldGender	48	48	48	48	48	48

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$

Table 8: Lags and Leads of NoSplit

From column 1 to 3 we first removed one treatment year from the treat variable for all provinces, setting the 1 to a zero. This is to test for anticipation, the coefficient is insignificant and shrinks as we remove two and then three treatment years. The lag of NoSplit is much smaller in magnitude and thus it does not appear there was anticipation of the incoming changes to incorporation rules. Or if there was, a small minority of physicians were privy to such information. Columns 4-6 we do the opposite, adding one treatment year to the Treat variable for all provinces. The coefficient is significant at the 1% level in column 4 and 5 when we delay the end of treatment by one year and then two years. The treatment effect is actually larger when we delay for one and two years, it is now -0.13 then -0.11 compared to -0.08 in column 4 of Table 2. The treatment effect is expected to be persistent for years after the incorporation rules were changed. It takes time for physicians to prepare to move and realize the opportunity has been created. Furthermore, the financial benefits of income splitting will influence migratory physicians decisions years into the future not just the interim.

A1.3. Including Newfoundland and Labrador

	1	2	3	4	5
NoSplit	−0.14 (0.06)*	−0.12 (0.06)*	−0.11 (0.06)	−0.12 (0.05)*	−0.11 (0.05)*
UR	−0.03 (0.01)	−0.04 (0.02)*	−0.03 (0.02)	−0.03 (0.02)	−0.03 (0.02)
HCexp	0.06 (0.07)	0.02 (0.07)	−0.04 (0.08)		
PHYexp		0.94 (0.54)	−0.19 (0.55)	−0.31 (0.65)	
HPidx			0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***
Num. obs.	1620	1620	1620	1620	1620
R^2 (full model)	0.65	0.65	0.65	0.65	0.65
R^2 (proj model)	0.01	0.01	0.02	0.02	0.02
Adj. R^2 (full model)	0.63	0.63	0.63	0.63	0.63
Adj. R^2 (proj model)	−0.04	−0.04	−0.03	−0.03	−0.03
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	54	54	54	54	54

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 9: 4-way Including NL

Similar to the main results the point estimate of NoSplit is -0.11 or -0.14. Standard errors of NoSplit are slightly larger when we include NL. In Table 1 they are consistently estimated to be 0.04 or 0.05. In columns 1, 2 and 3 they are 0.06. Being a large outlier, it is unsurprising that NL increases the standard errors of NoSplit yet because the coefficient is actually larger in columns 4 and 5, our preferred specification of the DiD model, we feel it is justifiable to remove NL from our primary regression analysis. Seeing that NL has the largest negative outflow of physicians the treatment effect of that province could be the key determinant of our results – which is not true. Even if there were substantive changes to our estimate of NoSplit there would still be a strong argument to exclude NL, given how persistently it loses physicians each year to the rest of Canada and the fact that is population has declined over the past 30 years.

A1.4. Fee-for-Service and expenditure

	1	2	3	4	5
NoSplit	-0.17 (0.05)**	-0.15 (0.06)*	-0.10 (0.05)	-0.11 (0.05)*	-0.10 (0.05)*
UR	-0.06 (0.02)**	-0.06 (0.02)**	-0.05 (0.02)*	-0.05 (0.02)*	-0.05 (0.02)*
AvgFFS	0.00 (0.00)*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
HCexp	0.10 (0.06)	0.08 (0.07)	-0.01 (0.07)		
PHYexp		0.70 (0.75)	-0.18 (0.71)	-0.21 (0.64)	
HPidx			0.01 (0.00)**	0.01 (0.00)**	0.01 (0.00)**
Num. obs.	1260	1260	1260	1260	1260
R^2 (full model)	0.56	0.56	0.56	0.56	0.56
R^2 (proj model)	0.02	0.02	0.03	0.03	0.03
Adj. R^2 (full model)	0.53	0.53	0.54	0.54	0.54
Adj. R^2 (proj model)	-0.04	-0.04	-0.03	-0.03	-0.03
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	42	42	42	42	42

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province, Specialty and Gender. Standard errors, shown in the parenthesis, are clustered by Province, Specialty and Gender.

Table 10: 4-way FFS Excluding QC

Quebec does not report average FFS payments made to physicians annually. We have to drop this province when including that variable. However, doing so does not change our initial results and FFS does not have any explanatory power when we account for House Price Index, our proxy for cost of living. This is true in Colum 5 where both Health and Physician expenditure are excluded. In fact, the estimated coefficient of NoSplit is larger when we exclude QC. This is likely due to strong preferences over practicing medicine in French as opposed to English, since there are much fewer opportunities outside of QC compared to within.

A1.5. Separate Regressions by Gender and Gender NoSplit Interaction

	1	2	3	4	5
NoSplit	$-0.23\ (0.07)^{**}$	$-0.18\ (0.08)^{*}$	$-0.14\ (0.07)^{\circ}$	$-0.13\ (0.07)^{\circ}$	$-0.13\ (0.06)^{\circ}$
UR	$-0.05\ (0.02)^{*}$	$-0.06\ (0.03)^{*}$	$-0.05\ (0.02)^{\circ}$	$-0.05\ (0.02)^{\circ}$	$-0.05\ (0.02)^{*}$
HCexp	$0.22\ (0.08)^{*}$	$0.17\ (0.10)^{\circ}$	0.07 (0.07)		
PHYexp		1.07 (1.07)	−0.26 (0.88)	0.03 (0.73)	
HPidx			$0.01\ (0.00)^{***}$	$0.01\ (0.00)^{***}$	$0.01\ (0.00)^{***}$
Num. obs.	720	720	720	720	720
R^2 (full model)	0.62	0.62	0.63	0.63	0.63
R^2 (proj model)	0.03	0.04	0.06	0.06	0.06
Adj. R^2 (full model)	0.59	0.59	0.60	0.60	0.60
Adj. R^2 (proj model)	−0.05	−0.04	−0.02	−0.02	−0.02
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	24	24	24	24	24

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province, Specialty and Gender. Standard errors, shown in the parenthesis, are clustered by Province and Specialty.

Table 11: 3-way Males Specialty Province Time

	1	2	3	4	5
NoSplit	$-0.08\ (0.05)^{\circ}$	−0.03 (0.06)	−0.02 (0.05)	−0.06 (0.05)	−0.06 (0.05)
UR	−0.04 (0.02)	$-0.05\ (0.03)^{\circ}$	$-0.05\ (0.03)^{\circ}$	$-0.05\ (0.03)^{\circ}$	$-0.04\ (0.02)^{\circ}$
HCexp	−0.04 (0.06)	−0.10 (0.08)	−0.12 (0.08)		
PHYexp		1.12 (0.79)	0.75 (0.74)	0.24 (0.63)	
HPidx			0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Num. obs.	720	720	720	720	720
R^2 (full model)	0.40	0.40	0.41	0.40	0.40
R^2 (proj model)	0.01	0.02	0.02	0.02	0.02
Adj. R^2 (full model)	0.35	0.35	0.35	0.35	0.35
Adj. R^2 (proj model)	−0.07	−0.07	−0.06	−0.07	−0.07
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	24	24	24	24	24

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province, Specialty and Gender. Standard errors, shown in the parenthesis, are clustered by Province and Specialty.

Table 12: 3-way Females Specialty Province Time

Tables 11 & 12 present the results from separate regressions by gender. Male physicians are clearly more responsive than female ones to income splitting changes implemented by various provinces. This result is supported by what we know about assortative mating: men tend to marry equal or lower earning women on average and having a lower earning spouse, along with having children, is required in order to benefit from the rule changes.

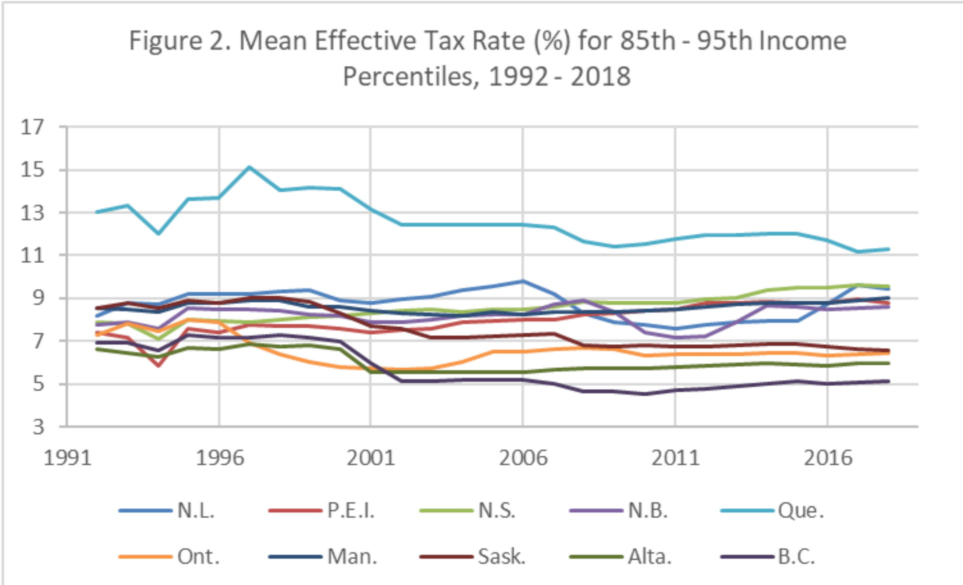
	1	2	3	4	5
NoSplit	−0.20 (0.05)***	−0.15 (0.06)**	−0.13 (0.06)*	−0.14 (0.05)*	−0.14 (0.05)**
Female*NoSplit	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)
UR	−0.05 (0.01)**	−0.06 (0.02)***	−0.05 (0.02)**	−0.05 (0.02)**	−0.04 (0.01)**
HCexp	0.09 (0.05)°	0.04 (0.06)	−0.03 (0.06)		
PHYexp		1.10 (0.62)°	0.25 (0.65)	0.13 (0.60)	
HPidx			0.01 (0.00)***	0.01 (0.00)***	0.01 (0.00)***
Num. obs.	1440	1440	1440	1440	1440
R^2 (full model)	0.55	0.55	0.56	0.56	0.56
R^2 (proj model)	0.02	0.02	0.04	0.04	0.04
Adj. R^2 (full model)	0.53	0.53	0.53	0.53	0.53
Adj. R^2 (proj model)	−0.04	−0.04	−0.02	−0.02	−0.02
Num. groups: Time	30	30	30	30	30
Num. groups: i.ProvFieldGender	48	48	48	48	48

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
NoSplit is a binary variable that is set to 1 when the treated province does not allow physicians to register their private practices as CCPCs and hence split income, UR is the seasonally adjusted annual unemployment rate for each province, HCexp is the provincial expenditure on the health care system adjusted by provincial population (per 100k), PHYexp is the provincial expenditure on physicians per physician and HPidx is the House Price Index that compares the average costs of housing across Canadian provinces. This model is estimated using year and group fixed effects, here the groups are Province, Specialty and Gender. Standard errors, shown in the parenthesis, are clustered by Province, Specialty and Gender.

Table 13: 4-way Gender and NoSplit Interaction

In Table 13, above, we can see the results from including the interaction term between the binary variable Female and NoSplit. The coefficient is 0.09, with a p-value of 0.128-which is very close to what is conventionally regarded as statistical significance. The positive coefficient implies that the treatment effect, NoSplit is smaller for women than men, though it is still negative. The value of NoSplit itself, is the estimate of the treatment effect for men, this varies from -0.13 to -0.20, depending upon the specification. Thus, the treatment effect for women ranges from -0.13 + 0.09=-0.04 to -0.20 + 0.09=-0.11. We cannot firmly conclude that the treatment effect is significantly different for women compared to men, however, there is reasonable evidence suggesting that is the case.

A1.6. Mean Marginal Effective Income Tax Rates 1992-2018 (85th-95th percentile).



Chapter 2 Political Economy of Covid-19 Public Health Measures in Canada

2.1 Introduction

Throughout the pandemic the political support for government-mandated restrictions has varied substantially within and across countries, as have the severity of such restrictions. South Korea, Japan, and Taiwan implemented policies that many would deem unthinkable in other OECD countries. In contrast to these east Asian countries, several American states did not follow the basic guidelines set out by the WHO. Canadian provincial governments' approach to the management of the pandemic was moderate in comparison to these two extremes. There were differences between the various provincial governments' strategies, however, all those strategies were moderate in comparison to the USA and east Asian countries. Despite this, there was still discontent amongst a significant fraction of the Canadian population – the culmination of which was realized during the so-called "freedom convoy" blockade of downtown Ottawa between January 22nd and February 23rd of 2022.

There is no doubt that lockdowns were effective in slowing the spread of the Covid-19 virus and saving lives relative to full laissez-faire. For example, Sweden was the last of the three Scandinavian countries to implement formal government restrictions targeting the spread of Covid-19. Before then, the government had recommendations in place for the population to follow on their own accord. Restaurants and stores were still open, children of all ages were going to school and there was limited social distancing in public. Over two years later the deaths per capita from Covid-19 reported by Sweden is 50% larger than Denmark's and 200% larger than Norway's (coronavirus.jhu.edu). The comparison is relevant because these three countries are almost identical in terms of GDP per person, population demographics and quality of health systems. Similarly, the US has over 100% more Covid-19 related deaths per capita than Canada – even though the comparison is not entirely warranted since the two health systems are less similar than their Scandinavian counterparts.

But there are trade-offs: restrictions and mandates are not popular with everyone because they inflict a burden and an economic cost (loss of employment or income, loss of leisure opportunities, changes in lifestyle). Moreover, this burden is not uniformly distributed but systematically affects certain groups of the population more than others, typically those who work or study. Similarly, the benefits of slowing the spread of Covid-19 are not uniformly distributed across the population but benefit hose who are more most vulnerable (who are more likely to die or be hospitalized if infected). This study is concerned with the unequal distribution of benefits and costs (broadly conceived) of these restrictions and mandates along one dimension: age.

The Case-Fatality-Rate (CFR) of Covid-19 has a steep gradient across age: for 18 year olds the CFR is currently less than 1 in 100,000; while for people aged 80+, the CFR of Covid-19 was near 30% at the onset of the pandemic and is presently above 10% (Public Health Agency of Canada).[3] Conditional on surviving contracting Covid-19, the short and long run implications are significant nonetheless. Such as the possible need for receive intensive-care or hospitalization, the discomfort which accompanies recovering from mild cases, or the risk of suffering from "long covid" – all of which are also skewed by age. In the baseline analysis of this study, the benefit of restrictions is formalized as their effect on reducing the likelihood of dying from contracting the Covid-19 virus; a sensitivity analysis includes "long covid" as a

[3] The CFR is the probability to die conditional on contracting the disease. It is different from the mortality rate, which is the probability to die from the disease in the population (both those infected and those not infected).

permanent reduction in the quality of life when contracting the disease. Given the significant difference in the CFR of Covid-19 between young and old people it is clear the benefits from restrictions are unequally distributed across age groups of the Canadian population.

The costs resulting from the Covid-19 public health measures (PHMs) were substantial in their breadth. In this study, the PHMs are representative of the Canadian case: schools were closed, as were most businesses that serve the public in person (restaurants, gyms, hotels, travels) and seemingly all of the jobs that can be performed remotely were done so. The most direct and observable costs are the potential lost income from the increased likelihood of losing employment during the Covid-19 recession and the value of lost leisure opportunities that were no longer available to the public at various stages of government lockdowns. Contrary to the CFR of Covid-19, the likelihood of being unemployed during the recession was larger for the young than old. The age-gradient of lost leisure opportunities is certainly less pronounced but hypothesized to be higher on average for the young and decreasing with age. Other costs to individual Canadians included: the increased home production required to care for children sent home from school; the decline in mental health and/or life satisfaction due to stay-at-home orders; the backlog of hospital/medical care procedures; and the increase in the federal, and various provincial, governments' fiscal deficit. These costs are outlined in more detail in the discussion section.

Using an adaptation of the methods developed by Bergstrom and Hartman (2008), this paper makes an empirical contribution to the Covid-19 political economy literature through estimating the Net-Present-Value (NPV) of Covid-19 related public health measures for voting age Canadians. The main idea is that individuals use their private expected NPV to decide whether they support (positive NPV) or oppose (negative NPV) the restrictions. The population is stratified into unitary groups from ages 18 to 100- assuming homogeneity therein. Specifically, the CFR of Covid-19, monthly income and expenditure statistics are held constant within each age group. Of course, there are outliers, an immunocompromised young person may have a higher CFR than a healthy middle-aged person. In addition, there are working professionals in their 20's whose annual income is higher than some in their 50's.

The NPV is calculated as the benefits of restrictions net of the costs. The NPV is estimated for three-time horizons: six months; one year; and two years. Present value is used because the benefits are lifetime, and thus dependent upon surviving beyond the pandemic and into old age. The costs, alternatively, are immediate (though some long-term costs are discussed in Section 6). For the baseline analysis there is no altruism, no external factors taken into consideration, each person only cares for their own private NPV of lockdowns. Whether an individual supports lockdown is determined by their associated NPV. If an age group has a positive NPV they are in favour of lockdowns but if their NPV is negative, they are opposed.

The aggregate electoral support for lockdowns can be determined by comparing the median age of Canadian voters, 48, to the pivotal age, defined as in Bergstrom and Hartman (2008) as the age at which the NPV changes sign.[4]

Baseline results indicate that the majority of Canadians is in support of lockdowns lasting six months, one year and two years. This unanimity is due primarily to the generosity of the Canadian Emergency Response Benefit (CERB) – which paid out a maximum of $2000 CAD

[4] To use this criterion the NPV is required to pass through the origin only once between 18 – 100, which it does.

per month to those who lost employment during the Covid-19 recession – and is accounted for when estimating the expected income of individuals during lockdowns.[5]

When the CERB is excluded from the analysis, support for lockdowns shrinks and the majority of Canadians are projected to oppose lockdowns lasting for one and two years. The CERB benefit was not financed deus ex machina; rather, the Canadian government resorted to deficit spending to provide this program and other Covid-19 related services. This has implications for the political economy of the Covid-19 PHMs. Not only does the NPV of restrictions vary by age group but so will the responsibility of paying down government debt through taxation. In likelihood, the CERB benefit will be an intragenerational transfer, since young people who are net contributors into the fiscal purse will have to finance this program through future taxes on behalf of the other young lower earning fiscal beneficiaries. That being said, the CERB was highly concentrated across a small bandwidth of age groups, whereas the burden tax will be spread across a wider pool of Canadians and over many years.

A simulation is conducted to estimate the permanent reduction in the value of life-years from its initial value of $100,000 CAD that is required for the majority of Canadians to oppose lockdowns. As a sensitivity check, the value of life-years is permanently lowered, separately for each age group, until the NPV of lockdowns declines below zero. This provides an estimate of how much the Covid -19 related lockdowns would have to permanently decrease living standards for there to be unanimous opposition. According to the results of this exercise, the permanent reduction in value of life-years ranges from 30% to 93% (reducing value of life-years from $100,000 CAD to $70,000 CAD, or $100,000 CAD to $7000 CAD). In spite of the long-term

[5] Individuals were required to have earned at least $5000 CAD through employment over the past 12-months and not earned more than $1000 CAD during the 4-weeks prior to their application for financial support.

consequences of the lockdowns there should still be support for these restrictions since the former is unlikely to reduce the value of life-years of Canadians in the post-pandemic era by 30% let alone 93%.

The remainder of this paper is structured as follows: Section 2 is a brief review of relevant literature; Section 3 outlines the data used in the analysis; Section 4 is the methodology; Section 5 presents the results and Section 6 is the discussion and concluding remarks.

2.2 Relevant Literature

There are numerous economics papers concerned with Covid-19, to my knowledge this paper stands alone in approximating the political support of lockdowns using demographics and individual level cost-benefit analysis. Most work is concerned with macro-level cost-benefit analysis. Miles, Stedman and Heald (2020) investigate the case of the United Kingdom (UK). They estimated benefits to be the value of the all the lives saved by Covid-19 restrictions, while the costs were the reduction in GDP and increase in unemployment rates. They did not collapse these estimates to the individual level, nor did they attempt to estimate an aggregate measure of lost leisure opportunities.

There has been much discussion regarding how much government mandated lockdowns decrease economic activity since people may take it upon themselves to avoid high and moderate risk activities during the pandemic. Andersen, Hansen, Johannesen and Sheridan (2020) observe that in Scandinavia the reduction in consumer spending from formal government restrictions was quite small, implying that personal agency was motivating citizens to take the necessary precautions to avoid contracting the Covid-19 virus. Goolsbee and Syverson (2020) used nationwide cellular phone records data in the US to estimate the decline in consumer visits to business. Cross state and county comparisons were possible because government restriction in the US varied so much across the country. Their findings suggest that formal restrictions were only responsible for a 7% decline in consumer traffic. In a similar study, Relihan, Ward Jr., Wheat, and Farrell (2020) used credit card transactions from 16 US cities and found that expenditure on local commerce decreased by 12.8% between March 2019 and March 2020. In another paper focusing on US consumption patterns from a Nielson panel dataset, Coibion, Gorodnichenko and Weber (2020) find that between January and April 2020 aggregate consumer spending of households that were under formal lockdowns dropped by 31 log percentage points compared to households that were not under formal lockdowns.

In another example of the impact of Covid-19 public health measures on consumption, Surico, Kanzig and Hacioglu (2020) were granted access to transaction data from a Fintech company operating in the UK. Much like the other countries, there was a large decline in economic activity after the pandemic began. They found the median decline to be 30%, with the retail, restaurant, and transportation industries accounting for the largest declines in expenditure.

Finally, the methods used in this paper can be sourced back to Bergstrom and Hartman (2008). However, there have been substantial additions and adaptations made to the methodology because the problem of estimating the NPV of Covid-19 lockdowns across the population differs categorically from estimating the NPV of pension reform. Bergstrom and Hartman (2008) were interested in simulating the political support for changes to the Social Security Plan in the United States. They estimated the costs and benefits of a one-time $1 USD increase or decrease in the payments made by Social Security. Using population projections for the US and survival probabilities into old age, both derived from life tables, they were able to estimate the costs and benefits of the $1 USD increase, while also accounting for changes in the Old Age Dependency (OADR) of the US voting age population.

2.3 Data

The data used in this analysis is all public access and the Royal Bank of Canada (RBC) debit card expenditure data was manually scraped from the interactive webtool -which allows users to see the exact value of each data point on the graph- while the other information was sourced directly from datasets.

Population Projections: using the Life Tables from Statistics Canada 2016 census the age distribution of the population is projected into the year 2020. Using this information, the median age of the population aged 18-100 is estimated to be 48 years.

Case Fatality Rates: data was taken from the Health Canada Covid-19 information base and Public Health Ontario. The CFR is computed as the number of Covid-19 related deaths divided by the number of reported Covid-19 cases. Both Health Canada and Public Health Ontario require the cause of death to be Covid-19 or Covid-19 related in order for that observation to be counted. If a patient with Covid-19 dies of other causes it is not accounted for when estimating the CFR of Covid-19. Note that the CFR is not easy to estimate, as it requires a reliable measure of the population at risk, namely the number of cases of Covid-19. Especially in the later half of the pandemic Covid-19 cases have been underreported. For example, during the Omicron outbreak that occurred around Christmas of 2021 in the province of Manitoba, the Chief Public Health Officer, Dr. Brent Roussin, told citizens under the age of 40 with no underlying medical conditions that if they have flu-like symptoms do not get tested and assume they contracted the Covid-19 virus (Bernhardt, 2021). This would bias the number of reported cases downward, meaning that the CFR values are expected to be upward biased. The bias is most severe for the age groups that are least likely to be tested when they experience Covid-19 symptoms. It is reasonable to suggest that for older groups the bias is smaller, since they will be more inclined to confirm through formal testing whether they have Covid-19 or not regardless of the severity of their symptoms.[6] From all the sources, CFR statistics are reported in age categories, typically bins of 10 years (10-19, 20-29 etc.). A smoother was used to approximate the CFR for each age group, denoted as CFR(a).

Income: the average market income for the year 2018 is provided by Statistics Canada, grouped by ages 16-24, 25-54, 55-64, 65 and above. The market income was used because that is what will be affected by the lockdown, government income, should not be interrupted. Meaning that programs and payments that were in place prior to the pandemic should have not been interrupted.

Canadian Emergency Response Benefit (CERB): the Canadian Government provides $500 per week to those who qualify. This is assumed to be the income of people who are unemployed due to the lockdown.

Unemployment rates: taken from Statistics Canada, the average unemployment rate for each age groups 18-24, 25-54 and 55-64 for the year 2019 is first computed. Then the average unemployment rates from March 2020 to September 2020 (short term model), March 2020 to March 2021 (medium-term model) and March 2020 to January 2022 (long-term model) for the same age groups are estimated. The difference between the latter three averages and the 2019

[6] Any reasonable correction to the CFR for young people, which entails increasing the observed statistics by no more than 20% of the original value, or CFR(a) = CFR(a) x (1.2), is inconsequential to the main results of the paper as well as the sensitivity analyses.

average is then constructed. This provides an estimate of how much the Covid-19 related PHMs increased the unemployment rate, for the three different time horizons.

Hours worked: the Labour Force Survey conducted by Statistics Canada has data on the decline in hours worked. This ranged from between 1-3% of regular, meaning $\alpha(a)$ in Section 4, ranges from 97-99% of regular hours.

Consumption: within the household expenditure tables from Statistics Canada, which are separated by age groups, under-30, 30-39, 40-54, 55-64 and 65 and above, there is information on the monthly expenditure on recreational activities and restaurants at the household level. To obtain an estimate of the per-person expenditure the data is adjusted to account for the size of the household for each age group.

Debit card expenditure: the monthly debit card expenditure of Royal Bank of Canada (RBC) customers is provided on their Covid-19 tracker webpage (thoughtleadership.rbc.com). The report contains an interactive graph where users can manually obtain the percentage change in expenditure on recreational activities or restaurants relative to their pre-Covid 19 shock averages.

The RBC Economics Debit Card Expenditure and the Statistics Canada Household Expenditure Survey data are used to estimate the reduction in consumption that resulted from the implementation of the Covid-19 PHMs. It is assumed that 2020 and 2021 household expenditure can be estimated using the 2019 observations. These observations are then matched with the RBC debit card expenditure data to predict how much household expenditure on consumption and leisure activities declined after the PHMs were introduced.

2.4 Methods

Each person within an age group has the same NPV and will support or oppose government mandated lockdowns if their NPV is positive or negative. Each person is assumed to only care about their own NPV. There are no intergenerational linkages of any kind – though an altruistic link can be introduced by connecting people of age a, with those aged a +/- x, x being the average age gap between two generations. The NPV(a) for each age group, a, is the difference between the estimated benefits B(a) and costs C(a) of lockdowns.

Three different scenarios are estimated: lockdowns that last for six months; one year; and two years. In each of the scenarios relevant statistics are updated whenever possible. For example, the CFR of Covid-19 decreased for all ages as vaccination programs were introduced, health care systems became more effective at treating Covid-19 patients and the less lethal Omicron variation spread.

$$NPV(a) = B(a) - C(a) \quad (1)$$

a. Benefits

The benefit of PHMs is the expected value of life-years saved by limiting the spread of the Covid-19 virus. Each person is assumed to experience the same reduction in the likelihood of contracting Covid-19 after PHMs are introduced, however, the CFR of Covid-19 varies drastically by age group and so does the value of life-years remaining. It is improbable for a healthy 20-year-old person to die from Covid-19, but the expected value of the life-years they have left to live is much larger than an elderly person- for whom Covid-19 is a more lethal virus. The benefits of lockdowns are constructed to encapsulate these facts. Recall that $B(a)$ varies across age groups but not within age groups, the same is true for $CFR(a)$ and $L(a, a + j)$.

$$B(a) = [\Delta\, P(Infection)]CFR(a)\left[\sum_{j=0}^{100-a} \beta^j\, L(a, a+j)YoL\right] \quad (2)$$

In the leftmost brackets is the reduction in the likelihood of contracting Covid-19, $\Delta\, P(Infection)$, when there are PHMs in place. Formally,

$$\Delta P(Infection) = P(Infection|NoLockdowns) - P(Infection|Lockdowns) \quad (3)$$

This value is logically bounded within the interval of [0,1]. If there is no reduction in Covid-19 contagion from introducing lockdowns, the value of $\Delta\, P(Infection)$ is 0 and hence lockdowns have no benefit whatsoever. If, however, the probability of contracting Covid-19 is 100% without lockdowns and 0% with lockdowns then $\Delta\, P(Infection)$ is 1. For the initial estimates, $\Delta\, P(Infection)$ is set to equal 0.75. This is to reflect the facts that even without any public health measures not all people will contract Covid-19 (Randolph and Barreiro, 2020), and that despite the strict public health measures introduced in Canada, the probability of contagion is still greater than zero.

CFR(a) is the case fatality rate for each age group. There are observations from the onset of the pandemic, after Omicron spread and between Jan and May 2022. The first six-month simulation uses the initial estimates, while the annual simulation uses an average of the initial and Omicron CFR; and biannual simulations use an average of the three observations.

The rightmost parenthesis is the expected value of life-years remaining for a person aged a. β is the future discount rate set to 0.97, compounded by j, the remaining number of years they have left to live. $L(a, a+j)$, is the probability of surviving from age a to a + j, before the pandemic started. For example, $L(18{,}35)$ is the likelihood of an 18-year-old surviving until they are 35. Finally, YoL is the value of one year of life, this is set to be $100,000 CAD.[7]

b. Costs

The costs of the PHMs for each individual age group are estimated to account for the potential loss in income that arises from becoming unemployed due to the lockdown induced Covid-19 recession, and the value of the lost leisure opportunities (see equation 4 below). The costs are total, not marginal, measured on a monthly basis and cumulated over the three-time horizons. This means the costs of one-year of lockdowns includes the costs of the first six months and the costs of two years of lockdowns includes the first year. The lost leisure opportunities do not include purchases or activities that were deferred into the future, instead the focus is on experiences that cannot be replaced. For example, many birthdays were spent at home not out with friends at restaurants and/or bars, this results in a loss of utility which has corresponding value in CAD. Another example is concerts that were cancelled due to the pandemic. Even if the band may tour in the future, a person may no longer be interested in seeing it and thus forever missed out on that experience.[8]

$$C(a) = Lost\ Income\ (a) + Lost\ Leisure\ (a) \quad (4)$$

i. Lost Income

The expected lost income is estimated using equation 5 below.

$$Lost\ Income(a) = E[Inc(a)|Lockdown] - Inc(a) \quad (5)$$

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[7] This estimate is on the lower bound of values for *YoL* since the original paper, Cutler and Richardson (1997), from which the value is sourced, was written over 25 years ago and their value of *YoL* is expressed in USD.

[8] A colleague's daughter was planning to see the famous Korean Pop group BTS when they were in Toronto, but the concert was cancelled in early 2020. They are now scheduled to return to Toronto in 2023, but her preferences have now changed, and she no longer wishes to go- experience lost.

It is the difference between the expected monthly income of a person aged a when there is a lockdown minus their average monthly earnings, in the extreme case, when there is no lockdown and aggregate economic activity is relatively normal. The expected monthly income conditional on a lockdown, below, is the weighted sum of the average monthly income earned when a person remains employed and when they become unemployed. π_1 is the difference between the average unemployment rate before the Covid-19 pandemic and the average unemployment rate after the pandemic started. As with the CFR statistics, π_1 is updated when we move through the three different time horizons. To account for a reduction in hours, data from the Labour Force Survey was used to construct $\alpha(a)$.

$$E[Inc(a)|Lockdown] = \left(1 - \pi_1(a)\right) \alpha(a)\, Inc(a) + \pi_1(a) CERB \quad (6)$$

Using equations 5 and 6, we have equation 7 below.

$$Lost\ Income(a) = \pi_1(a)[CERB - \alpha(a) Inc(a)] + (\alpha(a) - 1)\, Inc(a) \quad (7)$$

The CERB monthly payment is equal to $2000 CAD. The CERB benefits are not financed deus ex-machina and must be paid for initially with deficit spending that must be repaid as future taxation – the political economy of this emergency response program will be discussed in Section 5. As a sensitivity analysis, to account for perfect Ricardian Equivalence, in Section 5 the CERB payment is removed from equation 4 to see how the NPV(a) of different age groups is affected.

ii. Lost Leisure Opportunities.

$$Lost\ Leisure\ (a)\ = \delta Cons(rec, a) + \kappa Cons(restaurants, a) \quad (8)$$

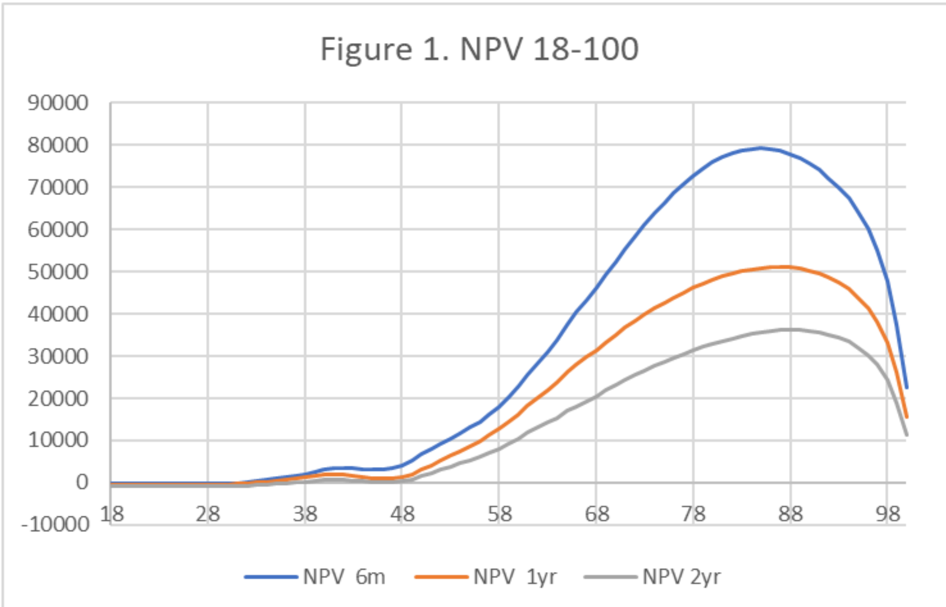
The average monthly expenditure on recreational activities is $Cons(rec, a)$, while $Cons(restaurants, a)$ is the average monthly expenditure on restaurants. Both measures are provided at the household level, by the age of the head of household. To account for the number of people who live in a household, since the individual expenditure on recreation and restaurants is what is required here, the average monthly expenditure is divided by the average number of people that live in each household group.

The values of δ (19%) and κ (20%) are the reduction in debit card expenditure on entertainment, arts, and movies; and food services compared to the 2019 pre Covid-19 pandemic averages. These statistics are not available by age, and they do not vary over the three-time horizons.

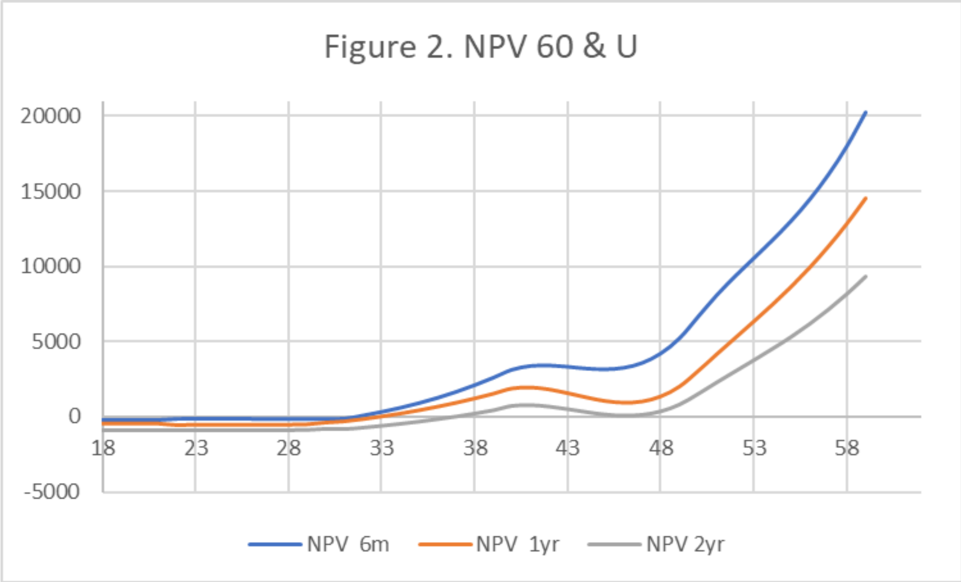
2.5 Results

The results from the initial analysis are presented in Figure 1. Notice how steeply the NPV of restrictions increases after the age of 48. This is driven by the pronounced age gradient of the Covid-19 CFR. NPV peaks in the mid 80's and then begins to decrease precipitously thereafter. This drop off is caused by the decline in survival probabilities, $L(a, a + j)$, outpacing the increases in CFR. The NPV curves shift downward as we move from a six-month lockdown to one- and two-year lockdowns. The CFR is updated to match each time horizon and decreases secularly. The Omicron variant is by default less lethal than early strains of the Covid-19 virus- vaccination programs were well under way before that variant and health care systems improved in their ability to treat the virus. These three forces lower the CFR for each age group over time.

Finally, costs are cumulating over the six-month, one-year and two-year lockdowns. The unemployment statistics are updated, the likelihood of losing a job does decrease, however, even for the second year of the pandemic people were significantly more likely to lose their jobs compared to the 2019 averages.



The median age of voting-age Canadians is 48. For each of the three-time horizons the pivotal age, where the NPV changes sign from negative to positive, is less than 48 years old. The pivotal ages are 32, 33 and 37, respectively. This implies the majority of voting age Canadians are in support of Covid-19 related PHMs for up to two or more years. It should be noted that for restrictions lasting two years Canadians in their early to mid 40's have a marginally positive NPV, it is as low as $105 CAD for 46-year-old's. Figure 2 below focuses on the NPV of Canadians aged 60 and below. CFR is near zero and stable for young people under the age of 30. As a result, the benefits of restrictions are also near zero, despite the fact they have much more life-years remaining than older Canadians. They were also more likely to lose their jobs. That they earn less than older



people, who were more likely to retain employment, somewhat offsets the disparity in unemployment rates. Therefore, there is a small dip in the NPV between the ages of 40 – 45, earnings are higher which increases the expected lost income from government restrictions. The CFR increase begins to dominate any wage increases for people in their 50’s and above.

a. Sensitivity Analyses

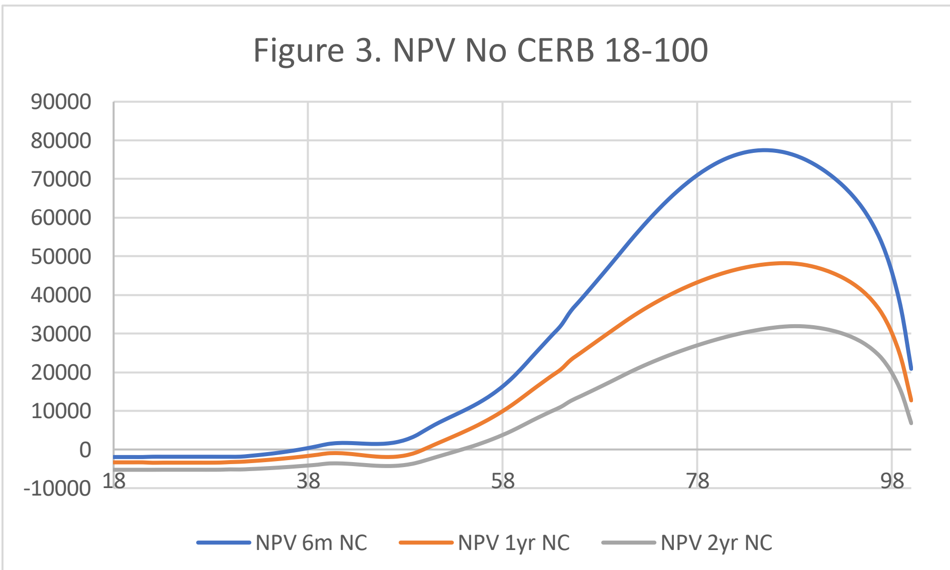
Three exercises are conducted: the CERB is removed from the analysis; altruism is introduced and the lowest value of life-years, YoL*, is calculated such that the NPV is negative for the majority of Canadians for each of the three-time intervals.

The CERB is a lump transfer from the government that must be financed through future taxation. Assuming Ricardian Equivalence people will not spend any of these funds, instead they will set it aside to repay the government when future taxes are collected.[9] This can be accounted for by removing CERB from equation (6) so that expected lost income from equation (7) is now:

$$E[Inc(a)|Lockdown] = \left(1 - \pi_1(a)\right)\,\alpha(\mathrm{a})\;Inc(a) \qquad (6.i)$$

$$Lost\ Income(a) = (\alpha(\mathrm{a}) - \alpha(\mathrm{a})\,\pi_1(a)\; - 1)Inc(a) \quad (7.i)$$

Figure 3, below, displays the NPV excluding the CERB. Each of the three NPV curves has shifted downward, as the CERB benefit is akin to an intercept. The pivotal ages are now higher,



for the six-month lockdown the pivotal age is 38, for one-year 50 and 53 for two-years. Therefore, the majority of Canadian voters would reject the one-year or two-years lockdowns if the CERB were unavailable to them should they become unemployed due to the Covid-19 PHMs.

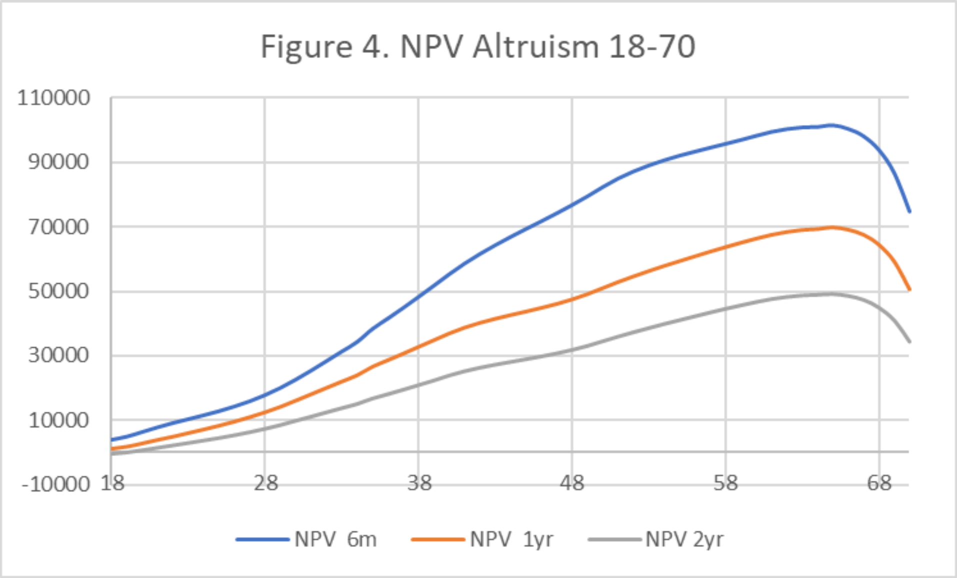
Altruism is incorporated by linking people aged, a, with an older Canadian aged, a + 30. This is equivalent to a young person valuing each of their parents NPV half as much as their own

[9] Naturally it is also plausible that individuals may choose to invest these funds, or perhaps spend them, depending on the rate of interest and future discounting.

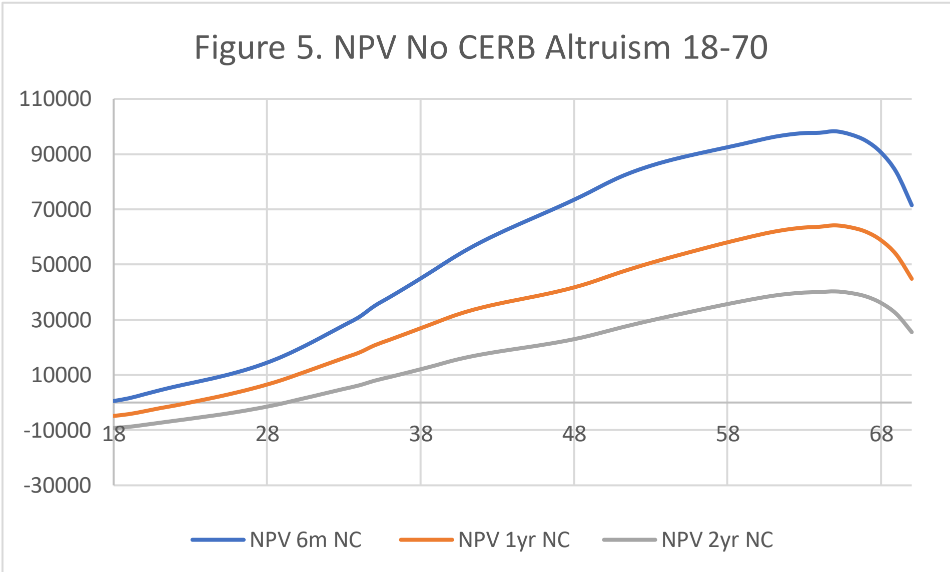
– assuming their parents are still living. Since we do not include persons aged over 100 in the analysis the age range is truncated at 70. The costs C(a) are estimated to be the same and benefits, B(a), with altruism is expressed below in equation (9):

$$B_{altruism}(a) = B(a) + B(a + 30) \quad (9)$$

When direct intergenerational altruism is accounted for, the NPV is strictly positive for all Canadians for both the six-month and one-year time horizons, see Figure 4. When lockdowns are extended to two-years 18- and 19-year-olds have negative NPV, while the remainder of Canadians have positive NPV. With altruism toward the older generation, not surprisingly, lockdowns are massively supported.



Applying equation (8) when the CERB is removed from the analysis generates similar results, as can be seen below in Figure 5. For six-months of lockdowns every age has positive NPV, for one-year of lockdowns people aged 23 and under have negative NPV and for the two-



year lockdowns 30 and under have negative NPV. Altruism is then enough to change the results of removing the CERB, as now the majority of the population is in support of the PHMs for all three-time horizons.

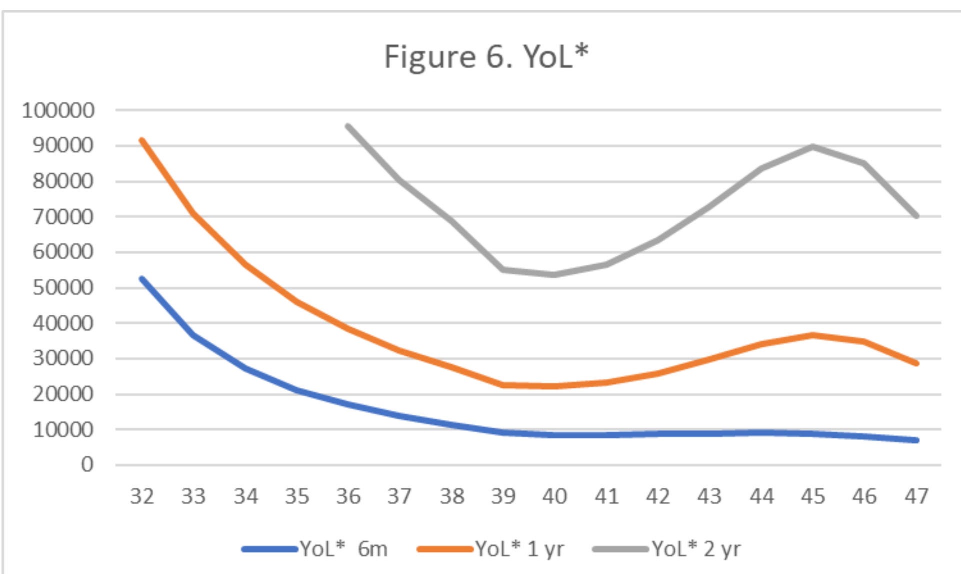
Finally, the *YoL* parameter (value of one year of life) is adjusted because quality of life declined for most Canadians during the height of stay-at-home orders. When young children were sent home from school, parents had to increase home production to care for their children. For many this happened while they were contemporaneously working from home. Even for Canadians without children, quality of life was still lower than before restrictions were put in place. Everyone's day-to-day routine was disrupted; therefore, it is a worthwhile exercise to consider just how much the value of life for each age groups needs to decrease in order for there to be majority opposition to PHM. Holding costs constant there exists a value of life-years, YoL*, such that the majority of Canadians are opposed to restrictions lasting six-months, one-year and two-years. This can be found by equating B(a) to C(a) for every age group below the median of 48 where NPV > 0, as shown in equations 10 and 11 below:

$$[\Delta\, P(Infection)]CFR(a)\left[\sum_{j=0}^{100-a} \beta^j\, L(a, a+j)YoL\right] = C(a) \quad (10)$$

$$YoL^{*}(a) = \frac{C(a)}{[\Delta\, P(Infection)]CFR(a)\left[\sum_{j=0}^{100-a} \beta^j\, L(a, a+j)\right]} \quad (11)$$

/The minimum value of YoL*(a) has to be applied to all Canadians, as the value of a year of life is assumed to be constant across age groups. In addition, the decrease in value of life is permanent, not temporary. Naturally, as the costs increase with each time horizon, YoL*(a) increases.

As shown in Figure 6, even for two-years of restrictions the reduction in YoL is unrealistic, the minimum value of YoL*(a) is under $54,000 CAD, or a greater than 46% permanent decrease in the value of life-years. For the one-year of restrictions the minimum of YoL*(a) is slightly above $22,000 CAD while the minimum for six-months is just under $7000 CAD, a 93%



permanent reduction in the value of life-years. A temporary, six-month, one-year and two-year decreases in YoL were estimated but in many cases implied a negative YoL*(a). A discussion of what it means for YoL to be negative is beyond the scope of this paper. Thus, for the sensitivity analysis YoL*(a) was assumed to be positive and therefore changes in YoL could not be restricted to six-months, one-year, or two-years.

2.6 Discussion

The NPV of Covid-19 related PHMs has been estimated for the Canadian electorate. There are substantial differences across age groups, young people benefited less from restrictions because the associated risks of contracting Covid-19 are minimal while they were also more likely to become unemployed during the pandemic. The reciprocal is true for older Canadians, especially retirees whose income was uninterrupted, and are at higher risk of serious complications and death from Covid-19. In the baseline analysis, the majority of the Canadian electorate have a positive NPV for all three-time horizons. However, as shown in the sensitivity analysis, when the CERB benefit is excluded the NPV lowers substantially for all age groups, so much so that the majority has negative NPV for restrictions lasting one and two years. If Ricardian Equivalence is strictly binding, the analysis without the CERB is a reasonable approximation of the costs and benefits of lockdowns. In actuality, Ricardian Equivalence is unlikely to hold, meaning people will have spent the CERB payments they received instead of saving it to pay taxes in the future. Furthermore, these same people are unlikely to pay for these benefits through future taxation as they tend to be net fiscal beneficiaries.

The total costs of the CERB (and its various counterparts) are in excess of $71 billion CAD (Statistics Canada, 2022). Not only will this be paid for by Canadians who make net contributions to the fiscal purse, the repayments will be spread over many years, not the immediate future. Therefore, the most probable outcome is that the CERB will be less an intergenerational transfer (old to young) and more an intragenerational transfer (higher income young to lower income young). From a normative perspective, both the inter- and intragenerational transfer schemes can be considered equitable. Lower income young people working in the service industry and other low-skill sectors of the economy were more likely to lose their jobs, compared to higher-skill workers – for whom work from home was more common (Lemieux, Miligan, Schirle and Skuterud, 2020).

There are other, less observable and measurable, costs from government mandated Covid-19 restrictions that were unaccounted for in the baseline and sensitivity analyses. These costs are both short and long term. The short-term costs include the increased home production required of parents when their children were sent home from school. This would be costly for parents that were unable to work from home during the pandemic and thus had to find alternative arrangements for childcare or quit their jobs altogether. For those who were able to work from home, their daily tasks were doubled: managing their work responsibilities and homeschooling their children.

Canadians with and without children experienced psychological hardships during the pandemic – though for a select group of introverts work from home and stay-at-home orders were less consequential. For example, a Statistics Canada survey conducted in late 2021 and early 2022 asked people to self-report their level of hopefulness regarding the future. Compared to the results of the same survey from 2016, hopefulness was 11.3% lower in the 2021 and 2022 sample. There is variation across provinces, British Colombian had the largest decline in hopefulness while Quebec had the smallest. Interestingly, despite the increased burden of childcare during the height of the pandemic, individuals living in a household of two or more people, including children, reported higher hopefulness scores than people living in a household of two or more without children. People living on their own experienced the largest decline in hopefulness.

The medical system was strained by the influx of Covid-19 cases. Non-elective and lower priority medical procedures were delayed as a result. This created a significant backlog that will take years to clear. In Ontario, between March 15th and June 13th of 2020 the backlog of surgeries, not other medical procedures such as diagnostics or routine checkups, was approximately 148,364 (Wang et al, 2020). The clearance time for this four-month backlog is approximately 84 weeks. Other provincial healthcare systems have similar backlogs and clearance times.

The marriage market was disrupted by the pandemic. This has both short and long run implications. In the short run, dating opportunities were more limited, delaying matching and denying young people the enjoyments of this process. This may permanently decrease marriage rates of cohorts that should have matched between 2020 – early 2022, recent data from Statistics Canada show that marriage rates fell to a twenty-year low in 2020 (see Appendix E). Though it is still possible for the shortfall to be recovered in the near future. However, this reduction in marriage, if permanent, may be small but will spillover into fertility as well. Fewer marriages, ceteris paribus, will mean fewer children.

The long-term effect of school closures on children's human capital accumulation has yet to be realized. Recent literature has demonstrated that learning loss from school closures is largest for socioeconomically disadvantaged students. Betthausesr, Bach-Mortensen and Engzell

(2023) conducted a meta-analysis of 42 studies from 15 different countries -representing Europe, North America, South America and Africa. They found that learning deficits were larger in maths than in reading while the aforementioned socioeconomic gap is present across time periods, subjects, countries and grade levels. These results are corroborated by the findings of a study focused on the Netherlands. Engzell, Frey and Verhagen (2021) used data on the test scores of roughly 350 000 Dutch children, aged 8 – 11 between the years 2017 – 2020 (inclusive). As with the meta-analysis, they also found that the effects of school closures are disproportionately larger for children from disadvantaged homes. Future work will determine the magnitude of the scarring effect on lifetime earnings of the Covid-19 cohort of school-aged children. Finally, the psychological well-being of children was certainly impacted by the pandemic, much of their life was disrupted just as much or more than the adult population. Recall that when altruism was accounted for there is very little opposition to restrictions. Young people do care for the well-being of their children; however, family size is low, and these same young people have parents.[10] Much like the case of lowering the value of life for individuals, any temporary decline in the quality of life of children is unlikely to offset the benefits accrued by their grandparents.

[10] Average size of a Canadian family in 2020 was 3.5 (Statista).

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https://thoughtleadership.rbc.com/covid-consumer-spending-tracker/?utm_medium=referral&utm_source=economics&utm_campaign=special+reports

The report is titled "Household Data Glides into November on a Strong Footing" and was published on Nov 12th 2021

https://thoughtleadership.rbc.com/covid-consumer-spending-tracker/

Statistics Canada Canadians total income:

https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110001201

Statistics Canada Canadians Income by age:

https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1110001201#timeframe

https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1110023901

Statistics Canada Canadians Household Spending:

https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110022701

Statistics Canada Adjusted consumption data:

https://www150.statcan.gc.ca/n1/daily-quotidien/181212/dq181212a-eng.htm

Statistics Canada Unemployment Stats by age

https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410028703

Statistics Canada Labour Force Survey

https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410003001

Statistics Canada Hopefulness Survey

https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2022030-eng.htm

Statistics Canada Marriage Rates

https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3910005501

CERB Information

https://www.canada.ca/en/services/benefits/ei/cerb-application.html

Canada Emergency Response Benefit with CRA - Canada.ca - Canada.ca

Canada Recovery Benefit (CRB) - Canada.ca

Statista Family Size

https://www.statista.com/statistics/478951/average-size-of-families-with-children-in-canada/

Case tracker for Canada – similar to John Hopkins

https://resources-covid19canada.hub.arcgis.com/app/82e586188b7049e1896b771cd4875815

Health Canada CFR

https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html#a1

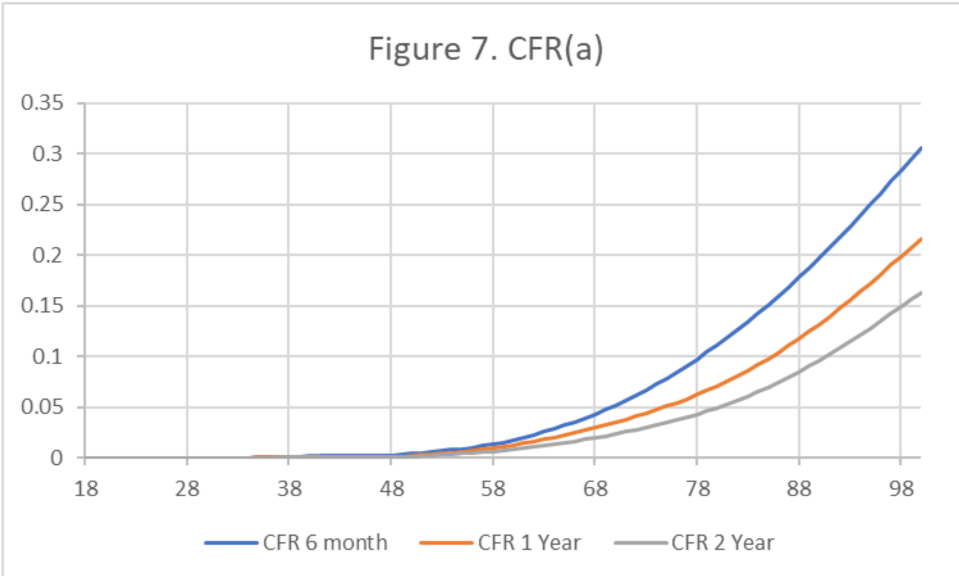
https://health-infobase.canada.ca/Covid-19/epidemiological-summary-Covid-19-cases.html?stat=rate&measure=deaths#a2

Public Health Ontario CFR

https://www.publichealthontario.ca/en/Data-and-Analysis/Infectious-Disease/Covid-19-Data-Surveillance/Covid-19-Data-Tool?tab=ageSex

Appendicies

A2.1 Case Fatality Rate by Age



A2.2 Unemployment rates relative to 2019

Table 1: Unemployment Rates Relative to 2019 Average

age	1st 6 Months	1st Year	2nd Year
18 – 24	14.29%	10%	6.12%
25 – 54	4.89%	3.4%	2.35%
55 – 64	4.21%	3.12%	2.51%

A2.3 Expected Lost Income (Monthly)

Table 2: Monthly Expected Lost Income

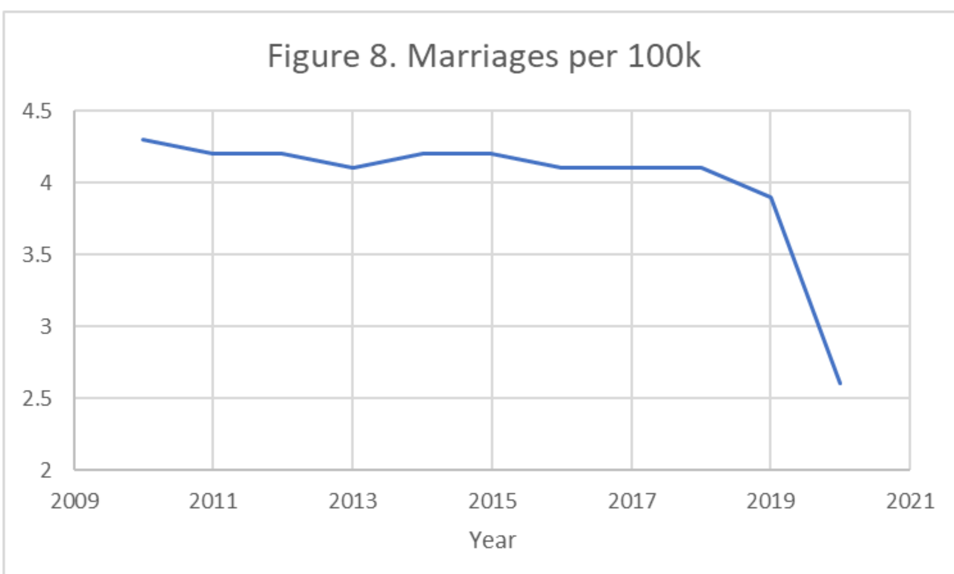
age	Montly Income	Expected Loss with CERB	Without CERB
18 – 24	2292	-42	-327
25 – 54	4758	-135	-233
55 – 64	4700	-114	-198

A2.4 Value of Lost Leisure

Table 3: Monthly Lost Leisure

age	Avg Expd. Restaurants	Avg Expd. Recreation	Weighted Lost Leisure
*Under*30	113	115	-22.5
30 – 39	137	164	-30
40 – 54	79	126	-21
55 – 64	65	135	-20
*Over*65	80	170	-25

A2.5 Marriage Rates



Chapter 3 Secular Stagnation, the Service Economy and Population Aging

3.1 Introduction

The Secular Stagnation Hypothesis (SSH) lay dormant for decades until Larry Summers resuscitated the theory in 2015. First put forth by Alven Hansen in 1939, the hypothesis conjectures that developed economies will be stricken with rates of economic growth below the average of the preceding decades/century as their populations cease to expand or even contract, and profitable investment opportunities become scarce during the later stages of economic development. Since the revival of the theory there has been a plethora of research on the subject, both in agreement and disagreement.

Recently the debate has centered around three arguments- which are complementary. The first is a classical Hicksian IS-LM explanation for the slower economic growth observed in the developed world since the Financial Crisis. If the market clearing interest rate, where savings equals investment, is deeply negative then the economy can be stuck with an excess amount of savings when nominal interest rates are near zero and inflation is itself low – which leaves the real interest rate above the market clearing rate. The developed world resembled this state, before the Covid-19 pandemic, where savings in the economy were in excess of investment and the latter would only increase if the negative real interest rates were to decline further (which would require higher inflation since nominal interest rates cannot fall below zero, the so-called Zero Lower Bound) (Summers, 2015). Until then the economy would be operating below capacity. The second argument claims that the global economy is nearing the end of the third industrial revolution- that being Information and Communication Technologies (ICT)- where the returns on investment begin to decline and then stagnate. Gordon (2015) argues that the personal computer and similar technologies have been fully integrated into modern society. If he is correct, additional investments in ICT R&D will have limited scope and generate minimal returns. He refers to the internal combustion engine as an example. It was one of the primary technological breakthroughs of the Second Industrial Revolution and is now in the process of being phased out of the personal automotive industry due to concerns over environmental degradation. However, even before the transition towards Electric Vehicles (EV) started, the applicability of the internal combustion engine had been actualized. The internal combustion powered vehicles today are just as efficient in transporting people from point A to point B as they were 50 years ago- insofar as the amount of time it takes to make the journey. Admittedly, there are substantive differences between past and present vehicles, such as increased fuel efficiency (and thus decreased carbon emissions), more sophisticated accessories, and advanced safety features. Functionally speaking, however, the two, past and present motor vehicles, are identical. In Gordon's view, ICT is approaching this point of actualization where future iterations of the technology will be less and less different than past iterations.

The third argument is concerned with population aging, specifically the increasing Old Age Dependency Ratio (OADR; the ratio of the population aged 65+ to that aged 20-64) observed in the developed world and projected for the developing world. This paper is focused on how population aging may be contributing to Secular Stagnation.

It must be noted first that not every economist agrees that population aging is bad for economic growth, in particular there has been disagreement over the empirical relationship between population aging and economic growth. Favero and Glasso (2015), and Acemoglu and Restrepo (2017) found a positive relationship between the OADR and real annual economic growth. The former investigated Europe, while the latter used data from across the developed and developing world. Acemoglu and Restrepo (2017) also found evidence of increased investment in labour-replacing technologies and robotics in countries with higher OADRs, as hypothesized by Cutler et al. (1990). Acemoglu and Restrepo (2017) believed that the capital deepening was the cause of the positive relationship between economic growth and population aging. Kotschy and Bloom (2023) use a standard production function, which incorporates capital, labour, and human capital, to structurally estimate the effect of increasing or decreasing the working age population on economic growth. Their analysis uses an unbalanced panel data of 145 countries between the years 1950 – 2015. They make a novel contribution to the literature on population aging and economic growth by including an estimate of the Prospective Old Age Threshold (POAT) – which increases the age limit beyond which people are considered elderly to account for the continual increase in the functional capacity of older workers – into their projections of future economic growth. That is, instead of fixing the old age threshold at 65 they increase the limit, successively with each cohort, in relation to the predicted improvements in functional capacity of labour. Their results indicate that the improved capacity of elderly workers will help to cushion the negative effects of population aging on growth but not so much as to eliminate them.

In contrast to Favero and Glasso (2015) and Acemoglu and Restrepo (2017), Eggertson, Lancanstre and Summers (2019) found evidence of a negative relationship between aging and economic growth. They used the *same dataset* as Acemoglu and Restrepo (2017), but instead of taking the difference between 1990 and 2014, the two end points of the data, they split the data into two parts: before and after the Great Recession, 1990 - 2008 and 2009 – 2014. For the global sample, the negative relationship was present in the second period, while for the restricted OECD sample the sign for aging was always negative but increased in absolute terms and became statistically significant in the second half of the dataset, the years following 2008. The authors believed this was a direct result of the Zero Lower Bound (ZLB) on nominal interest rates and low inflation restricting the real interest rate from declining enough to equate savings and investment. The latter, investment in labour- replacing or assisting technologies, is supposed to offset the decline in working age population, however, when the real interest rate is not low enough there will be too much savings and too little investment which hinders economic growth (as per the classical IS-LM explanation of the business cycle).

That is an interesting finding because aging is a problem for rich countries today and for developing nations tomorrow. These countries will inevitably experience aging as their economies advance through the development stages: whereby economic advancement leads to longer life expectancy; lower childhood, especially perinatal and infant, mortality; a decline in fertility; and then finally after the latter trends stabilize the population begins to age and possibly decline (Lee, 2003).

Prior to the resuscitation of the SSH, using a large panel dataset of developing and developed countries Buera and Kobaski (2011) documented how macroeconomies transition away from manufacturing-based economies towards services-based economies as they progress through the various stages of economic development. In their analysis they did not specifically link population aging to the emergence of the service economy.

In the case of the US, the service sector is responsible for roughly 80% of output, compared to manufacturing which makes up only 12% (Clarke, 2016). This is problematic because the most recent technological improvements in Information and Communication Technologies (ICT) have limited applicability to the service industry. There are several jobs that have not been mechanized over the past three centuries, despite being relatively simple ones. For example, a brick layer today is no faster than they were at the end of the 18th century, and machines that perform that task are only economical for very large construction projects (Clarke, 2016). Also, restaurant staff, such as servers, are performing the same tasks they were 200 years ago: taking orders and bringing food and beverages to the table. There have been significant improvements in the production of food, specifically the emergence of the fast-food industry, however, the tasks of restaurant servers are exactly the same today as they were in the past. Finally, live acoustic concerts, such as operas and orchestras, are also providing the same service to the audience but are paid substantially more to do so today than they were even 200 years ago (Clarke, 2016). What this suggests is that once the productive, surplus generating, sectors of the economy have fully integrated ICT there might be insufficient demand/scope for the technology within the service industry.

Furthermore, Kim (2020) using data from 14 economies over the course of 17 years, estimates the relationship between annual real GDP growth and the concentration of R&D investment (measured using the Herfindahl – Hirschman Index), taking particular interest in the share of R&D investment going to the technological-manufacturing and service industries.[11] He found an inverted u-shaped relationship between R&D concentration and growth, where a certain degree of concentration is necessary for growth but too much is restrictive. With respect to the service industry there was a negative relationship between the concentration of R&D investments going to the latter and real GDP growth, while the share of investment going to tech-manufacturing had a positive impact. When coupled with Clarke's assessment, this has serious

[11] The Herfindahl – Hirschman Index is computed using the individual share of aggregate R&D attributed to each sector.

implications for future growth rates of advanced economies and is suggestive of supply side Secular Stagnation.

More recently, Cravino, Levchenko and Rojas (2022) investigated the relationship between population aging and the structural transformation towards a service economy. Using aggregate data from several OECD countries they observed a positive relationship between population aging and the relative size of the service sector. In an attempt to better understand this statistical relationship, they obtained data from the US Consumer Expenditure Survey on the share of household consumption being spent on services. With this information, and demographic statistics, they applied a shift-share decomposition method and found that approximately 20% of the increase in the household consumption of services between the years 1982 and 2016 can be explained by population aging.

This paper investigates the same question empirically: how does the aging of the median household influence aggregate consumption choices? Specifically, is the trend observed in the US, whereby the basket consumed by households contains an increasing share of services as they approach and then enter retirement age, also present in other developed and developing countries? This is an interesting question for several reasons: the trend observed in the US may be country specific and thus we cannot simply assume it will be true for the rest of the world. It is then necessary to obtain data from other developing nations since they are in various stages of both economic development and demographic transition. For example, it is possible that the relationship between OADR (ratio of those aged 65+ to 20-64) and the demand for services is contingent on achieving a certain level of economic development and life expectancy at birth – population aging might have different economic implications for South Africa than the US, Canada and other rich OECD countries, because life expectancy for that country is much lower than the aforementioned group. Finally, the increased demand for services – which tend to suffer from low to zero productivity growth – due to an aging population contributed to the increase in the relative size of the service sector in the US. This may have had a negative effect on economic growth since productivity growth in that sector has been anemic. It stands to reason that if the population aging is contributing to the increase in the relative size of the service sector in other economies then global economic growth may also slow down as a result. An empirical analysis of this mechanism, connecting population aging to the service economy and then economic growth, is left to future research.

To answer this question, data on country-level aggregate household consumption by sector/classification for Côte d'Ivoire (CI), Hungary (HU), Israel (IL), Mexico (MX), Peru (PE), Poland (PO), the Republic of Korea (KR), Slovenia (SL), South Africa (ZA), Taiwan (TW), the United Kingdom (UK) and Vietnam (VN) was acquired from the Luxembourg Income Study (LIS) and used in combination with country-level GDP and population statistics accessed from the World Bank and the United Nations. These countries were chosen because they had data available for all the goods and services classifications over multiple periods. Fortunately, these countries are from various geographical regions and at different stages of economic development. A country-time panel data model is estimated, and it is found that, conditional on GDP per capita, the Old Age Dependency Ratio (OADR) is negatively correlated with the consumption of food, alcohol, clothing, and education. The OADR is positively correlated with the consumption of health, transportation, and restaurants and hospitality. These three consumption items are generally considered to be services, thus it appears that the relationship between population aging and household consumption of services, as documented in the US, is true for the panel countries investigated in this paper as well.

The remainder of this paper is structured as follows: Section 2 outlines the data used in the analysis; Section 3 presents the methods; Section 4 is the results and Section 5 contains the discussion and concluding remarks.

3.2 Data

GDP per capita (measured in constant 2015 USD) and demographic statistics are sourced from the World Bank "DataBank" (databank.worldbank.org) – which is an open access datacenter. In the case of TW, GDP per capita (measured in current USD) and demographic statistics are taken from Statista and the United Nations Population Division Data Portal, as the World Bank is restricted from publishing any data on that country since it is not recognized as such by China. Using the demographic data, the OADR is computed by dividing the percentage of the population aged 65+ by the percentage of the population aged 20 – 64. There are no gaps in data availability for these statistics (demographic or GDP).

The annual data on the composition of aggregate household consumption for each of the countries are taken from the LIS Data Center.[12] The LIS provides aggregate measures of total household expenditure on consumption as well as aggregate measures of the household consumption of particular goods and services. These goods and services are classified as hc1 to hc12. The following definitions are taken directly from the LIS codebook:[13]

- hcexp: Total consumption including that stemming from goods and services that have been purchased by the household, and goods and services that have not been purchased, but either given to the household from somebody else, or self-produced. Excludes imputed rent.

[12] The data must be used for scholarly, research or educational purposes only. Students from across the world can access the LIS/WIS database for free. Whereas researchers must come from financially contributing countries or financially contributing institutions to be granted full access to the database at no cost.
[13] The LIS codebook can be found here: https://www.lisdatacenter.org/our-data/lis-database/

- hc1: Consumption of food and non-alcoholic beverages. Ideally, corresponds to Code 01 of the COICOP classification. [14]

- hc2: Consumption of alcoholic beverages, tobacco, and narcotics. Ideally, corresponds to Code 02 of the COICOP classification.

- hc3: Consumption of clothing and footwear. Ideally, corresponds to Code 03 of the COICOP classification.

- hc4: Consumption of housing (actual rentals and maintenance and repair of the dwelling), water (water supply and miscellaneous services relating to the dwelling), electricity, gas, and other fuels, for both the primary and secondary residences (kept for own use). Renovation costs as well as expenditure on furniture are excluded, as well as expenditures on mortgages (both the capital and interest parts).[15] Ideally, corresponds to Code 04 of the COICOP classification with the exception of imputed rent which is included according to COICOP and excluded from this variable.

- hc5: Consumption of furnishings (furniture and furnishings, carpets, and other floor coverings), household equipment (household textiles, household appliances, glassware, tableware and household utensils, tools and equipment for house and garden) and goods and services for routine household maintenance. Ideally, corresponds to Code05 of the COICOP classification.

- hc6: Consumption of health goods and services, including medical products, appliances and equipment, outpatient services, and hospital services. Payments for health insurance are excluded.[16] Ideally, corresponds to Code 06 of the COICOP classification.

[14] COICOP is the abbreviation of the Classification of Individual Consumption by Purpose which is the United Nation's international reference classification of household expenditure which does not always perfectly match the LIS codebook.
[15] It is not specified whether mortgage reimbursements are included in this measure.
[16] Contributions made to publicly financed health services are excluded.

- hc7: Consumption of transport, including purchase of vehicles, operation of personal transport equipment, and transport services. Ideally, corresponds to Code 07 of the COICOP classification.

- hc8: Consumption of communication, including postal services, telephone and telefax equipment, and telephone and telefax services. Ideally, corresponds to Code 08 of the COICOP classification.

- hc9: Consumption of recreation and culture, including audio-visual, photographic and information processing equipment, other major durables for recreation and culture, other recreational items and equipment, gardens and pets, recreational and cultural services, newspapers, books and stationery, package holidays. Ideally, corresponds to Code 09 of the COICOP classification.

- hc10: Consumption of education, including pre-primary and primary education, secondary education, post-secondary, non-tertiary education, tertiary education, and education not definable by level.[17] Ideally, corresponds to Code 10 of the COICOP classification.

- hc11: Consumption of restaurants (catering services) and hotels (accommodation services). Ideally, corresponds to Code 11 of the COICOP classification.

- hc12: Consumption of miscellaneous goods and services, such as personal care, prostitution, personal effects (not elsewhere classified), social protection, insurance, financial services (not elsewhere classified), other services (not elsewhere classified). Ideally, corresponds to Code 12 of the COICOP classification.

[17] As with hc6, these are strictly private expenditures, and exclude taxes paid to finance publicly funded education.

For each country and year, variables hc1 to hc12 are then divided by hcexp to calculate the share of aggregate household consumption that is dedicated to each of these categories. Note that adjusting hcexp and the hc classifications by Purchasing Power Parity or real exchange rates is unnecessary as these are ratios. Data availability for the LIS variables are as follows:

- HU (1999, 2005, 2007, 2009, 2012, 2015)
- KR (2006, 2008, 2010, 2012, 2014, 2016)
- IL (2001-2017)
- CI(2002, 2008, 2015)
- MX(1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016)
- PL(1999, 2004, 2007, 2010, 2013, 2016, 2019)
- PE(2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018)
- SL(1999, 2004, 2007, 2010, 2012, 2015)
- ZA(2008, 2010, 2012, 2015, 2017)
- TW (1997, 2000, 2005, 2007, 2010, 2013, 2016)
- UK(1968, 1971, 1974, 1977, 1980, 1983, 1986, 1989, 1992)
- VN(2005, 2007, 2009, 2011, 2013).

HU is missing one observation of hc11 for the year 1999. The UK does not have any data on hc3, hc6, hc8, hc10 nor hc11. Data for hc9 is only available for the years 1989 and 1992 in the UK. None of the remaining countries are missing any observations.

Table 1 contains the descriptive statistics of the 12 dependent variables – which are the share of total household dedicated to each hc categories - as well as the independent variables OADR and GDP.pc.

Table 1: Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
hc1.p	90	0.253	0.083	0.141	0.453
hc2.p	90	0.032	0.046	0.002	0.190
hc3.p	81	0.048	0.016	0.006	0.091
hc4.p	90	0.135	0.057	0.069	0.333
hc5.p	90	0.060	0.022	0.012	0.141
hc6.p	81	0.058	0.029	0.017	0.152
hc7.p	90	0.123	0.036	0.042	0.202
hc8.p	81	0.046	0.015	0.004	0.089
hc9.p	83	0.063	0.033	0.018	0.164
hc10.p	81	0.045	0.026	0.005	0.112
hc11.p	80	0.074	0.051	0.007	0.195
hc12.p	90	0.089	0.042	0.021	0.220
OADR	90	0.177	0.062	0.055	0.291
GDP.pc	90	14,839.610	10,706.520	693.190	42,406.850

hc1.p, the share of consumption reserved for food and non-alcoholic beverages is the outlier- which is unsurprising since this is a necessity for survival. hc1.p has the largest minimum share and largest maximum share, at 0.141 and 0.453 respectively. The absolute minimum share of household consumption is spent on hc2.p, alcoholic beverages. The maximum of hc2.p however, is quite large, nearly 20% of household expenditure on consumption goods and services. hc8.p has the smallest maximum value, with only 8.9% of household expenditure being spent on this good/service. The remaining hc shares are rather similar in that their min and max values do not differ too significantly from one another.

As for the OADR, the minimum ratio is 0.055 while the maximum is 0.291, with a mean of 0.177. Likewise, there is substantial variation in GDP per capita, the minimum is $693.19 USD and max is $42,406.25 (both in 2015 current USD).

3.3 Methods

To estimate the relationship between the share of household expenditure dedicated to each of the hc categories and the OADR, a country-time panel data model is used. In the appendix the matrix of the cross-correlation of the 12 errors terms is presented. This was estimated using the Seemingly Unrelated Regression (SUR) package in R. Note this is a special case where the independent variables are the same across the different regression equations, so the only benefit of SUR is estimating the cross-correlations of the error terms since the coefficient estimates are equivalent to the separate OLS estimates. Data on the prices for each of the hc categories, by country and year, are not readily available. However, if they were this would be an ideal opportunity to estimate a variant of the Almost Ideal Demand System introduced by Deaton and Muellbauer (1980).

Equation 2 below is estimated 12 times, once for each of the respective hc classifications. Where $y_{c,t}$ is defined as:

$$y_{c,t} = \frac{hc\#\#_{c,t}}{hcexp_{c,t}} \qquad (1)$$

the ratio of household expenditure that is spent on hc1, hc2, hc3,…, hc12.

$$y_{c,t} = \beta_1 OADR_{c,t} + \beta_2 GDP.pc_{c,t} + \lambda_c + \epsilon_{c,t} \qquad (2)$$

$OADR_{c,t}$ is the fraction of the population aged 65+ to that aged 20 – 64. $GDP.pc_{c,t}$ is Gross Domestic Product per capita and included to control for the fact that the OADR is highly and positively correlated (see Figure 1) with economic development and so too are the demand for various consumption goods and services.[18] If $GDP.pc_{c,t}$ were omitted, then any correlations between OADR and the dependent variable would likely be spurious. λ_c are the country fixed effects to account for cultural, sociological, political, and geographical factors that are time invariant, specific to each country and potentially correlated with $y_{c,t}$ and/or the independent variables. Since the time periods for the LIS data is sporadic, meaning there are several years with just one or two observations when the maximum is twelve, year fixed effects were excluded from equation 2. Finally, $\epsilon_{c,t}$ is the random error term. The error terms from the 12 different specifications are highly correlated with each other, for some error terms the correlation is great than 0.5 (see Table 8 in the appendix). Finally, the error terms are estimated using the default heteroskedastic standard errors in the LFE package of R.

In the appendix, the results from splitting the 12 countries into two groups and then estimating equation 2 again are presented and discussed. The groups are organized in accordance with Figure 1 (also in the appendix) which displays the relationship between OADR and GDP.pc from the dataset. There are two distinct clusters of countries, the first is comprised of developing and recently developed nations: CI, KR, IL MX, PE, TW, VN and ZA. The final group of nations is all-European: HU, PL, SL and UK. If you draw a 45° line starting from the value of 0.1 on the y-axis towards the right-hand side of Figure 1 all the European countries lie above the line and the remaining countries are below. This is how the clusters are determined.

$$y_{c,t} = \beta_1 OADR_{c,t} + \beta_2 GDP.pc_{c,t} + \beta_3 GDP.pcSQ_{c,t} + \lambda_c + \lambda_y + \epsilon_{c,t} \qquad (3)$$

[18] GDP.pc is divided by 100 000 so that the estimated coefficients thereof are not presented as 0.00 on the tables in the results section.

A final regression, equation 3, which accounts for year fixed effects, λ_y, and a non-linear relationship between the hc variables and GDP.pc is also presented in the appendix.

3.4 Results

	hc1	hc2	hc3	hc4	hc5	hc6
OADR	−0.41 (0.17)*	−0.02 (0.06)	−0.16 (0.06)**	−0.22 (0.27)	−0.17 (0.12)	0.22 (0.10)*
GDPcap	−0.10 (0.06)°	−0.06 (0.02)**	−0.02 (0.02)	0.06 (0.09)	0.07 (0.04)	−0.01 (0.03)
Num. obs.	90	90	81	90	90	81
R^2 (full model)	0.96	0.98	0.86	0.77	0.70	0.89
R^2 (proj model)	0.23	0.22	0.22	0.01	0.04	0.09
Adj. R^2 (full model)	0.95	0.98	0.83	0.73	0.65	0.87
Adj. R^2 (proj model)	0.10	0.09	0.09	−0.16	−0.13	−0.07
Num. groups: C.ID	12	12	11	12	12	11

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD (except for Taiwan, where it is measured in current, 2023 USD). The model is estimated using country fixed effects and the standard errors are heteroskedastic robust.

Table 2: Country-Time Panel

Above are the results from estimating equation 2, including all the countries, for hc1 – hc6. The number of countries, C.ID, is 11 in columns 3 and 6 because the UK does not provide data for neither hc3 nor hc6.

Beginning with column 1 where the dependent variable is hc1.p there is a negative statistical relationship with both OADR and GDP.pc, with the former being slightly more significant than the latter. That the fraction of total consumption that is dedicated to food and non-alcoholic beverages declines as both the OADR and GDP.pc increases is unsurprising. Conditional on GDP.pc, those aged 65+ tend to eat less or eat less costly food than those aged 20-64, so the total share of their income dedicated to these goods will fall. Furthermore, the majority of additional household wealth from economic development will be spent on other goods once subsistence is achieved. Though people will still substitute away from inferior foods (Kraft Dinner) for superior foods (steak, desserts, fine cheese, and champagne).

Surprisingly, there is no correlation between hc2.p, the share of expenditure on alcohol and OADR, it is strongly and negatively correlated with GDP.pc, however. The rationale is the same as with hc1.p, as household become richer, they will spend the same amount of their income on alcohol and use the extra income on other consumption goods and services. It is also plausible that households use the additional income to purchase more expensive alcohol in the same or lesser quantity, however, the fact remains that overall, they are spending a smaller fraction of their consumption expenditure on alcohol as GDP.pc increases.

Hc3.p, share of expenditure on clothing and footwear, is strongly and negatively correlated with OADR, but has no statistical relationship with GDP.pc. Higher OADR is the result of longevity and lower birth rates, fewer fashion-sensitive young people and more fashion-indifferent elderly, means that the demand for these items falls. Furthermore, children and young people physically outgrow their clothing as well as preferentially.

Hc4.p, share of expenditure on actual rent and utilities, has no relationship with either OADR or GDP.pc. Whereas hc5.p, the share of expenditure on housing equipment, is weakly negatively correlated with OADR but not GDP.pc. The p-value of the OADR coefficient is 0.161- which is very close to, but not conventionally considered as, statistical significance. A simple interpretation is that older people move to lower maintenance properties (rentals or newer homes), or they are skimping on home repair.

Hc6, share of expenditure on private, not public, health goods and services, is positively correlated with OADR but not correlated with GDP.pc. The latter result is unexpected, while the former is expected. Precisely how much the additional expenditure on private health goods and services, due to an increasing OADR, is influenced by the structure of the healthcare systems of each country, though interesting, is beyond the scope of this paper.

Below, Table 2 presents the results from estimating equation 2 for the hc7.p – hc12.p variables. As with Table 1, columns 2, 4 and 5, have 11 countries because the UK does not have any data for these variables. The UK has limited data for hc9, and two large outliers were removed from hc12.p (1989 and 1992).

	hc7	hc8	hc9	hc10	hc11	hc12
OADR	0.19 (0.11)	0.08 (0.11)	−0.03 (0.07)	−0.08 (0.05)	0.42 (0.21)*	0.07 (0.10)
GDPcap	0.01 (0.04)	−0.00 (0.04)	−0.08 (0.03)**	−0.00 (0.02)	0.08 (0.07)	0.14 (0.04)***
Num. obs.	90	81	83	81	80	88
R^2 (full model)	0.89	0.45	0.95	0.96	0.83	0.94
R^2 (proj model)	0.07	0.01	0.19	0.05	0.15	0.28
Adj. R^2 (full model)	0.88	0.36	0.94	0.95	0.80	0.92
Adj. R^2 (proj model)	−0.09	−0.16	0.04	−0.12	−0.00	0.15
Num. groups: C.ID	12	11	12	11	11	12

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD (except for Taiwan, where it is measured in current, 2023 USD). The model is estimated using country fixed effects and the standard errors are heteroskedastic robust.

Table 3: Country-Time Panel

Hc7.p, the share of expenditure on transport, has a weakly positive correlation with OADR and no statistical relationship with GDP.pc. The p-value of the OADR coefficient for hc7 is 0.108. Persons aged 65+ become increasingly dependent, and in particular less mobile, as they age. Thus, it is sensible that households spend a larger share of their total expenditure on transportation, both public and private.

The share of expenditure on communications, hc8.p, has no statistical relationship with OADR or GDP.pc. The share of expenditure on recreation and culture, hc9.p, is uncorrelated with OADR but has a negative correlation with GDP.pc. This result is somewhat surprising as recreation and culture should be luxury goods – the consumption of which increases with income, or in the context of this model, GDP.pc. The observed negative correlation is likely the result of expenditure on recreation and culture increasing at a slower rate than total household income.

Moving to hc10.p, share of household expenditure on private education, has a weakly significant and negative relationship with OADR and is conditionally uncorrelated with GDP.pc.

The p-value of the coefficient of OADR is 0.134. As the share of households aged 65+ increases, it is unsurprising that households are spending less of their disposable income on education as that is typically reserved for infants and young adults.

Hc11.p, the share of expenditure on restaurants and hospitality, has a positive and significant relationship with OADR. GDP.pc does not have a statistically significant relationship with the share of expenditure on restaurants and hospitality.

Finally, hc12.p, which is the share of expenditure on miscellaneous goods and services, is positively correlated with GDP.pc but uncorrelated with OADR. This result likely reflects the broad nature of the hc12.p variable (it includes prostitution, financial services, personal care, and personal effects). All these goods are normal goods in that their demand increases with wealth, however, their combined relationship with the OADR is ambiguous.

3.5 Discussion

The results from this analysis strongly suggest that population aging is positively correlated with the share of household consumption spent on services, specifically the fraction of consumption expenditure devoted to transportation, health and restaurants and hospitality. Transportation and health do include durable goods as well as services, so it is plausible that the majority of the increased expenditure thereon is the result of consuming more transport and health goods/equipment, as opposed to services. However, even if the minority of the increase expenditure is spent on services, there is still a positive relationship with the latter and OADR. These correlations are conditional on controlling for GDP per capita and country specific fixed effects (but, due to data limitations not time fixed effects). It is reasonable to suggest that the case of the US is not unique and that the emergence of the service economy in other countries can be partially attributed to aging households demanding more private sector services relative to the other types of consumer goods.

There are three major observations/questions deriving from the positive relationship between the share of household consumption dedicated to services and the OADR that will be explored. Firstly, it is possible that population aging is contributing to Secular Stagnation via an increasing share of household consumption being spent on services (both private and public). Resources are being reallocated away from sectors with higher productivity growth towards the service industry. The relative size of the service sector is negatively correlated with GDP growth (Kim, 2020) which is probably due to the low to zero productivity growth observed therein (Clarke, 2016). The direct empirical relationship between population aging, the size of the service sector and economic growth is left to future research.

The second observation is related to the “Cost Disease” (Baumol, 1993) and how population aging is contributing thereto. One of Baumol’s primary questions was whether or not the private sector should be responsible for the procurement of public services, to help minimize the costs thereof, as the US was continuing to spend an increasing share of GDP on education and healthcare. The fundamental difference between Baumol’s past observations and predictions, is that, presently, both private and public services are accounting for an increasing share of GDP, not just government spending. As this paper, and Cravino, Lechenko and Rojas (2022) indicate, the demand for private sector services is linked with population aging- which is not exclusively a problem of government inefficiency or largesse. Therefore, it no longer appears to be a question of public or private provision, instead, the increased share of the GDP spent on services may simply be the inevitable result of population aging.

Thirdly, in an era of post-scarcity – where fully developed rich countries such as Canada are capable of providing the most basic needs to their entire population, though for various reasons most rich countries are failing to do so – is the emergence of the service economy and even Secular Stagnation undesirable? If households, choose to redirect their consumption towards services as they age that is their prerogative and an efficient outcome in a market economy. Furthermore, the service sector does not become the dominant industry of the economy until the later stage of economic development. Perhaps this is what happens during the post-scarcity stage of development? All of the material needs of the economy are met, the additional surplus being created is now allocated towards services. This is a luxury. Demand for agricultural output and manufacturing durables is finite and proportionate to the size of the population. Once domestic demand is satiated consumers turn to alternatives, chief amongst these being services – leisure is another option that has not been popularized. That being said, there still exists an opportunity cost to producing these services but it is much lower for developed countries as opposed to developing nations. Holding this to be true one could argue there is little to be concerned about when observing the rise of the service economy instead, perhaps, this could be applauded as a marker of advanced economic development.

This would also imply that slower growth rates are not a cause for concern either or, perhaps, are illusionary. It could be argued that economies are growing more slowly because they are more service orientated by choice, where productivity growth is slow or zero, as opposed to manufacturing based where there is still productivity growth. Ignoring the service sector, the rest of the economy could be growing at a rate within historical norms but when pooled together with the service industry aggregate GDP growth rates are lower.

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Data Sources

Taiwan GDP

https ://www.statista.com/statistics/727592/gross-domestic-product-gdp-per-capita-in-taiwan/

World Bank GDP Statistics

https://databank.worldbank.org/reports.aspx?source=2&series=SP.POP.1564.TO.ZS&country=#

UN Population Statistics

https ://population.un.org/dataportal/

Appendices

A3.1 Tables

	hc1	hc2	hc3	hc4	hc5	hc6
OADR	−0.59 (0.28)*	0.02 (0.03)	−0.02 (0.07)	−1.38 (0.44)**	−0.09 (0.17)	0.54 (0.17)**
GDPcap	0.02 (0.07)	−0.01 (0.01)	−0.02 (0.02)	0.18 (0.11)	−0.01 (0.04)	−0.06 (0.04)
Num. obs.	62	62	62	62	62	62
R^2 (full model)	0.96	0.91	0.88	0.46	0.78	0.88
R^2 (proj model)	0.11	0.05	0.07	0.16	0.02	0.18
Adj. R^2 (full model)	0.96	0.90	0.86	0.37	0.74	0.86
Adj. R^2 (proj model)	−0.04	−0.12	−0.09	0.02	−0.15	0.03
Num. groups: C.ID	8	8	8	8	8	8

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD (except for Taiwan, where it is measured in current, 2023 USD). The model is estimated using country fixed effects and the standard errors are heteroskedastic robust.

Table 4: Group 1 Country-Time Panel

Table 4, above, and Table 5, below, present the results from splitting the pool of countries into two groups – in accordance with the criteria outlined in the methodology section (sorting countries by plotting GDP.pc against OADR as shown in Figure 1, where there are two distinct clusters of countries, one in the top left corner and the other spans the middle and middle right area of the graph). The countries in this first group include: CI, KR, IL, MX, PE, TW, VN and ZA. These countries span different geographical regions and levels of economic development.

As with the pooled model, hc1 is negative and significant at the 5% level. The coefficient is slightly larger, equal to -0.59 compared to -0.41. hc2 is still unrelated to the OADR. The relationship between the OADR and relative consumption of hc3 has been eliminated. Evidently, clothes and footwear are still in high demand for these countries when their population is aging. Relative consumption of hc4, which was not significant in the pooled model, now declines with the OADR. The consumption of housing (actual rents and maintenance) declines as populations age. This could possibly be explained by the prevalence of older generations living in the same dwellings as younger generations-which was once commonplace in the developed world but is now a rarity. hc5 is still uncorrelated with OADR. The positive correlation between hc6 is now larger in magnitude and more statistically significant (beyond the 1% level). Previously, the coefficient was 0.22, and now it is 0.54, a substantial increase. It appears that the consumption of private health goods and services is more pronounced amongst these countries than it is for the entire set. This might indicate that the relationship between OADR and the consumption of hc6 is non-linear. The same is true for conditioning on GDP.pc.

	hc7	hc8	hc9	hc10	hc11	hc12
OADR	0.36 (0.21)°	0.11 (0.20)	0.16 (0.11)	−0.17 (0.10)°	1.01 (0.38)**	0.20 (0.19)
GDPcap	−0.03 (0.05)	−0.04 (0.05)	−0.13 (0.03)***	0.01 (0.02)	0.01 (0.09)	0.12 (0.05)*
Num. obs.	62	62	62	62	62	62
R^2 (full model)	0.86	0.36	0.95	0.92	0.79	0.83
R^2 (proj model)	0.06	0.01	0.36	0.07	0.21	0.28
Adj. R^2 (full model)	0.83	0.24	0.95	0.90	0.76	0.80
Adj. R^2 (proj model)	−0.10	−0.16	0.25	−0.09	0.07	0.16
Num. groups: C.ID	8	8	8	8	8	8

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD (except for Taiwan, where it is measured in current, 2023 USD). The model is estimated using country fixed effects and the standard errors are heteroskedastic robust.

Table 5: Group 1 Country-Time Panel

Moving onto Table 5, above, we can see that the relationship between hc7 and OADR is still positive, though it is now larger in magnitude and statistical significance. Previously the coefficient was 0.19, while it is now 0.36, and the p-value was above the 10% threshold, while it is now below. The increased consumption of transportation goods and services is thus stronger for these countries. Again, this might be explained by a non-linear relationship in GDP.pc and/or the OADR, countries at the early to mid stage of economic development, and population aging, could be increasing their consumption of transportation goods and services more aggressively than the developed countries because these are luxury/normal goods that have recently become attainable to the average consumer. hc8 remains uncorrelated with OADR. hc9, though still not statistically significant, has changed sign, from -0.3 to 0.11 and the p-value is now just over 15% whereas it was previously above 60%. This suggests that he consumption of recreation and culture is increasing with OADR. As with transportation goods and services, the increased consumption of recreation and culture for this set of countries could be explained by a non-linear relationship between either OADR or GDP.pc and consumption choices, where the relationship is concaved (the consumption variable being on the y-axis and the independent variable on the x-axis). hc10 was nudged below the the 10% significance threshold. The interpretation of this result is less clear. As countries become wealthier, birth rates decrease and the investment in children's human capital increases, at least for the developed world. It is plausible to suggest that these countries have yet to reach the stage of development where birth rates have dropped below replacement and the investment in children's human capital arms race begins. The relationship between the consumption of restaurants and OADR has also increased in magnitude and statistical significance. This fits in with the previous narrative of a potential non-linear relationship between hc11 and the independent variables. Restaurants being a luxury/normal good would become increasingly popular as economies develop and then the consumption of which would plateau beyond a certain level. Finally, the relationship between hc12 remains the same. Interestingly both the coefficient and standard deviation nearly doubled in scale. Overall, the increased relative consumption of services (private health, transport, and restaurant and hospitality) with OADR is present for this subset of countries.

	hc1	hc2	hc3	hc4	hc5	hc6
OADR	−0.10 (0.19)	0.09 (0.09)	−0.12 (0.12)	0.29 (0.28)	−0.37 (0.18)$^{\circ}$	0.02 (0.04)
GDPcap	−0.37 (0.09)***	−0.21 (0.04)***	−0.16 (0.08)$^{\circ}$	0.07 (0.13)	0.26 (0.08)**	0.04 (0.03)
Num. obs.	28	28	19	28	28	19
R^2 (full model)	0.95	0.99	0.89	0.84	0.66	0.96
R^2 (proj model)	0.63	0.62	0.51	0.14	0.31	0.37
Adj. R^2 (full model)	0.94	0.99	0.86	0.81	0.59	0.95
Adj. R^2 (proj model)	0.54	0.54	0.37	−0.06	0.15	0.19
Num. groups: C.ID	4	4	3	4	4	3

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD. The model is estimated using country fixed effects and the standard errors are heteroskedastic robust.

Table 6: Group 2 Country-Time Panel

Table 6, above, and Table 7, below, present the results from the second group of countries: HU, PL, SI, and UK. All these countries are developed nations, unlike the first group. Note that the sample has been drastically reduced, the first group has 62 time-country observations, while the second has 28. The coefficent of hc1 has shrunk and is no longer statistically significant. Even when these countries age their consumption of food and alcohol thus remains unchanged. This may be explained by the prevelance of **alcoholism**, and the over indulgence in food, that is common within European culture. hc2 is still insignificant. Alternatively, hc3, no longer has a statistically significant relationship with OADR. Compared to the pooled model the coefficient has shrunk by 25%, from 0.16 to 0.12, while the stanard error has increased by 100%, 0.6 to 0.12. The latter is at least partially due to the smaller sample size, while the former is puzzling. hc4 is still does not have significant statistical relationship with OADR. For hc5, the coefficient is now substantially larger, moving from -0.17 to -0.37, and has a statistical significance below the 10% threshold. The households of developed European countries are decreasing their consumption of furnishings as they age. This makes sense intuitevly, consumers slowly build up a collection of furniture throughout their life-which, being a highly durable good, can last for decades if not longer. Finally, hc6 is no longer increasing with OADR. The private consumption of health goods and services is not increasing as these households age. Health care for these contries is predominantly administered within the public system. Thus, it is likely that the majority of additional expenditure due to population aging will be public and not private.

	hc7	hc8	hc9	hc10	hc11	hc12
OADR	0.05 (0.12)	−0.09 (0.07)	−0.28 (0.09)**	−0.04 (0.04)	0.19 (0.13)	0.01 (0.11)
GDPcap	0.09 (0.06)	0.21 (0.05)***	0.14 (0.06)*	−0.00 (0.02)	0.00 (0.09)	0.14 (0.06)*
Num. obs.	28	19	21	19	18	26
R^2 (full model)	0.95	0.86	0.97	0.34	0.83	0.99
R^2 (proj model)	0.22	0.65	0.39	0.14	0.25	0.32
Adj. R^2 (full model)	0.94	0.82	0.95	0.16	0.78	0.98
Adj. R^2 (proj model)	0.04	0.54	0.19	−0.11	0.02	0.15
Num. groups: C.ID	4	3	4	3	3	4

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD. The model is estimated using country fixed effects and the standard errors are heteroskedastic robust.

Table 7: Group 2 Country-Time Panel

hc7 is now uncorrelated with OADR. The results observed in the pooled model were driven by the first group of countries, as discussed above the coefficient in Table 5 is positive and significant below the 10% level of significance. It appears that transportation patterns for the European countries remains constant over the lifecycle. hc8 has changed in sign compared to the pooled model but is not significant. hc9 is now negatively related with OADR, the coefficient is -0.28 compared to -0.03 in the pooled model, and the significance is below the 1% threshold. Recreation and culture in Europe seem to be consumed more by younger households than older ones. This makes sense for these countries since economic development over our sample period has been less intense, and thus the opportunities for leisure and recreation more stable. hc10 remains uncorrelated with OADR. hc11 is still positively correlated with OADR, however, the coefficient is much smaller, at 0.19 compared to 0.42, and the significance is just above 15%. Therefore, the relationship between restaurants and the OADR is less pronounced for the European countries, but still notable. Finally, hc12 is still unrelated with OADR.

	hc1	hc2	hc3	hc4	hc5	hc6
OADR	−0.59 (0.38)	−0.06 (0.05)	−0.00 (0.12)	−0.05 (0.58)	−0.34 (0.18)°	0.64 (0.18)***
GDPcap	−0.24 (0.47)	0.03 (0.06)	0.23 (0.15)	−0.10 (0.72)	−0.02 (0.23)	0.29 (0.22)
GDPsq	0.44 (0.71)	−0.03 (0.09)	−0.30 (0.23)	0.25 (1.10)	−0.05 (0.34)	−0.40 (0.33)
Num. obs.	90	90	81	90	90	81
R^2 (full model)	0.97	1.00	0.92	0.87	0.92	0.95
R^2 (proj model)	0.07	0.04	0.06	0.01	0.11	0.26
Adj. R^2 (full model)	0.95	1.00	0.86	0.75	0.84	0.91
Adj. R^2 (proj model)	−0.85	−0.90	−0.67	−0.97	−0.77	−0.31
Num. groups: Year	32	32	23	32	32	23
Num. groups: C.ID	12	12	11	12	12	11

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; °$p < 0.1$.
OADR, the Old Age Dependency Ratio, is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD. The model is estimated using country and year fixed effects while the standard errors are heteroskedastic robust.

Table 8: Pooled Country-Time Panel With GDPsq and Year FE

Finally, Table 8, above, and Table 9, below, present the results from including GDP.pc squared, GDPsq, and controlling for year fixed effects. Comparing the results to the pooled model, presented in Tables 2 and 3, we can see that the relationship between hc1, food and non-alcoholic beverages, is no longer significant below the 5% threshold. The p-value is 0.124, meaning there still exists a negative relationship between hc1 and OADR, however, it is less strong after controlling for year fixed effects and GDPsq. hc2 is still does not have a statistical relationship with OADR. Interestingly, the relationship between hc3 and OADR has now been completely eliminated. The relative decline in consumption of clothing and footwear can be explained away by GDPsq – technically year fixed effects could play a role, though the logic is less clear as demand for footwear and clothing is rather stable overtime. hc4 still does not have a statistical relationship with OADR. hc5, however, now has a larger and more significant relationship with OADR. The coefficient has increased exactly twofold, from -.17 to -0.34 and now has a p-value equal to 0.064. Thus, the consumption of furnishings does appear to decline with the OADR – this was true for European countries without controlling for GDPsq and year fixed effects, as demonstrated in Table 6. hc6, the relative consumption of private health goods and services is increasing substantially with OADR. the p-value is below the 0.01% threshold, previously below the 5%, and the coefficient has almost tripled from 0.22 to 0.64. Previously, GDP.pc was negatively correlated with hc6, though insignificantly so. Now the relationship resembles an inverted u, meaning that after controlling for OADR, hc6 declines as GDP.pc increases. This trend is compatible with the earlier argument which claims countries tend towards publicly procured health care as they develop.

	hc7	hc8	hc9	hc10	hc11	hc12
OADR	−0.01 (0.23)	−0.14 (0.16)	−0.06 (0.15)	0.01 (0.13)	−0.07 (0.39)	0.14 (0.24)
GDPcap	−0.65 (0.28)*	−0.15 (0.20)	0.47 (0.18)*	−0.15 (0.16)	0.16 (0.49)	0.26 (0.29)
GDPsq	1.00 (0.43)*	−0.02 (0.31)	−0.87 (0.28)**	0.23 (0.24)	−0.33 (0.74)	−0.19 (0.44)
Num. obs.	90	81	83	81	80	88
R^2 (full model)	0.95	0.84	0.97	0.97	0.92	0.96
R^2 (proj model)	0.11	0.32	0.27	0.02	0.01	0.14
Adj. R^2 (full model)	0.90	0.71	0.95	0.94	0.86	0.92
Adj. R^2 (proj model)	−0.76	−0.21	−0.33	−0.74	−0.77	−0.67
Num. groups: Year	32	23	25	23	23	30
Num. groups: C.ID	12	11	12	11	11	12

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\circ}p < 0.1$.
OADR, the Old Age Dependency Ratio,is the ratio of the total population aged 65+ to the total population aged 20 - 64. GDP.pc is the Gross Domestic Product per capita, measured in constant 2015 USD. The model is estimated using country and fixed effects while the standard errors are heteroskedastic robust.

Table 9: Pooled Country-Time Panel With GDPsq and Year FE

Moving onto Table 9 we can see that non of the variables have a significant relationship with OADR. In Table 3, hc7 is on the boundry of statistial significant, p-value of 0.108, now the p-value is approximately 0.959. The consumption of private transportaion goods and services appears to be rather stable across various stages of popuation aging, after controlling for GDP.pc, GDPsq and year and time fixed effects. Note that the coefficient of GDP.pc is negative, and the coeffcient of GDPsq is positive, so the relationship between GDP.pc and OADR is a u-shaped parabola. Previously it was modelled to be linear, meaning the increaseed consumption due to higher GDP.pc was not being properly accounted for, and hence the estimates were biased upwards. After introducing the non-linear relationship the coeffcient of OADR has almost gone to zero. The same logic can be applied to the variables hc10 and hc11, however, the estimated non-linear relationship between these variables and GDP.pc is statistically insignificant.

Table 10, Covariance Matrix from Seemingly Unrelated Regression of HC1 - HC12

	HC1	HC2	HC3	HC4	HC5	HC6	HC7	HC8	HC9	HC10	HC11	HC12
HC1	1	0.1516046	0.5342187	0.3533174	0.5889488	0.5174903	0.537531	0.5413267	0.1230781	0.5745551	0.5014223	0.437775
HC2	0.151605	1	0.0764736	0.1221897	0.3486113	0.0610562	0.20509	0.1590191	0.0750525	0.1883435	-0.0257605	0.488956
HC3	0.534219	0.0764736	1	-0.1290652	0.5711705	0.3943213	0.797369	0.5022571	0.3973484	0.6118087	0.5635677	0.680217
HC4	0.353317	0.1221897	-0.1290652	1	0.0730147	0.0693207	-0.110098	0.1340809	-0.0502096	0.1423659	-0.3364567	-0.153775
HC5	0.588949	0.3486113	0.5711705	0.0730147	1	0.1801258	0.753622	0.4048832	0.4217108	0.4689247	0.2537473	0.768032
HC6	0.51749	0.0610562	0.3943213	0.0693207	0.1801258	1	0.234244	0.2914667	0.0470349	0.6394942	0.6118143	0.463027
HC7	0.537531	0.20509	0.7973691	-0.1100978	0.7536219	0.2342438	1	0.4686531	0.4905446	0.5311426	0.3642444	0.744117
HC8	0.541327	0.1590191	0.5022571	0.1340809	0.4048832	0.2914667	0.468653	1	0.0764704	0.5269555	0.4438348	0.308949
HC9	0.123078	0.0750525	0.3973484	-0.0502096	0.4217108	0.0470349	0.490545	0.0764704	1	0.0155676	-0.027803	0.371562
HC10	0.574555	0.1883435	0.6118087	0.1423659	0.4689247	0.6394942	0.531143	0.5269555	0.0155676	1	0.6727142	0.520978
HC11	0.501422	-0.0257605	0.5635677	-0.3364567	0.2537473	0.6118143	0.364244	0.4438348	-0.027803	0.6727142	1	0.390269
HC12	0.437775	0.4889562	0.6802166	-0.1537754	0.7680319	0.4630268	0.744117	0.3089485	0.3715621	0.5209779	0.3902688	1

A3.2 Figures

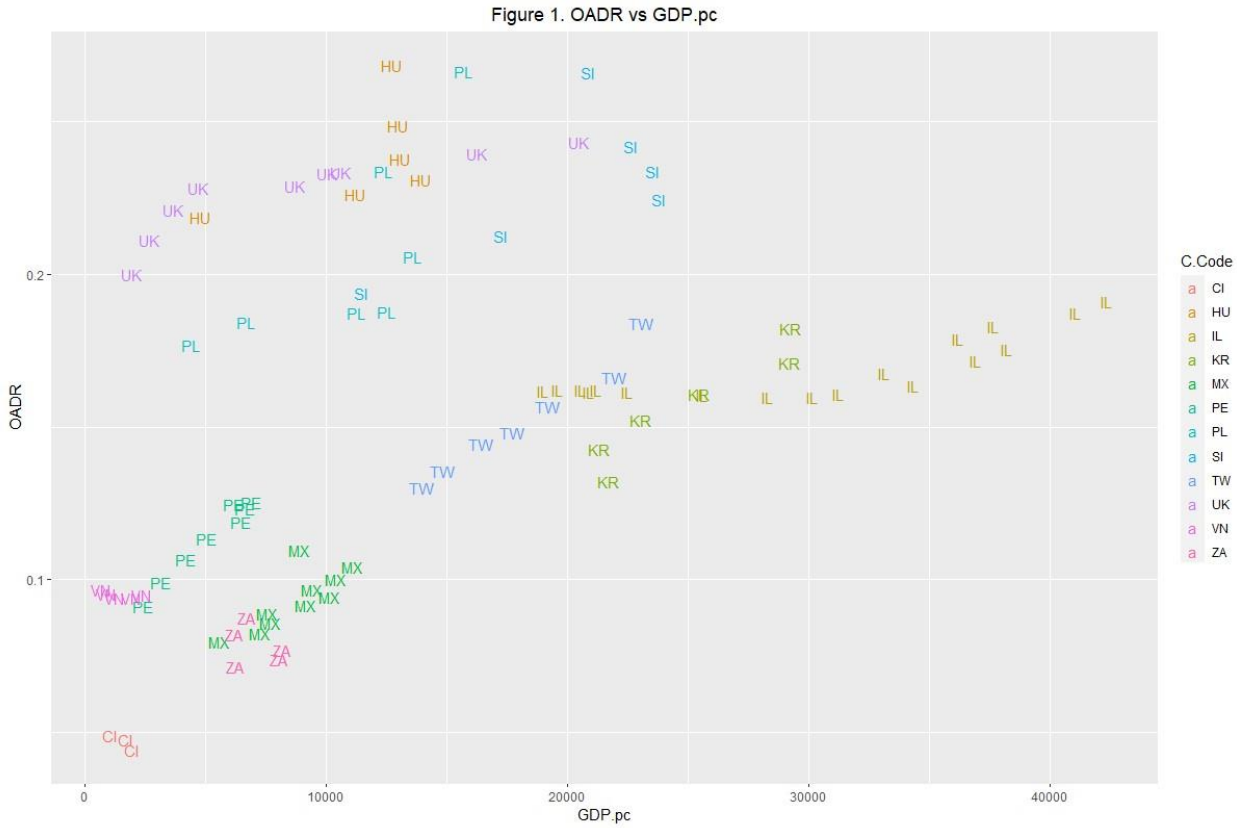


Figure 1. OADR vs GDP.pc
OADR
GDP.pc
C.Code
CI
HU
IL
KR
MX
PE
PL
SI
TW
UK
VN
ZA

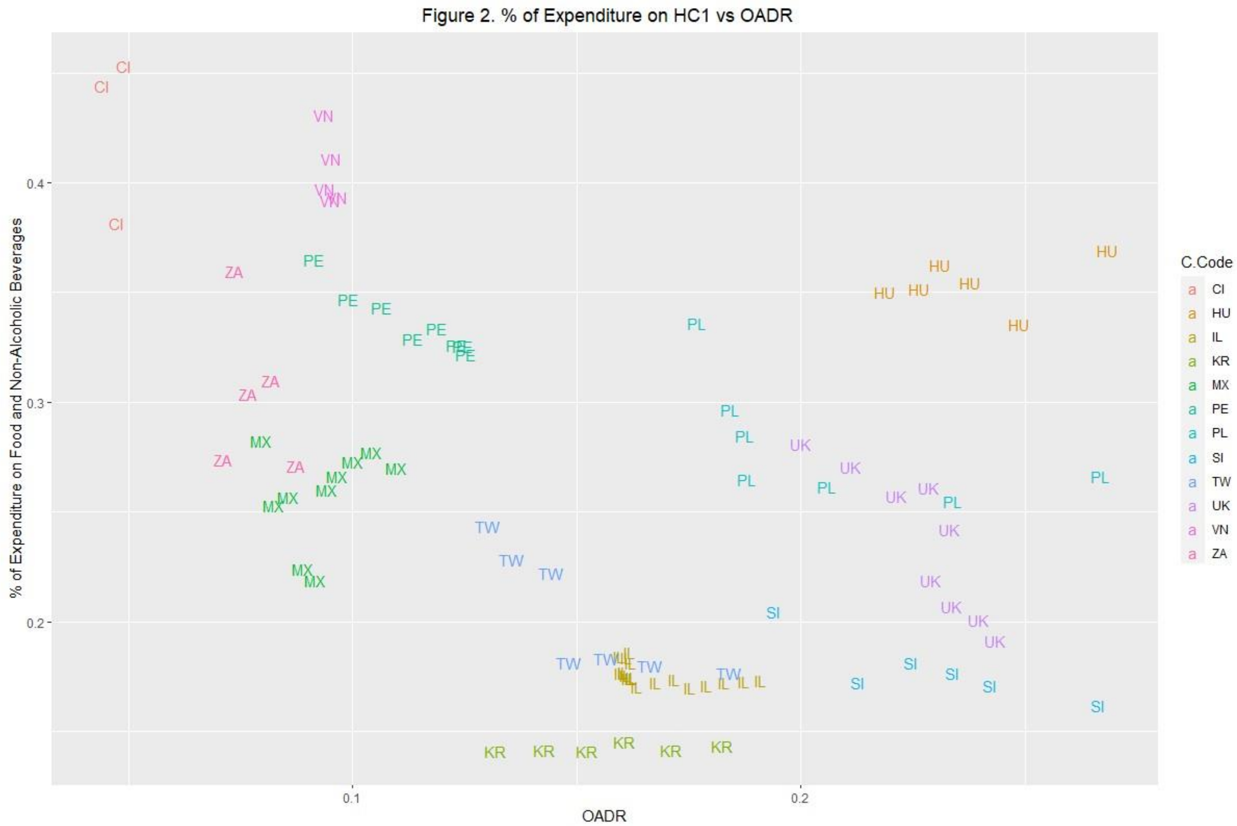


Figure 2. % of Expenditure on HC1 vs OADR
% of Expenditure on Food and Non-Alcoholic Beverages
OADR
C.Code
CI
HU
IL
KR
MX
PE
PL
SI
TW
UK
VN
ZA

Figure 3. % of Expenditure on HC2 vs OADR

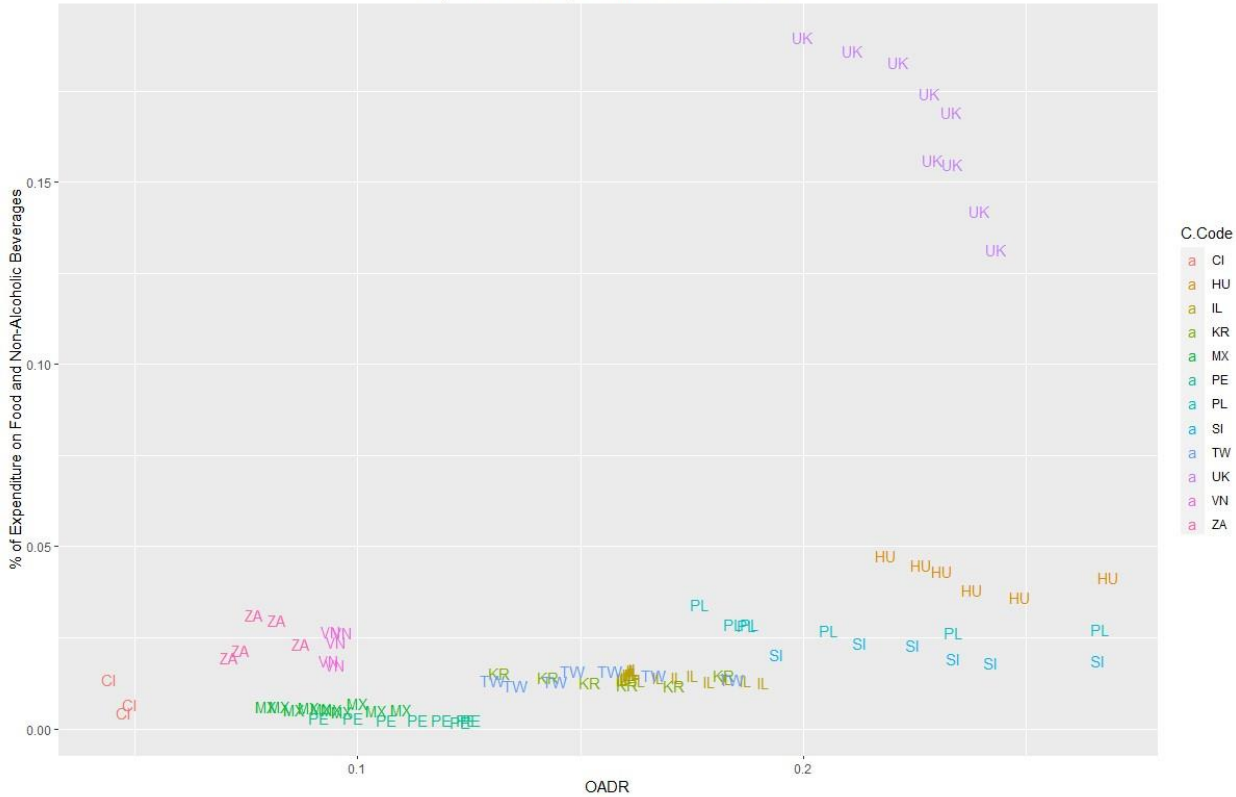


Figure 4. % of Expenditure on HC3 vs OADR

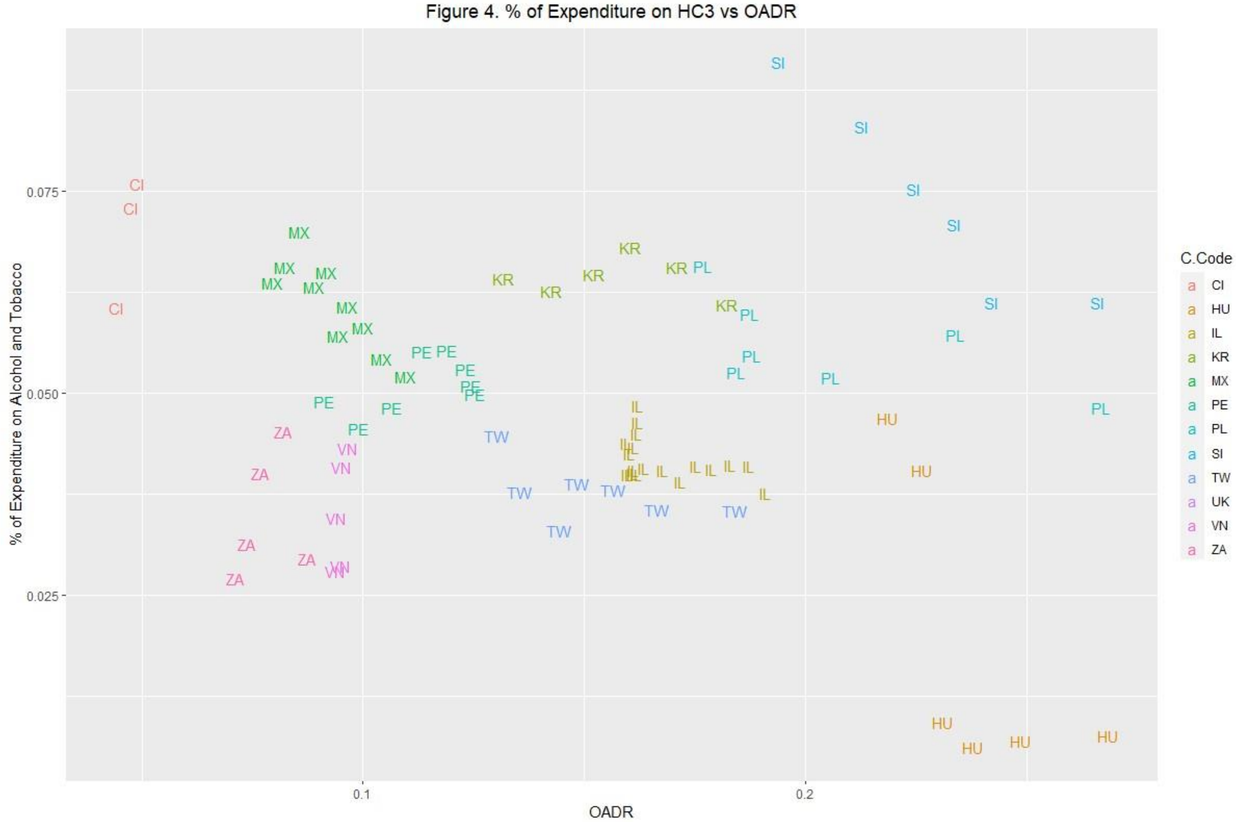


Figure 5. % of Expenditure on HC4 vs OADR

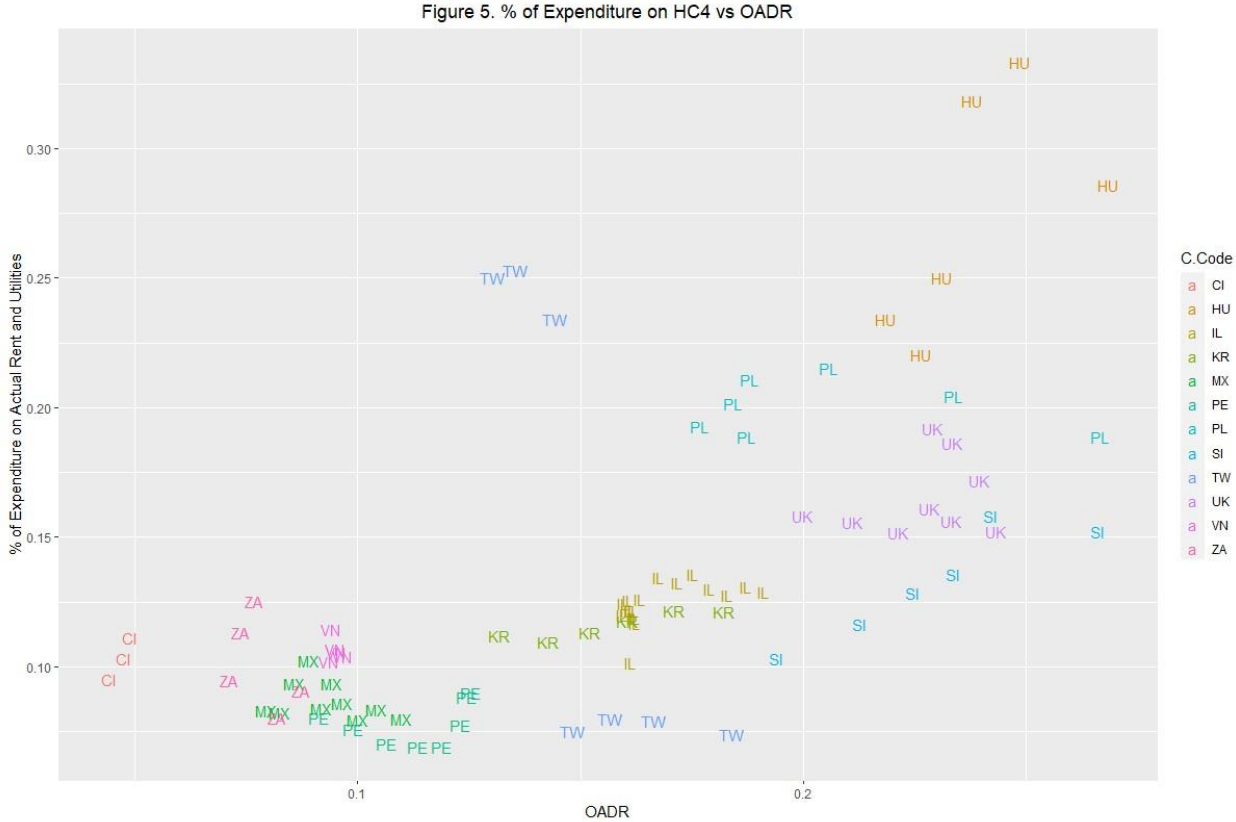


Figure 6. % of Expenditure on HC5 vs OADR

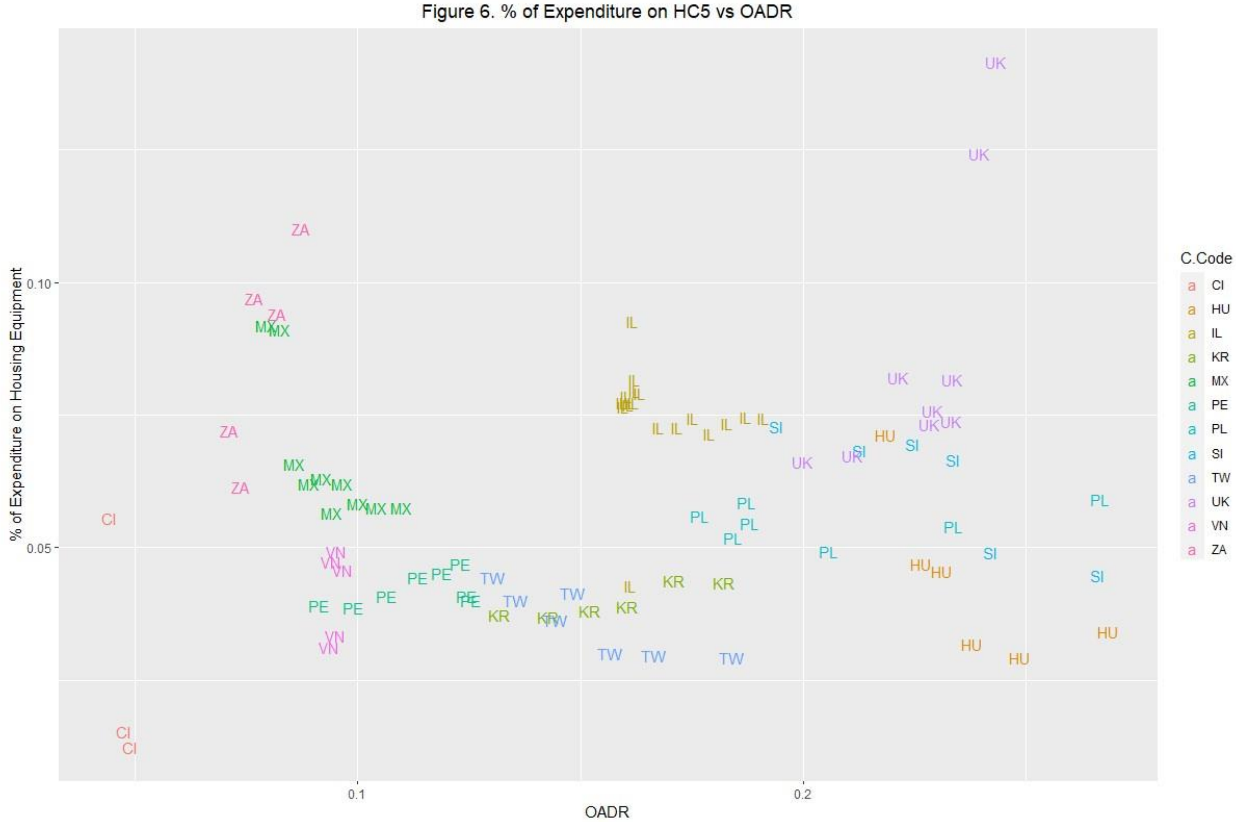


Figure 7. % of Expenditure on HC6 vs OADR

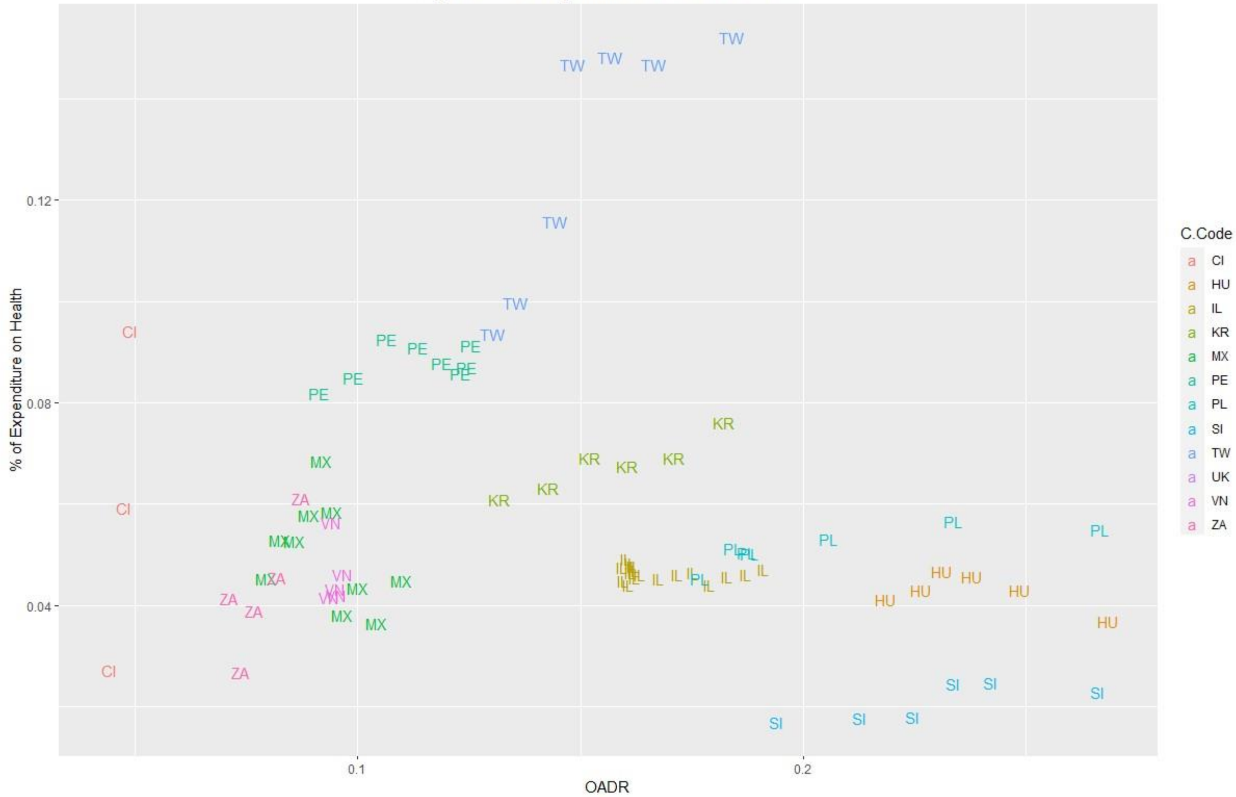


Figure 8. % of Expenditure on HC7 vs OADR

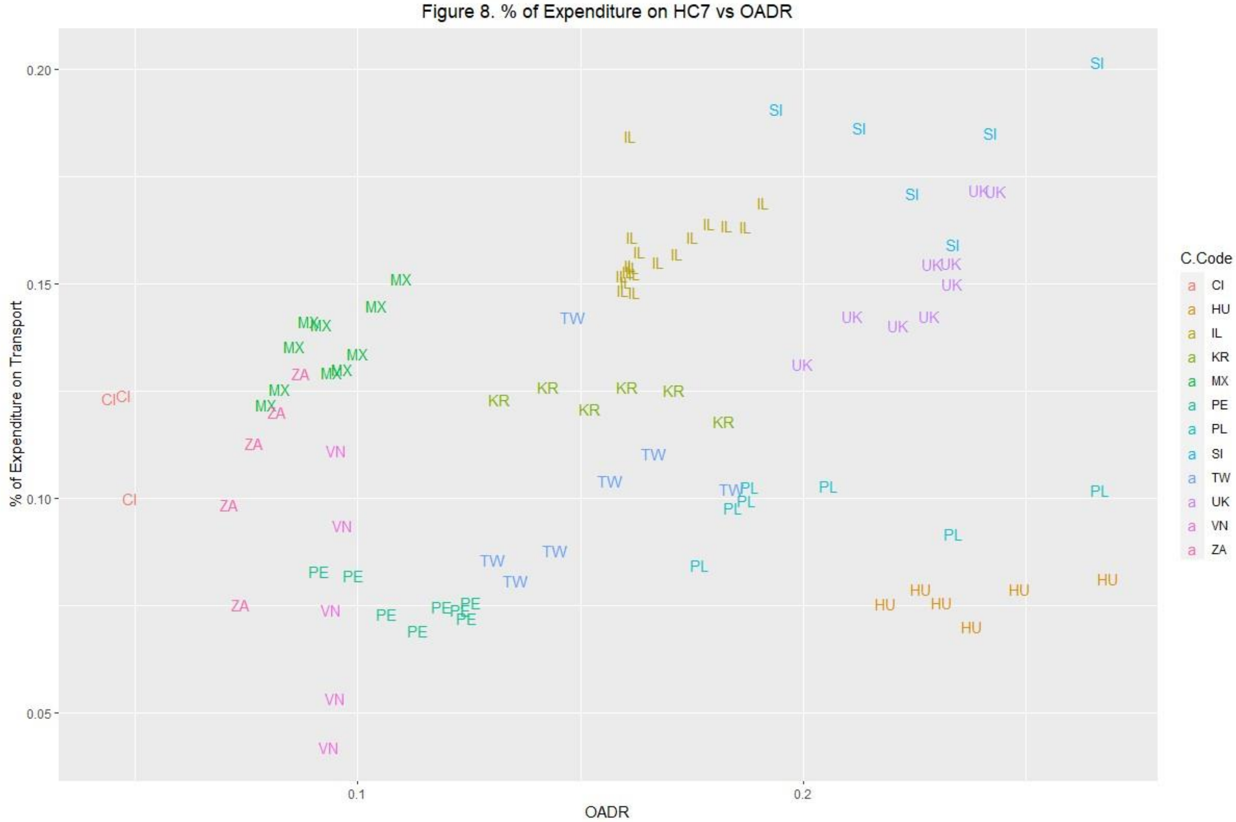


Figure 9. % of Expenditure on HC8 vs OADR

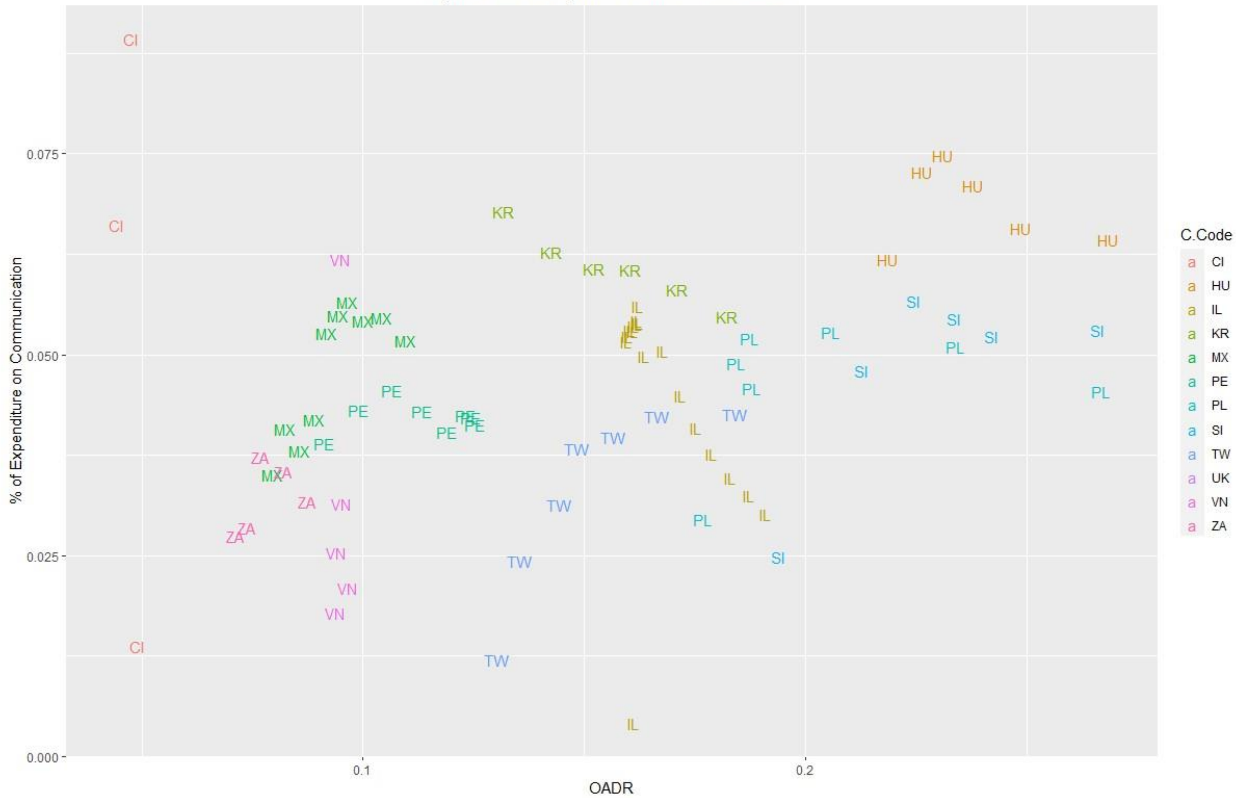


Figure 10. % of Expenditure on HC9 vs OADR

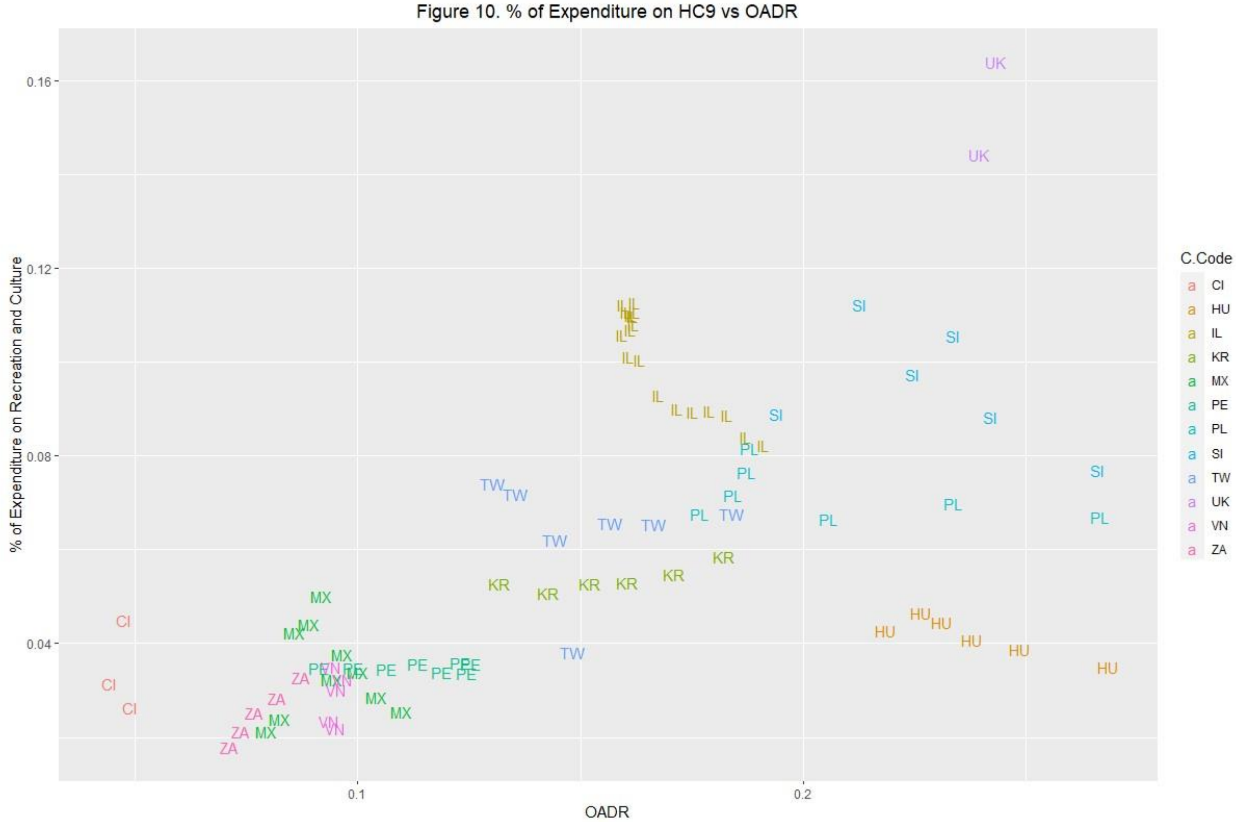


Figure 11. % of Expenditure on HC10 vs OADR

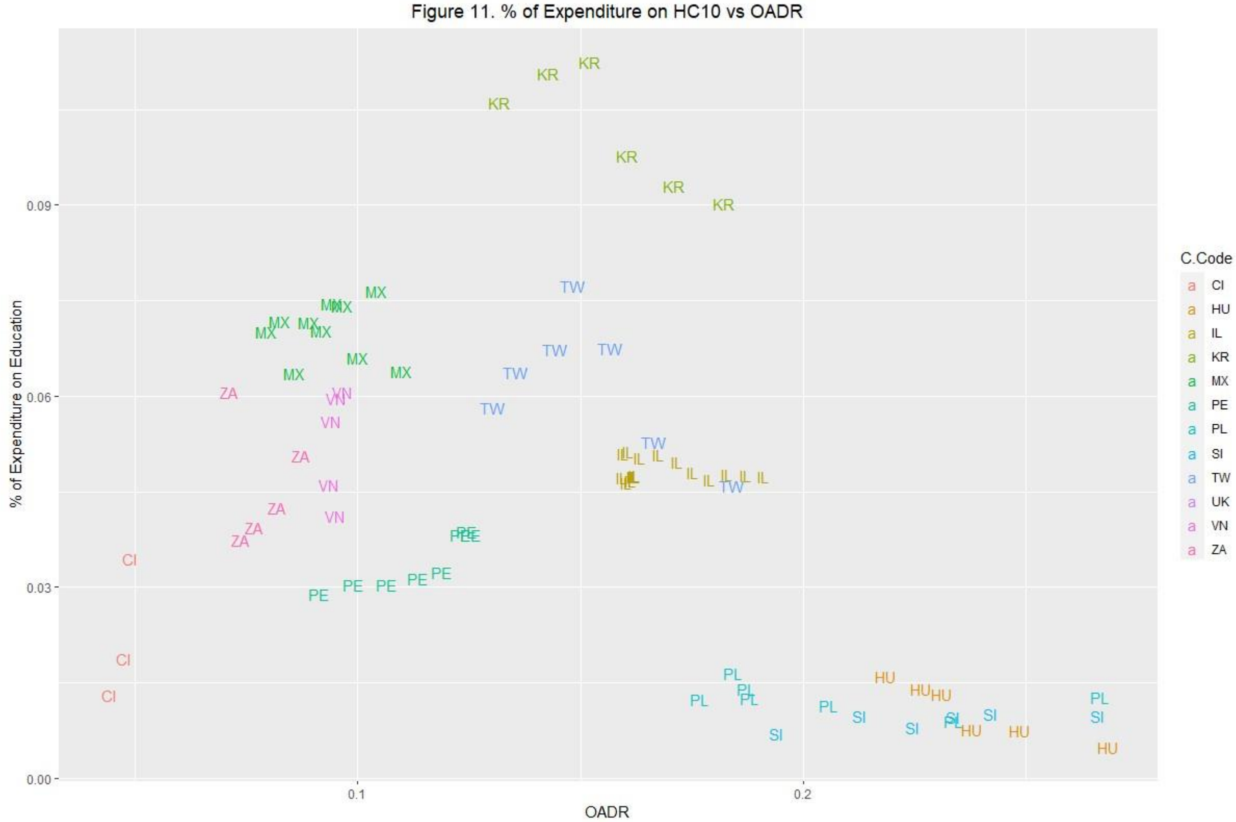


Figure 12. % of Expenditure on HC11 vs OADR

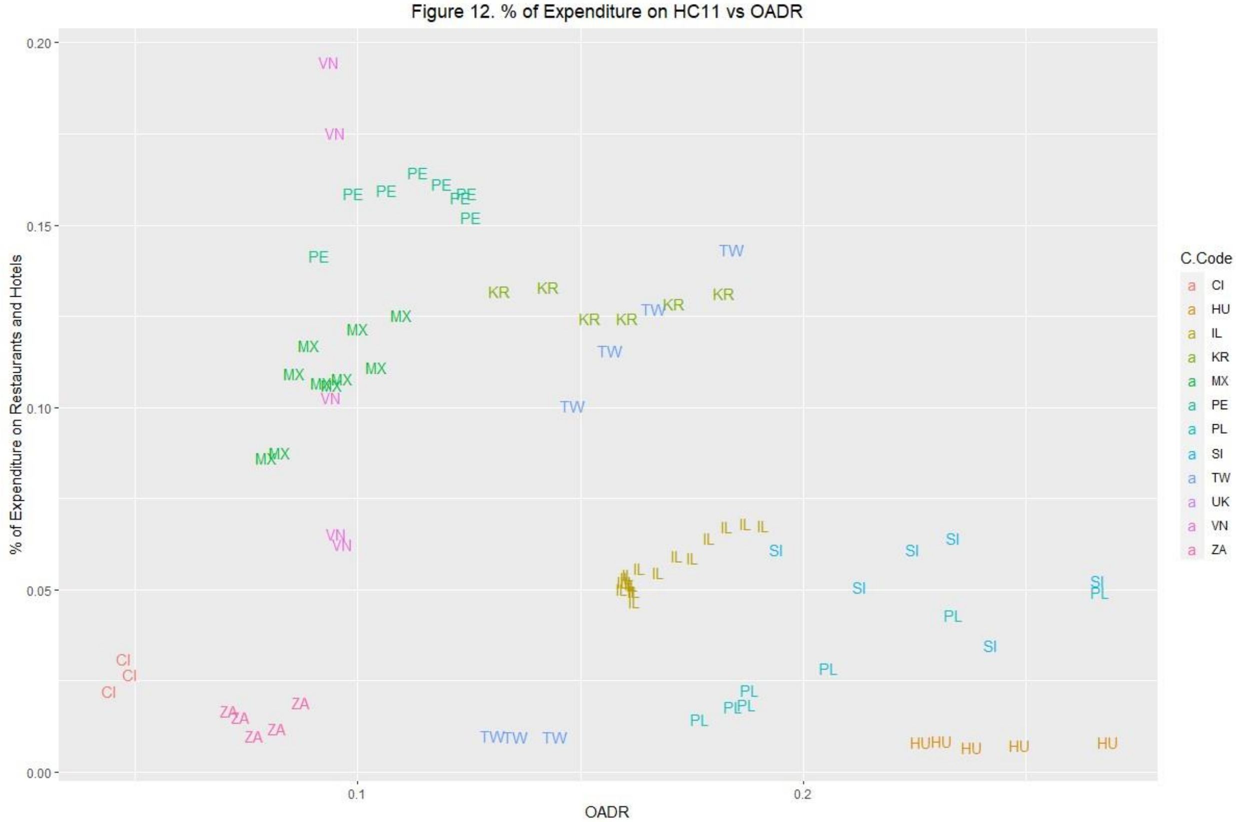
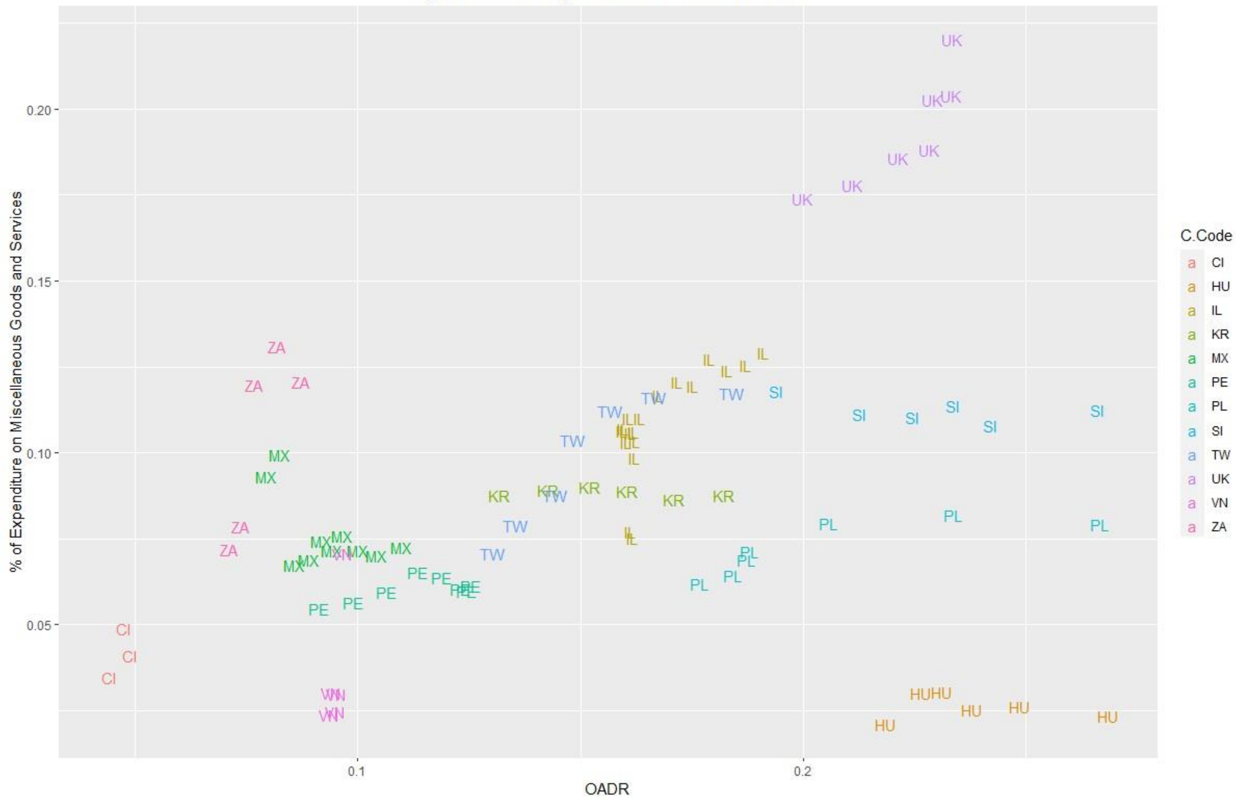


Figure 13. % of Expenditure on HC12 vs OADR



Conclusion

Prior to 1990, 4 out of the 10 provinces of Canada allowed physicians to privately incorporate their practices as CCPCs. Between 1990 and 2019 each of the remaining provinces altered their rules to allow the establishment of physicians owned CCPCs. Using the DiD framework, Chapter 1 found an empirical relationship between the changes to these provincial tax rules regarding the incorporation of privately owned physicians' practices and the interprovincial migration of physicians within Canada. There exists a large financial incentive to incorporating a practice because it enables physicians to split income with members of their family who are in lower tax brackets thereby increasing the after-tax income of households. Naturally, provinces that allow for this are, financially, more attractive destinations for migration than provinces that do not. The results were significant in magnitude, statistics, and plausibility. When provinces did not allow for incorporation the net migration of physicians thereto was roughly 20% lower than the national average. That a substantial fraction of physicians is responsive to these financial incentives, opting to move out-of-province despite the externality imposed onto their former patients and provincial healthcare system, suggests their own wellbeing takes precedence over that of their patients and provincial healthcare system.

Chapter 2 separates the Canadian electorate into single age bins and then estimates the costs and benefits of Covid-19 public health measures for each of these age groups. From an individualistic perspective, the costs of the pandemic outweigh the benefits for younger Canadians while the benefits are larger than the costs for those aged 40 and over. This reflects two facts from the pandemic, the first is that the risks associated with contracting Covid-19 are negligible for the youth but massive, life threatening, for the elderly. Secondly the economic burden of the pandemic, namely the increase in unemployment, was disproportionately shouldered by the youth – whose more social lifestyles were also interfered with as a result of the stay-at-home orders and other public health measures. Under different circumstances, when the median age of voters is much lower than 48, the response to the pandemic may have been more sympathetic to the young (no stay-at-home measures, except for the elderly). Their incomes were supplemented by the CERB; however, this scheme was deficit financed and must be paid back through taxation in the future. If the younger Canadians are responsible for paying down the CERB deficit it could at best be described as a low-interest loan from the government instead of as a form of compensation in exchange for their compliance.

Chapter 3 addresses the implications of population aging on the economy, focusing on the consumption choices of aggregate households. A large country-time panel data model was estimated to determine the relationship between the share of household consumption dedicated different goods and services classifications and the OADR. Results indicate that the share of household consumption allocated to services does increase with the OADR. This may be one of the channels through which population aging slows economic growth: productivity growth in the service industry lags behind other sectors in the economy and the former will continue to account for a growing share of global output as the population continues to age.

This dissertation contributes novel insights to both Health and Population Economics and has implications for both health and public policy. Chapter 1 demonstrates that provincial tax policies can influence the migration of physicians interprovincially in Canada, and consequentially the supply of physicians practicing in each province; and that physicians are responsive to financial incentives. The economic impact of the Covid-19 public health measures was exposed, more precisely, how these impacts varied across the age groups which makeup the Canadian electorate is now more thoroughly understood. Finally, establishing a statistical relationship between population aging and household consumption choices- which was observed across 12 different countries- illuminates yet another channel through which population aging will influence national economies, in both the short and long run.

A common theme within these chapters is that the individual reactions to both external and internal forces and incentives have implications on the aggregate. Physicians were moving across the country to increase their annual after-tax salaries, contributing to the shortage of physicians in particular provinces; politicians responded to the pandemic knowing well the median age of the electorate and when the next election would be held; and aggregate capital formation appears to be sensitive to the median age of households because individual consumption choices change over the lifecycle.

I assert, with pride, that future research and policy making may benefit from the knowledge presented within this dissertation. Future avenues of research and policy include, but are not limited to: the management of human health resources in Canada and the spillover effects of provincial legislation and policy on domestic and neighbouring provincial health systems; general questions regarding the motivation of physicians; the fairness of public health measures and/or government responses to future crisis – it is ambitious, yet plausible, to suggest the framework developed for Chapter 2 can be used to estimate the impact of certain climate change policies across demographics; and an empirical investigation of the relationship between population aging, the consumption of services, the size of the service sector and economic growth.