

UNIVERSITÉ D'ORLÉANS
ÉCOLE DOCTORALE SCIENCE DE LA SOCIÉTÉ TERRITOIRE,
ÉCONOMIE, DROIT
LABORATOIRE D'ECONOMIE D'ORLEANS
THÈSE présentée par :

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soutenue le : 4 février 2022
pour obtenir le grade de : Docteur de l'Université d'Orléans

Discipline/ Spécialité : Sciences Economiques

Three Essays on Demographic Transition and Wealth
Inequality

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Trois Essais sur la Transition Démographique et les Inégalités de Patrimoine

Le fil conducteur de la thèse tourne autour des inégalités de patrimoine liées au vieillissement de la population. Le premier article présente un modèle à générations imbriquées (OLG) et vise à mesurer l'effet de la transition démographique sur la croissance en France depuis le XIX^{ème} siècle. Le modèle reconstruit la participation des femmes non seulement à la production marchande mais aussi à la production domestique et nous a permis de mieux comprendre les dates charnières de l'inclusion progressive des femmes à l'économie marchande. De plus, une analyse par cohorte et genre nous a amené à repenser les théories traditionnelles sur les baby-boomers et à examiner l'évolution des inégalités de revenus par genre. Le deuxième article est quant à lui consacré à l'évaluation d'un retour à la taxation des loyers imputés (existante en France entre 1914-1964) pour rétablir de l'équité inter et intragénérationnelle dans l'accès au patrimoine. Cela est particulièrement important dans un contexte de hausse des prix du marché immobilier, sans précédent dans les vingt dernières années, créant des plus-values pour les propriétaires et rendant plus difficile l'accès des jeunes à l'accumulation de patrimoine. Enfin, le troisième article met en œuvre une évaluation d'impact des réformes de retraite Balladur (1993) et Fillon (2003) sur l'endettement des ménages en utilisant la méthode de Différences en Différences. Les résultats mettent en lumière les caractéristiques des retraités affectés après chaque réforme en termes d'éducation et de vulnérabilité financière : les moins éduqués n'ayant pas eu pour autant des difficultés financières présentent des niveaux de dette plus élevés. Cependant, les retraités du secteur privé et les indépendants ciblés par la Réforme Balladur qui ont fait face à des problèmes financiers structurels depuis plusieurs années apparaissent aussi comment étant particulièrement vulnérables.

Mots clés: inégalités, patrimoine, vieillissement, intergénérationnel, retraites, femmes.

Three essays on Demographic Transition and Wealth inequality

This dissertation focuses on the effect of population ageing on wealth inequality. The first article uses an OLG Model to assess the effect of the demographic transition in France on economic growth since the 19th century. It reconstructs female labour force participation in both the labour market and domestic production to get a better understanding of the key events leading to women's progressive inclusion within the market economy. In addition, it performs an intergenerational analysis by cohort and gender, and challenges widespread theories on baby-boomers. Finally, it examines the evolution of lifetime income gender inequalities. The second article evaluates the effects of imputed rent taxation in France (a tax that was in force between 1914-1965) to restore wealth equity across and within generations. This is of particular importance in the current context of unprecedented rise of real estate market prices. Over the past two decades, homeowners have realised significant income gains, while younger generations have faced major difficulties to accumulate wealth. Finally, the third article uses a Difference-in Difference approach to assess the effects the Balladur Reform of 1993 and the Fillon Reform of 2003, two major recent pension reforms in France, on indebtedness among retirees. Results shed light on the characteristics of the retirees affected by each reform in terms of educational and financial background: underline that both reforms increased private debt levels among the low-educated and those not having financial difficulties at least once during the last five years. Moreover, a strong significance is found among private workers and aligned regimes having had structural debt during the last years.

Keywords : inequalities, wealth, ageing population, intergenerational economy, pensions, women.

Remerciements

Après cinq années bien remplies de découvertes, défis, satisfactions, mais aussi de quelques moments de sursaut, d'incertitude, on touche finalement au but ! L'aboutissement de cette thèse a été le fruit de l'intérêt, la solidarité et la générosité d'une légion de collègues, famille, amis, et de visages empathiques toujours très présents. A ce sujet, toute cette équipe qui gagne, mérite des remerciements officiels et palpables.

Tout d'abord je tiens à remercier mon directeur de thèse, Alexis Direr, qui m'a reçue spontanément et m'a fait confiance tout de suite pour entamer ce projet ensemble. Par la suite, je tiens à remercier d'une part les rapporteurs (Muriel Roger et Clément Carbonnier) pour la lecture exhaustive de cette thèse, ainsi que le reste du jury : André Masson et Faustine Perrin. De même, je souhaite remercier tout particulièrement mes co-auteurs Hippolyte d'Albis et Miguel Sánchez -Romero de leur intérêt pour notre projet et de la véritable immersion dans la démographie économique.

Par la suite, la personne qui mérite d'être citée est sans doute le Leo du LEO (cf. Leonardo Calcagno) qui a fait un excellent entremetteur à un moment crucial où l'envie d'entreprendre la thèse avait besoin d'un petit coup de pouce. Ainsi le LEO, malgré le fait de m'y rendre moins dans les dernières années, s'est transformé dans le lieu où tout cela fut possible et où l'intérêt, empathie et soutien des collègues furent toujours très présents. Une pensée forte pour Oléssia, Laura, Dylan, Marie-Pierre, Eva, Florian, JC, Raphaël, Hajare, Nico, Yunzhi, la nouvelle team (Inessa, Pauline, Hugo), Anthony, Louis, Daria et Gilbert, ainsi que bien sûr la « Manga de Sudacas » (Leo et José !). Un petit mot aussi pour Cécile, Mélie, Solange et Karine pour toute leur aide et patience aussi.

D'autre part, le LIEPP, mon lieu de travail quotidien, mérite un remerciement tout aussi important. Un grand merci à Bruno Palier et Anne Revillard pour leur accueil chaleureux au sein du laboratoire. Un remerciement tout particulier pour Guillaume Chapelle qui a été non seulement mon co-auteur, mais aussi un soutien sans faille et un véritable « Maître Yoda » du début à la fin. Des après-midis sans fin avec Quentin Raymond, Camille Urvoy (ma complice et compagne au quotidien), Célia Bouchet, Julien Blasco, Michael Zemmour, Jean-Benoît Eyméoud et Federico Filetti (il cuoco!). Notre quotidien au labo n'aurait pas été le même sans l'énergie infinie de

Samira Jebli, Juliette Seban, Latifa Lousao et Andreana Khristova.

Los ex-colegas , pero sobretodo amigos de la OCDE, que fueron sin duda impulsores importantes de mis primeros pasos en la investigación: Sebastián Nieto, Juan Vázquez, Christian Daude. Un abrazo para mis grandes apoyos Barbara Castelletti, Adrià Alsina, Ania Jankowska y Keiko Alvarez.

Mon univers parisien a été aussi divers que présent ces dernières années. J'ai une pensée particulière pour la Chaire TDTE (Charlène, Hélène, Stella, FX), qui m'ont poussée à y croire quand la possibilité d'entamer ce projet semblait lointaine. La team Poitiers et associés : d'excellents supporteurs et une véritable famille poitevine : les filles (Kimette, Dan, Pops, Steph, Sarita, Mariana, Carmen, Audie), Laura, Mathieu, Thibault, Chan, Eduardo, Luisfo, Elie, Camille, Angela, Andrea, Pinetouille, Matías, Matisse. Mention d'honneur pour Laura et ses révisions infinies d'Anglais, l'accueil studieux d'Audie en Creuse et les corrections magistrales de Luisfo. Un abrazo et mille merci pour les encouragements des amis de Dauphine pour débiter la thèse : Antoine Comps, Homero Martínez et Louisiana Teixeira. Une pensée très forte pour le groupe Rockland qui depuis la conception de cette aventure m'a soutenue sans faille tout en dansant: Maricel, Perrine, Delphine, Anaïs, Sophie, Flo, Florence, Pascale, Hélène, Diana. Une pensée toute particulière pour Elise et Anne, très présentes à tous les niveaux pendant tout ce processus. Sans oublier Angélique, Auriane, Françoise et bien sûr, Josiane, qui est devenue bien plus qu'une prof de danse pour nous toutes. Un abrazo a Juliette Bloin et Gabrielle Girault d'avoir été là pendant ce dernier sprint difficile.

Cependant, cet univers parisien ne serait jamais complet si je ne parlais pas du soutien que j'ai reçu de la part de mon quartier. Mes familles brésilienne et italienne : Raquel et Alexandre, ainsi que Morena e Luigi, toujours à l'écoute et d'une gentillesse infinie. De même que Philippe et Ninon, toujours disponibles et accueillants pour des séances de travail au caffè latte avec des « Pastéis de Nata ». Une mention plus que spéciale à mon refuge et ma famille parisienne qui est devenue « Le Royal ». D'une bibliothèque de rédaction, d'un QG de corrections, un karaoke pour faire une catharsis à une cantine où j'ai été plus que gâtée, le bar est sans doute l'endroit le plus emblématique de ce long travail. Je n'ai pas assez de mots pour remercier Aghi, Sab, Nabilou, Lounès mais aussi Sébastien, Jean Baptiste, Jean Luc, Bernard et tant d'autres qui ont été des véritables moteurs au quotidien pour continuer ! Finalement, je voudrais citer Nils qui a été un

pilier quotidien pendant la plupart de ce marathon à travers de repas, mots d'encouragement, voyages, ainsi que ta conviction et ta fierté de me voir atteindre la ligne d'arrivée. Une pensée pour ce pot que tu voulais tant organiser à Orléans le jour J avec des petites touches latinas pour célébrer la fin de cette aventure que tu as vécu de si près (comme personne d'autre!) depuis le moment même que je rêvais de pouvoir faire cette thèse. Cette thèse fait aussi partie de toi.

Le Costa Rica a été de loin et de près aussi un élément essentiel tout au long de cette aventure. Por una parte, agradecer la energía, apoyo y buenas vibras de todos los Parisiempres ya sea en París o en otras latitudes durante más de tres años en actividades desde fiesteras hasta de "tíos millenials". Mención especial para Andrea Zumbado, Adri, Marco, Adonay, Fabi, Tío Rodri, Santi, Tina y Lucho, claves en un empujón final particularmente difícil el verano pasado. Gracias a Beatriz Campos, casi del barrio por su amistad y siempre disponible para escuchar. Durante los 5 meses inesperados de redacción en Costa Rica, no puedo dejar de agradecer a Esteban, Alonso, Silvana (mi gran descubrimiento de 2021), David y los amigos de Olimpiadas de Matemáticas ("matletas" para los íntimos). Mención más que honorífica para Daniel Campos y Jesús Ulate por sus largas horas dedicadas a ponerle orden a los números y a la edición de esta tesis, fundamentales en la recta final de esta tesis. Amigos como ustedes que ayudan de forma tan desinteresada, no hay muchos. Gracias a Nico chileno-tico por meter mano cuando se necesitó y Grettel por estar pendiente. Un pensamiento para mis amigos Banco Centralistas de tertulia económica/josefina, Monsieur Albert y Mauricio que siempre estuvieron apoyándome. Un abrazo para la familia Madrigal Guardia: Doña Queca, Michi (guardián de mi compu!), don Rodrigo (por nuestra complicidad Sciences Pote) que me acompañaron con infinitos cafés, almuerzos y hasta sesiones de trabajo. Gracias a Marcia, Mauricio y Herbert por su compañía en la Feria Verde y París.

Finalmente, este proyecto de cinco años no hubiera sido posible sin el apoyo, paciencia e interés de mi familia. Un agradecimiento especial para mi abuelo y mi tía Ana María, siempre militantes inclusive años antes de comenzar esta aventura sobre mi potencial y la importancia para mi carrera de tomar el desafío. El gusto por los números y la perseverancia es sin duda algo que viene de mi abuela (la persona tal vez más rigurosa y coherente que conozco). Mi mamá es una porrista incondicional que, sin nunca entrar en juicios de valor, me impulsó y dio fuerza en los momentos más grandes de incertidumbre y duda. A mis tías Leonor e Ileana siempre disponibles sin condiciones para apoyarme desde materialmente y con palabras de orgullo para

nunca darme por vencida. Mi papá, Jaime, siempre con sus análisis finos y comentarios pertinentes me hicieron muchas veces tomar la perspectiva necesaria para continuar. A Andrea y Ximena les agradezco acompañar a los abuelitos en mi ausencia, y a Ximena inclusive meter las manos con las correcciones de fin de año.

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Chapter 1

Introduction

In September 2011, the Occupy Wall Street movement (OWS) at Zuccotti Park, in New York City's Wall Street financial district, took the world by storm with its cry for more equality and economic redistribution. It is perhaps not a surprise to the keen observer such a movement erupted in a world where corporations and finance were seen as the culprit for the severe depression and economic turmoil of the 2008-2009 financial crisis.

Indeed, in the years following this crisis, both the academic community and the media outlined the widening gap between the 1% wealthiest and the rest of the population. As a result, economic inequality has become one of the most sensitive contemporary concerns not only for advanced economies, but also for emerging ones. Following the publication of Piketty's "Capital in the 21st Century" (2014), a myriad of papers and academic research have attempted at disentangling the drivers of wealth concentration, either focusing on producing new estimates of wealth accounts and its determinants (Alvaredo et al. (2018)) or on specific regions (Piketty et al. (2019)); Assouad et al. (2018)). These findings have received cautious attention not only among academics (Benhabib and Bisin (2018)), but also among policy makers and wider audiences, putting wealth inequality at the heart of the economic and social debate. These papers underlined the extent to which inequalities have soared in the last three decades – and this strong message has been coopted not only by the political sphere but also the media and the activist movements.

In today's context, the 2011 Occupy Wall Street movement (OWS) appears less as an

isolated event in a climate of social unrest about rising inequalities where young people struggle to accumulate wealth. However, despite the active public discussion on these issues, the academic literature is much more exhaustive on questions of income inequality (Lakner and Milanovic (2016)) and relatively little is known about the global trends of wealth inequality.

Far from being a distant topic, demographics through population ageing is a major factor behind predictions of inequality, as noted by Piketty and Zucman (2014). During the last decades, this phenomenon has been more closely studied as the sustainability of pension systems and social safety nets are under growing scrutiny. The French case offers some perspective on this issue as despite having one of the highest fertility rates of continental Europe, forecasts on population ageing show it will still have a major impact on the pension system. According to the French national statistics bureau INSEE, metropolitan France will have 73,6 million inhabitants by January 1st, 2060, of which 31.2 will be active (28.6 millions). According to these forecasts, 23.6 million individuals will be more than 60 years old, which translates into an increase of 42.2% compared to 2014, where the percentage of working population was 8.33%. This phenomenon has a direct consequence on the dependence ratio: there will only be 1.5 workers for an inactive of more than 60 years in 2060, while there were 2,5 workers for an inactive of more than 60 years in 2016. This share has rapidly increased since the 2000's with the baby-boom generation reaching retirement age: seniors 65 years and older went from 16.2% in 2003 to 19.7% in 2018 (INSEE). This trend is widespread in Europe and OECD countries: in 1980, there were only 20 people aged 65 and over for every 100 of working-age, on average, across the OECD; by 2015 this number had risen to 28 and by 2050 is expected to almost double to reach 53 (OECD, 2017).

The link between demographic change and economic inequality has been studied by scholars in the last decades. Bloom et al. (2001), among others, have stated that the demographic dividend in terms of savings that comes along with demographic transition will disappear as populations age due to the rising costs of financing the old age. Similarly, (Goldstein and Klüsener (2014)) analyzed the consequences of this change in age struc-

ture in terms of economic inequality. They asserted that through capital deepening (an increase in the proportion of the capital stock to the number of labor hours worked) and longevity life-cycle savings, population ageing has direct impact on increasing income inequality. This conclusion is in line with Piketty’s argument on how higher capital intensity is linked to higher levels of inequality. Moreover in France, as noted by Masson (2018) who refers to the “patrimonialisation” of society, seniors older than 60 years old hold 60% of total financial wealth but only own 17% of real estate wealth compared to the national average (16%). Financial wealth accumulation among the elderly follows life-cycle theory (Modigliani, 1957) underlining the extent to which an increase in life expectancy plays a role on capital concentration at later ages.

Using this perspective, the scope of this dissertation is to study demographic change in France and its consequences on wealth accumulation and wealth redistribution from both a historical and contemporary angle. In fact, the French demographic transition started much earlier compared to other similar countries in terms of population size in continental Europe at the end of the 18th century. This process took place through a drop in fertility that progressively enabled an increase in GDP per capita and a general improvement of living standards which allowed for a rise in life expectancy. The launch of social protection schemes and female labor force participation during the first half of the 20th century, especially during WWI and WWII, consolidated these trends. Nowadays, despite a rather stable fertility, France, like other countries, faces fiscal challenges linked to higher dependency ratio through an increasingly higher share of seniors out of the total population. As population ageing has a direct impact on accumulation and transmission dynamics of both private and public wealth, this phenomenon deserves particular attention. Given this scenario, there are numerous courses of action that have been set by ageing societies to face this issue: increasing retirement age, lowering replacement rates, changing the redistribution systems towards capitalization regimes or mixed regimes such as the pension point system that is being widely discussed in France nowadays. These repercussions are not only essential from a public finance point of view, but also because of the consequences on the living standards of retirees through the reforms of social schemes and those of younger generations through the transmission and distribution of wealth

between them. According to the INSEE, the mean age of wealth transmission between generations increased by 8 years between 1980 et 2015. As a result, inheritance often happens after one's 50 years old birthday, and it is increasingly common to receive it while being retired. Therefore, inter-vivos have appeared as a new way to face this delay in capital transmission that penalizes younger generations. These trends make the study of the consequences of population ageing within generations, as well as public policies to tackle these issues a major priority not only among academics but also policymakers.

When it comes to specifically addressing public resources, an involvement of women in the workforce proves to be very relevant to face the growing public deficits related to population ageing. The INSEE created the term of "forced part-time work" to refer to women who would like to work full-time but are forced to take part-time jobs because of childcare duties. In a country where one third of women work part-time, the room for further potential contribution in a context of rising dependency ratios is of extreme importance. Bloom et al. (2011) underline the importance of addressing pay gap and childcare inadequacy as an effective policy response to sustain economic growth. Given this trend, public policy is crucial in allowing a greater participation of women within the labour force. Several studies discuss the relation between the childcare options and benefits available for childcare and the participation rate of women. David Biejck and Seungjin Han (2006), insist on the importance of public subsidies on childcare to increase female labour force participation and lower pay gap. Additionally, Olivetti and al. (2017) underline the extent to which investments on early childcare and education increase the number of working women and reduce gender gaps for high-income countries. Within this context, a greater comprehension of the historical contribution of women to the market economy is needed, starting with the drop in fertility in the 19th century, the major break-out in participation rates during the Industrial Revolution and their involvement during the 20th century through the two World Wars and their increased access to education. Additionally, as childcare within the household is considered unpaid work, a historical account of the evolution of both market and non-market activities of women could shed some light on the trade-off women have faced between home production and working outside the house.

As stated before, our main goal is to disentangle how inequality is linked to population ageing during the last two centuries. For this reason, we tackle the effect of population ageing from three different angles: the demographic transition and its contribution to growth by gender, the role of fiscal policy to fight intergenerational inequalities, and the financial effects on retirees after major pension reforms in France. The first chapter “Working Women and Economic Growth: evidence from France” is an article with a historical perspective through an OLG (Overlapping Generations Model) reconstructing the French economy since the early 19th century and quantifying the contribution of women to growth. The second chapter is a tax policy experiment where we micro-simulate the withdrawal of the property tax in France and redesign property taxation through the inclusion of imputed rent within the income tax base thanks to Taxipp, a micro-simulation taxation tool developed by Landais et al (2011). Our paper attempts to challenge the assertion that the abolition of this tax during the five last decades has democratized access to homeownership.

Finally, the third chapter assesses the effect of the biggest recent pensions reform in France (Balladur Reform in 1993 and Fillon Reform in 2003) on household indebtedness rates allowing us to weight the consequences on either public and private employees of less advantageous pension benefits and indexation using the 2004 and the 2014 French Wealth Surveys. These reforms first affected exclusively private employees and aligned regimes of independent workers (CANCVA, MSA, ORGANIC) and ten years later public servants with the 2003 Fillon Reform. To further explore the profiles of these retirees who have acquired debt, the sample is also divided into education levels and financial difficulties.

1.0.1 Working Women in France: a Tale of Two Centuries Closing the Gaps

1. The effect of demographic transition on growth and the role of women

The first chapter as stated before studies demographic transition in France from the 19th century and attempts to provide a measurement on the contribution by gender to growth as a result from this process. During the last decades, scholars have attempted to draw conclusions on the link between demographic transition and economic growth as observed in economic literature. On one hand, until the 1990's, conclusions on the effect of demography on economic growth were ambiguous as suggested by Kelley (1988). However, with the introduction of demography to the classic convergence models (Bloom, Williamson, 1998), it became more plausible to measure the effect of the demographic transition on economic growth. The main angles commonly studied in recent literature are usually the productivity component and the translation component. The first refers to changes in labour supply and capital accumulation, and the second refers to changes in population structure. Nowadays, understanding these issues seems essential in a context of secular stagnation as pointed out by Aksoy et al. (2019) who argue that demography has a clear influence on macroeconomic activity, altering demand, supply, and the production of ideas. However, the effects of an ageing population (both due to a drop in fertility and a rise in life expectancy) on growth remain ambiguous and additional dimensions such as contribution by gender and historical dynamics need to be further explored.

France is considered as a pioneer country in demographic transition with a fertility rate that has started to decrease considerably since the late 18th century, before richer countries with better education levels at the time such as the Netherland or England as depicted Daudin et al. (2016). Research on the causes behind this phenomenon raised interest among several authors: Cummins (2013) considers that a decrease in fertility rates in France is associated to the French Revolution. In this vein, Daudin et al. (2016) explore the role of internal migration within French departments as a vector of diffusion of new lifestyles that would explain this fertility drop during the 19th century. For this

reason, understanding the French demographic transition during the last centuries is of great interest and provides innovative evidence on factors influencing growth over time.

The increase of female labour force participation appears as an alternative response to the deterioration of old-age dependency ratios. On this vein, the link between female work participation and economic growth has been increasingly studied in the last decade by many scholars through empirical studies attempting to quantify the contribution of working women to economic growth. Sinha (1965) provides seminal evidence on the relation between women in the workforce and growth through an U-curve. In fact, according to this theory, during the first stages of economic development, women are pushed to participate actively in an economy based on agriculture, where subsistence tasks are shared by both sexes. Subsequently, the transition towards an industrialized economy relying on human capital would increase men's work, while women would be required for domestic and family tasks. This would represent a trade-off between economic growth and equality in the access to the labour market.

Therefore, an economy based on services progressively makes disappear this trade-off. According to Goldin and Olivetti (2013), a post-industrial economy would be “associated without ambiguities” to higher participation of women in the labour market. In the last half of the 20th century, economic growth, accompanied by declines in the fertility rates, as well as the improvement in women's access to education and independence, has produced an increase in women's participation rate in the labour market. This re-feminization of the labour market is represented by the growing side of the U curve. As far as advanced economies in Europe, are concerned, this U-shaped relationship is verified, which is the case of countries such as France, Germany, and England.

In this vein, during the last three decades social scientists have actively gathered and analysed historical series and have tried to reconstruct the evolution of labour dynamics from the late 18th century throughout the 19th century. This historical period is of great interest as the agrarian economies and feudal economies inherited from the “moral economy” (Dennison and Ogilvie (2016)) of self-subsistent peasant farms of the early 19th

century faced major structural change with the rise of the Industrial Revolution and the inclusion of women in the labour market. Moreover, not only this data is of great interest for historical economists, but also for economic demographers interested in studying fertility decline throughout the century as the starting point of a major demographic transition that preceded the rise of modern economies.

On this respect, as stated before, the French example is of particular interest as France was the first European country that experienced a decline in fertility during the 19th century and there still is a clear consensus on the reasons behind this phenomenon. Within this perspective, Marchand and Thélot (1990) wrote a pioneer book on the evolution of work in France from 1800 to 2000 accounting to the transition from an agricultural economy with two thirds of illiterate workers a low productivity toward an industrial economy. Within this context, the emergence of industrial workers takes place despite difficulties for accounting for work of women or young adults in non-paid family activities such as agricultural farms.

However, recent academic work has also added a gender dimension to historical retrospective on labour dynamics and demographic transition. On this line, Mauriani and Meron (2013) published one of the first historical accounts of female work between 1901-2011 underlining the evolution within the industrial and agricultural sectors, as well as the evolution of legislation concerning working of women and children before WWI and WWII. Later on, Diebolt et al. (2021) wrote a major piece for historical economic demography research as they collected data from mid 17th century until the 20th century to disentangle the key drivers of demographic transition in France. Findings underline the emergence of female work in the 19th century, its continuous expansion throughout the first half of the 20th century, following a decline until the 1970s and a recovery in the mid-1980s when highly educated women entered the labour market. In addition to this, the authors also focus on gender gaps concerning occupation sectors: pay gap, household bargaining, literacy, and educational attainment since the 19th century.

2. Contribution: Recent literature on OLG models does not accurately account for the historical role of women and their contribution to paid and unpaid activities

Unified Growth Models emerged as innovative tools in the early 2000s as new global approach to account for historical evolutions of production and population growth. Galor and Weil (2000) wrote a seminal paper entitled: “Population Technology and Growth: From Malthusian Stagnation to Demographic Transition and Beyond”, which lead to a new generation of models for analysing demographic changes. Indeed, the authors created a unified growth model that while using a historical perspective encompasses simultaneously the evolution of three variables: population, technology, and output. The three main periods are described throughout this pioneer paper became the main framework of analysis for this type of analysis: the Malthusian regime followed by the Post- Malthusian regime and the Modern Growth Regime. Low rates of technological progress and high mortality rates during the Malthusian regime were followed by higher technological progress that led to both higher income growth and rising population rates. Finally, a demographic transition led to the Modern Growth Regime with continuous technological progress in a context of reduced population growth and sustained income growth.

However, few attempts have been made to try to assess the impact of the economic transition on economic growth through OLG models through a gender perspective. On this vein, Galor and Weil (1996) wrote a major paper in the field of historical economics and gender contribution to growth, “The Gender Gap, Fertility and Growth”. The authors aim to assess the effect of fertility on growth to understand the role of capital, wages, and female labour force participation. Results show a positive relationship between capital accumulation and women’s relative wages and a subsequent negative effect of women’s relative wages on fertility by raising the cost of children respect to market income. However, the model has limitations that our work in the first chapter of this dissertation tries to overcome: the unit of analysis is not restricted to the couple, realistic demography is used which provides a case study for further analysis as done in Sánchez-Romero et al. (2018) using Spanish historical data from the 19th century without however creating gendered

agents.

In this context, historical accounts for female labour participation during the demographic transition using general equilibrium models to measure the effect by gender on the economy using realistic demography still needs to be filled. This chapter features the article “Working Women in France: A Tale of Two Centuries Closing the Gaps”, co-written with Hippolyte d’Albis and Miguel Sánchez-Romero and attempts to address this issue using French data starting in the 19th century from both a historical and gender perspective. Moreover, an original and innovative feature of our work is the inclusion of unpaid work in our calculations to better assess the trade-off between paid and unpaid work within the household affecting each gender’s participation in the market economy. Our first results concerning a two-sex model for France taking data from 1820 to 2010 using an Overlapping Generations Model (OLG) model allow us to draw conclusions not only about women’s contribution to the market economy, but also to what we refer as the “augmented GDP per capita” which includes both market and home production. Our results also describe women’s contribution to growth at the end of 19th century as an inflexion point, followed by a well-known peak in market participation during WWI and WWII and a rise since the 1970’s.

While analysing different scenarios where either education or fertility are held constant, we try to decompose the role all these variables have had on economic growth through the demographic transition that has taken place since the 19th century. Moreover, an education-fertility tandem is observed following Diebolt and Perrin (2013) and Diebolt et al. (2021), suggesting a child-quantity-quality trade-off that deserves to be explained. Moreover, we explore intergenerational equity by calculating lifetime labour income supply by gender in terms of overall income, labour income, asset income and social security wealth. These results are of great interest as they allow to confront widespread beliefs on the privileged status of baby-boomers not only within the academia but also the media and among younger generations struggling to enter the job market and accumulate wealth.

1.0.2 Population ageing and its effect on private wealth inequality: “Not taxing imputed rent: a gift to Scrooge?”

1. Wealth Inequalities: a socioeconomic and intergenerational issue within the French tax system on wealth

From 2000 to 2010, home prices outgrew income per household, as well as rents, by 70%. To purchase the same dwelling, a first-time buyer went in average from borrowing 15 years in 2000 to over 25 years in 2010. Households' mortgage debt doubled in 10 years, from 30% of their income in the late 1990's to 58% in 2010. If trends continue in this direction and housing prices stay at the current level, this will represent 85% of household income in 2030. (Banque de France, 2017)). Among explanations for this phenomenon, since 2000 a 2% decrease in interest rates and a 7-year rise in mortgage reimbursement years explain at least 50% of this surge in home prices relative to income per household. Within this context, access to homeownership becomes increasingly difficult among the poorest deciles and especially the young. Whereas in the early 1980s, homeowners represented more than 50% of households, this number stagnated due to anti-inflation policies, unemployment and low state financial aid. From 2000 to 2009, the share of homeowner households rose slightly from 55.6% to 57.6% as a response to wage stagnation and a dramatically rise in real estate prices in major cities deepening existing inequalities in access to homeownership (INED, 2015).

As the decline in taxation of capital income appears as the inevitable consequence of capital mobility as unrealized capital gains are difficult to tax, recurrent property tax is a more immediate and simple mean to tax latent housing capital gains given that properties are periodically reassessed to updated market values. Within this context France is considered a rather “good performer” in Europe in terms of wealth taxation. More specifically, apart from recurrent taxes on immovable property, an annual wealth tax and tax revenues on capital gains are largely above average which places second, after Belgium in terms of revenue/GDP ratio of wealth transfer taxation. Masson (2018). However, authors such as Piketty and Zucman (2014) and Piketty et al. (2013), Allègre et al. (2012) or Sterdyniak

(2015)) do not share this view and warn about the lobbying of the rich for lowering taxes on immovable property and capital flows. In this context, we must note that recurrent property tax in France, relative to GDP, was among the highest in the EU in 2015 but lower than in the UK were a tax relief on mortgage of owner-occupier's dwellings (see European Commission, 2015a).

In most developed countries during the period 1910-1980, the tax base for the personal income tax was, according to Piketty: “defined in very comprehensive manner, particularly for capital income: for instance, imputed rent was usually part of the tax base” Masson (2018). From this perspective, imputed rent is considered an income as a capital gain as any other type of income. Few countries still apply this tax including the Netherlands and Luxembourg and it appears not easy at all to implement due to the unpopularity of taxes linked to homeownership.

According to Allègre et al. (2012), to fully establish a fiscal neutral environment between owners and renters implies that imputed rent (net of interest payments for mortgage payers) should be taxed. Deducting net interest payments would establish an equilibrium between mortgage payers and full right owners. The authors also suggest deducting from taxation rents for renters arguing that the decrease in tax revenue would be compensated by a general increase of the income tax. The reform would ensure horizontal equity while being redistributive, since rent-to-income ratios are higher for low-income households and easier to put in place as declared rents are known. Moreover, from a political point of view, the redistributive dimension would help to introduce the reform within the public debate as imputed rent has usually created negative reactions as it occurred during Emmanuel Macron's presidential campaign in 2017 when his economic advisor, Jean-Pisani Ferry, mentioned this proposal before the election.

2. Contribution

The real estate market has always been a privileged source of taxing resources for governments. In fact, we often observe a wide number of tax schemes or subsidies aiming to

facilitate homeownership. On this matter, some french tax schemes are easily identified by the public such as the “Prêt à Taux Zéro”, however many others are not so widespread. Imputed rents are part of this category and play a leading role in recent academic or policy analysis such as Thomas Piketty’s book: “A Fiscal Revolution” or policy briefs by the French CAE (Conseil d’Analyse Economique). The main original feature of this chapter called: « Not taxing imputed rent: a gift to Scrooge? Evidence from France» and co-written with Guillaume Chapelle (Cergy Pointoise-THEMA) is to provide an assessment of the non-taxation of imputed rents which are considered as the most important housing subsidy in France (7% of GDP) according to National Accounts. Imputed rents are defined as a capital gain perceived by the household compared to a matching a corresponding household living in a rental dwelling paying rent at market price. Previous assessments of property tax such in France such as Allègre et al. (2012), Piketty et al. (2013). All have not included a demographic analysis tackling imputed rents and the implications of the non-taxation of these latter in intra and intergenerational equity analysis.

As stated before, these latter are not new to the French fiscal system as imputed rent taxation existed between 1914 and 1965. The creation of this tax in 1914 was the result of a need of public resources in a pre-war era of high wealth concentration and very few income taxpayers during the *Belle Époque*. After WWI and WWII, capital concentration decreased significantly and very high employment rates during the Glorious Thirties which led to a massive expansion of income tax among workers. As a result of this, a global perception of low unemployment and direct tax contribution through salaries created an environment of social pressure for a more democratic access to homeownership leading French authorities to abolish this tax in the name of equality. Nevertheless, this chapter aims to show that this tax should be rather considered a source of inter-generational inequality in terms of access to homeownership with respect to younger generations and modest households. As we will explore throughout the chapter, our results underline an existing subsidy since 1965 after the withdrawal of this tax that favors owners belonging to the highest income deciles. Moreover, from a demographic perspective, the oldest households are particularly benefited given that they constitute a vast majority among full-right owners that have fully reimbursed their mortgage for their main residence. Dis-

tinguishing full right ownership from owners with a mortgage is of capital importance given that we can give a more favorable fiscal treatment to the latter which implies the tax burden would rather rely on full-right owners.

1.0.3 Pension Reform & Indebtedness: a struggle to keep up with consumption levels?

1.Dependency ratios on the rise: a real challenge for European Welfare States

Pension reforms in Europe have taken place since the 1990's, because of requirements of the Maastricht Treaty (1992) on deficit containment and sound fiscal austerity policies as a previous step for the launch of European Monetary Union in 2002. In a context of high unemployment, sluggish economic growth and increasing population ageing in European countries such as Austria, Italy, France, Germany, Spain and Sweden, costly pension systems were identified as major threats to public finance sustainability. The latter explains the emergence of fiscal tools that still shape European economic policy such as the widely discussed fiscal rule setting budget deficit at maximum 3% of GDP (Gross Domestic Product) or the 60% public debt maximum. Consequently, European countries with Pay-as you-go redistributive Bismarckian mechanisms have implemented pension reforms to foster more sustainable pension systems to cope with growing public expenses linked to increasing population ageing. Some countries such as Sweden, Italy, Germany, and Austria enacted radical reforms to their pension systems by considerably lowering replacement rates and promoting a gradual shift from the dominant pillar model to a multi-pillar system (Hering, 2006).

However, a dominant majority of European countries such as Belgium, Portugal, Spain, and France did not join this transformation and launched policies with age and replacement adjustments still within an essentially redistributive system. In this vein, the French Pension System has been in the last decades undergoing a set of major reforms while keeping a dominant pillar. The first reform was the Balladur Reform in 1993 targeting private workers and aligned regimes which came only 10 years after President Mitterand lowered

retirement age to 60 years old (previously 65 years old) in 1983. This reform was followed by the Fillon Reform in 2003 that extended the previous reform to public servants after a failed attempt during the Juppé government in 1995. Later, further reforms have paved the way towards what is thought to be a more sustainable system, such as the Woerth Reform in 2010 which increased retirement age to 62 years or the Touraine Reform in 2014 which increased contribution length to 43 years of contribution.

After almost thirty years of reforms, much has been said about the slightly higher living standards of retirees compared to workers. The National French Council of Retirement (Conseil d’Orientation des Retraites (COR)) stated in its 2018 Annual Report that overall retirees living standards represented 105% of those of the active population despite a decline from previous estimations due to a surge in divorces, higher contributions imposed to pensions and overestimation of capital gains. On this respect, using European data, authors like Hershey et al. (2010) have studied income worries and saving practices or even how retirees substitute pension wealth by private savings Alessie et al. (2013). However, to which extent pensions reforms have contributed to indebtedness to keep up consumption levels among the elder has seldom been discussed.

2. Contribution

The third article presents an impact evaluation of Balladur (1993) and Fillon (2003) Reforms on household indebtedness using the Differences-in-Differences method for impact evaluation. These reforms are of great interest as they are the most significant reforms France has launched in the last three decades in a current context of intense debate on a major pension reform during the Macron administration where discussed proposals would radically change the current system and turn it into a “points system”. Our scope was to measure the impact of these reforms on the indebtedness rates of retirees after each reform. Not only this topic has not been tackled in previous assessments of these reforms such as Bridenne and Brossard (2008) and Debrand and Privât (2006)) more centered in the evolution of benefits among retirees, but indebtedness rates among seniors is not a widely discussed topic. While the first reform affected the mainly private sector and the second reform concerned the public sector with a decade difference, they both included

three main angles: longer contribution lengths, pension indexation on inflation (previously on salaries) and calculation of pension based on the best 25 years instead of the best 10 years. Therefore, these changes had an impact in terms of the duration of the contribution but also on the level of pensions benefits that are calculated and evolve over time affecting retirees' living standards. French Wealth Surveys from 2004 and 2014 allow us to conduct this type of analysis with weighted samples of around 2100 observations that include treatment and control groups. Given that aligned regimes to the private sector (MSA, CANCAVA, ORGANIC) corresponding to schemes of social protections of farmers, craftsmen, and traders were affected in the same manner by the reform as private sector employees, they are also part of the treatment group when assessing the 1993 Balladur Reform. Similarly, the control group of public employees, is also composed of retirees from liberal regimes which were not affected by the reform. However, when evaluating the 2003 Fillon Reform, the treatment group is strictly composed of public servants and the control group of private employees since both the aligned regimes to the private sector and the liberal regimes considered independent workers became part of the *Régime Social des Indépendants* from 2006.

Conversely to classic DID (Difference-in-Difference) analysis, the article follows Blake & Garrouste's (2017) identification strategy used to measure the impact of the Balladur Reform on health conditions of retirees. While private workers are considered the treatment group and public employees as the control group as it occurs within the Reform, the main difference relies on taking a cohort dimension instead of a time dimension. Given that the available data (Baromètre Santé 2005) in Blake & Garrouste (2017) was a cross-section health survey, the cohort dimension comparing private and public employee's cohorts between them allows to perform a difference-in difference analysis despite of not having panel data. In the same vein, we use this strategy in the same manner when tackling the Balladur Reform, but we also extend it to the analysis of the Fillon Reform inverting treatment and control groups.

Our main variable of analysis is a binary variable accounting for having or not having contracted debt, but we are also taking as dependent variables having a mortgage or re-

furbishment loans. A significant and positive effect concerning indebtedness is identified and further explained in this chapter. As Blake and Garrouste (2019), we also divide our sample in terms of educational attainment, and we add a further dimension using financial difficulties to better understand the profile of retirees having acquired loans after each reform. Results that will be discussed within this section underline an education divide also found in the work of Blake and Garrouste (2019) where the less educated are more prone to acquire debt after these reforms. Additionally, in terms of financial frailty, we also observe a pattern for both reforms where those not having had or having financial difficulties in the last five years seem to be those having access to credit. However, significance was also found exclusively for retirees from the private sector affected by the 1993 Balladur Reform who had structural financial struggles during the last years prior to the survey. Finally, the paper provides socio-demographic information on the profile of retirees under analysis after each reform. Overall, households which seem to have a more stable and traditional setting (homeowners, married with children, skilled workers) are found to be those with higher possibilities of having acquired debt. Regional patterns using the 2014 Wealth Survey for the 2003 Fillon Reform show that indebtedness seems to have increased particularly in the South-West, East, Mediterranean and Paris Basin regions among retirees from the public sector. A certain significance was also found using the 2004 Wealth Survey for retirees living in the South-West region.

Chapter 2

Working Women in France: a Tale of Two Centuries Closing the Gaps

2.1 Introduction

The impact of demography on growth, which comes to examine the impact on the demographic dividend resulting from a drop in fertility and a rise in longevity is relatively recent. Scholars were far from being unanimous on this link until relatively recently. Until the 1990's, the effect of demography on economic growth was still uncertain and unclear as suggested by Kelley (1988). Seminal work by Bloom and Williamson (1998) through an empirical convergence model using Asian data shed light on how demographic transition is a major factor behind rapid economic growth. This relationship is the result of working-age population growing at a much faster rate than its dependent population thanks to higher productivity per worker as a consequence of sound development policies and institutions.

Under this light, with the introduction of demography to the classic convergence models, it became more feasible to measure the effect of the demographic transition on economic growth. In the same line of Bloom and Williamson (1998), Kelley et al (2005), include a productivity model (changes in labour supply and capital accumulation) explaining output-per-worker growth and a translation model (changes in population structure) measuring that growth into per-capita terms. Cross-country panel regressions for the

1960-1995 period reveal that combined impacts of demographic change have accounted for approximately 20% of per capita output growth, with larger shares in Asia and Europe. However, the effects of an ageing population, both from a drop in fertility and a rise in life expectancy on growth remain ambiguous. Additionally, the gender dimension of this contribution constitutes a very unexplored field that could shed some light on how fertility trends and behaviours have had an impact on capital accumulation beyond classic theories relying heavily on technical innovation. From a historical perspective in the same vein of Galor and Weil (2000), we aim to measure the contribution of a decline in fertility and consequently a higher return to human capital in the transition from stagnation in Post-Malthusian regimes towards sustained growth a Modern Growth Regime.

For the present article, we consider an overlapping-generation model à la Auerbach et al. (1991), with realistic demographic as in d’Albis (2007) and heterogeneous family structures as in Sánchez-Romero (2013) and Sánchez-Romero et al. (2018). Our model not only displays heterogeneous households by level of education, but importantly also allows for a decomposition by gender. Measuring the educational dividend is of capital importance as underlined by Crespo Cuaresma et al. (2014) in the line of Bloom and Williamson (1998) given that the window of opportunity of the demographic transition (the ratio of working population of total population is increasing) is well addressed and substantial human capital investment is made, suggesting that the demographic gift is actually an education dividend responsible of higher productivity serving economic growth. Similarly, Murin (2013), highlights the role of education in fertility transition, as its main component rather than income or health-related variables, placing education as the key determinant of the demographic transition. Concerning population dynamics, the baseline model contains migrants, which implies that the total impact of demographic changes on the economy contains changes in fertility, mortality, and migration. In order to measure the effect of migration on results, a simulation without migration was added among counterfactuals of the model. Therefore, the difference between the benchmark and the migration counterfactual represents the impact of migration.

In recent decades, a growing interest has emerged among academics, in particular eco-

economic historians, for working on historical retrospectives such as Piketty and Zucman (2014) and provide new insights on the evolution of economic processes. Moreover, within this trend, a clear attempt has also been made in order to add a gender dimension to this exercise. For instance, Mauriani and Meron (2013) published one of the first historical accounts of female work between 1901-2011 underlining the evolution female work among different sectors within the industrial and agricultural sectors, the evolution of the working hours following legislation on working days and hours of women and children at the beginning of the XIXth century. The authors also include the impact of World Wars in the surge of female work in France as part of the war effort which continued to rise until the 1970s. More recently, Diebolt and Perrin (2013) wrote a major piece for historical economic demography research as they collect data from mid XVIIIth century until the XXth century to disentangle the key drivers of demographic transition in France. Conclusions underline the emergence of female work in the XIXth century, its continuous expansion throughout the century and the first half of the XXth century until a decline in the 1970s, and a recovery in the mid-1980s when women with better access to schooling started to enter the labour market.

However, gender decomposition in overlapping generation models which is one of the main features of our model was already featured in Galor and Weil (1996). The major differences of their analysis are having the couple as the main unit of analysis with no possibility of having single households and not using realistic demography to test empirically our model. Galor and Weil (1996) underline a positive relationship between the rise of capital per worker and women relative wages. The intuition behind this conclusion is that capital deepening "which occurs as a result of population ageing" raises capital per worker increasing relative wages and reducing fertility as a consequence of the opportunity cost of children respect to household income. As a consequence, a drop in fertility raises capital per worker and is accompanied by greater economic growth.

Our model reconstructs the French economy from the late 18th century to 2100 and as depicted in section 2.3, reproduces per capita income and time in paid labour, which we compare to former series. Moreover, the model also allows to compare to previous data

series and simulations on the subject such as Bergeaud et al. (2016). Additionally, the model provides us with a very original feature since it produces innovative calculations of unpaid labor for both gender during the same lifespan. In addition to this, while holding mortality, fertility and education constant, we attempt to disentangle the main drivers of two centuries of demographic transition in France. From a gender perspective, results shed light on the evolution of inequalities concerning gender contributions to augmented growth (both market and domestic production) retrace the evolution of inequalities between men and women during the last two centuries. Finally, lifetime income by cohorts challenge widespread theories on baby-boomers as the most privileged cohorts since WWII.

The article is organized as follows: Section 2.2 presents the demographic model as well as the data and the main demographic trends arising from our model. Section 2.3 goes through the main aspects of the economic model, even if the equations are shown in detail in the 2.6. Data and Calibration are also listed in this section, as well the evolution of the main aggregate measures of our model. Section 2.4 goes through the main results linked to our model. Finally section 2.5 on women's contribution to both market and home production and measures on inter-generational equity.

2.2 Demographic model

2.2.1 Basic Framework

The demographic model includes two genders, age-specific fertility rates, and age- and gender-specific mortality rates for each cohort. Without losing significant information, we consider women as the dominant gender.

Time is discrete. All variables related to individuals are indexed by time: $t = 0, 1, 2, \dots$, age: $a = 0, 1, \dots, 90$, and gender: $g \in \{f, m\}$. Lifetimes are uncertain. At time t , an individual of age a and gender g faces a probability, denoted $p_{t+1,a+1}^g$, to survive till the next period whereas $q_{t+1,a+1}^g = 1 - p_{t+1,a+1}^g$ is the probability to die. We denote by $\ell_{t,a}^g$ the probability of surviving to age a for the individuals of the birth cohort $t - a$ and by $L_{t,a}^g = (\ell_{t,a}^g + \ell_{t+1,a+1}^g)/2$ the person-years lived at age a for the same birth. Finally, the

cohort-life expectancy at age a is given by:

$$LE_{t,a}^g = \sum_{x=a}^{90} \frac{L_{t+x-a,x}^g}{L_{t,a}^g}. \quad (2.1)$$

The main novelty of the model is to consider a family structure. The life cycle of an individual is the following. Children first live in their parents' household, educate themselves, and leave their parents at age A_{t-a} to settle their own household with a partner of their age. The age at which they finish education is denoted E_{t-a}^g and we pose that $A_{t-a} = \max \{E_{t-a}^f, E_{t-a}^m\}$. We also assume that there is no divorce nor remarriage in case of widowhood. There are therefore three possible partnership status: being coupled, which we denote by c , and which lasts till the partner's death; and being single, which we denote by gender of the individual g with either a widow or a widower. We introduce variable $s_{t,a} \in \{c, g\}$ that indicates the state to which a given individual of age a belongs at time t , while $\mathbf{s}_{t,a}$ is the sequence of states experienced by the individual till age a . Note that we can rewrite $\mathbf{s}_{t,a}$ recursively as $(\mathbf{s}_{t-1,a-1}, s_{t,a})$. It will be also useful to define the dummy variable $\mathbf{1}_{s_{t,a}}$ which equals 1 if $s_{t,a} = c$ and 0 if $s_{t,a} = g$. The demography of partnership status is given by vector of probabilities of being in each specific partnership status, denoted $m(\mathbf{s}_{t,a})$, whose dynamics depend on the survival probabilities of both sexes such that:

$$\begin{pmatrix} m_{t+1,a+1}^c \\ m_{t+1,a+1}^f \\ m_{t+1,a+1}^m \end{pmatrix} = \begin{pmatrix} p_{t+1,a+1}^f p_{t+1,a+1}^m & 0 & 0 \\ p_{t+1,a+1}^f q_{t+1,a+1}^m & p_{t+1,a+1}^f & 0 \\ q_{t+1,a+1}^f p_{t+1,a+1}^m & 0 & p_{t+1,a+1}^m \end{pmatrix} \begin{pmatrix} m_{t,a}^c \\ m_{t,a}^f \\ m_{t,a}^m \end{pmatrix} \quad (2.2)$$

with $m_{t,a}^c = 1$ and $m_{t,a}^g = 0$ for $a = A_{t-a}$.

Fertility rates, denoted $f_{t,a}$, are cohort and age specific and are assumed to be independent to women's partnership status. Thus, the cumulative fertility until age a for cohort $t - a$ is given by $F_{t,a} = \sum_{x=0}^a f_{t,x}$. Parents take care of their children until they leave the household. If a spouse dies, the survivor takes care of the existing surviving children. Children whose both parents are dead, i.e. orphans, are being taken care of by parents of the same age. Therefore, by using system (2), we are able to compute the number of dependent children per partnership status, cohort and age.

We finally compute a female dominant population projection using Leslie matrices. The

Leslie Matrix for women writes:

$$\begin{pmatrix} A_{1,0} & A_{1,1} & \dots & A_{1,89} & A_{1,90} \\ \frac{L_{2,1}^f}{L_{1,0}^f} & 0 & \dots & 0 & 0 \\ 0 & \frac{L_{3,2}^f}{L_{2,1}^f} & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \dots & \frac{L_{T,90}^f}{L_{T-1,89}^f} & 0 \end{pmatrix} \quad (2.3)$$

where $A_{1,a}$ is the expected number of kids aged 0 to 1 at the end of the interval per person aged a to $a+1$ at the initial date $t = 1$ such that:

$$A_{1,a} = \frac{L_{1,0}^f}{2l_{1,0}^f} \left(F_{1,a} + F_{1,a+1} \frac{L_{1,a+1}^f}{L_{1,a}^f} \right) f_{fab}. \quad (2.4)$$

where f_{fab} is the share of women at birth, which is here supposed to be constant and set to 0.49. Moreover, the Leslie Matrix for men writes:

$$\begin{pmatrix} 0 & 0 & \dots & 0 & 0 \\ \frac{L_{2,1}^m}{L_{1,0}^m} & 0 & \dots & 0 & 0 \\ 0 & \frac{L_{3,2}^m}{L_{2,1}^m} & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \dots & \frac{L_{T,90}^m}{L_{T-1,89}^m} & 0 \end{pmatrix} \quad (2.5)$$

Migration is included in this setting, but in a simple way as we assume that immigrants and emigrants have the same characteristics as the average individual of the cohort they belong to.

2.2.2 Data and main demographic trends

1. Demographic Trends

We aim to reconstruct with our model a demographic structure by age and sex between 1820 and 2010. For this purpose, we require demographic data by single years of age on death rates, fertility rates, and population size for a time-span larger than the period analyzed (1820–2010). Historical demographic information from France, essential for our realistic demography two-sex model, was available through different sources. The age

distribution of the French population is taken for years: from National Census published every ten years 1821, 1831, 1841, 1851, 1856, 1866, 1871, 1881, 1891, 1901, 1911, 1921, 1931, 1941, 1954, 1962, 1968, 1975, 1982, 1990, 1999, 2009, and 2016. Fertility data was taken from the Human Fertility Database (HFD) for the period 1816-2017. For death rates, we use the Human Mortality Database for the 1816-2017 period and Eurostat for the 2018-2100 period.

Since age-specific fertility rates are not available before 1945 in France, we reconstruct them for the 1816-1945 period by implementing a Generalized Inverse Population Projection (GIP) using a two sexes population model. This method will report age-specific fertility rates that are consistent with historical demographic data. To construct a demographic database consistent with our economic model (i.e., a two-gender, closed population), we use simultaneously two demographic methods widely used in population reconstruction: Inverse Projection (IP) and Generalized Inverse Projection (GIP) (Lee (1985); Oeppen (1993)). The IP method as in Sánchez-Romero et al. (2018) is used to calculate net migration rates, while the GIP method is used to reconstruct consistent data on total population size by age (N), life expectancy and the total number of births. Moreover, age-specific fertility rates and age specific conditional survival probabilities also match historical data. GIP is a non-linear optimization that produces constrained demographic projections with a priori information (Oeppen (1993)). The GIP method is explained in more detail in the Appendix. The french demographic information used in the GIP model is the total population (1816–2015), total number of births (1816–2015), total number of deaths (1816–2015), net migration rates (1816–2015), infant mortality (1816–2015), life expectancy at birth and at age 65 (1816–2015), total fertility rates (1892–2015), the mean-age of childbearing (1892–2015), and the fraction of females at birth (1816–2015).

Figure 2.1 shows the estimated fertility rates, total population size, life expectancy, number of births and number of deaths in France for the period 1800–2050. Panels A to E show the in-sample performance of the GIP method to the existing demographic data, taken from the Human Mortality Database (HMD). The estimated age-specific fertility rates using the GIP method are consistent with the existing historical demographic data

Panel (A) shows how the model is capable of well replicating the total fertility rates (TFR) observed in France for the period 1892–2015. The total fertility rate is the average number of children a hypothetical women would have at the end of her reproductive period if she is not subject to mortality. Our estimates show a continuous decline in the TFR along the 19th century, with a period of stability in the TFR of around 3.5 children per woman during the third quarter of the 19th century. As underlined by Wrigley (1985), from the late 18th century, this fall set apart France from other european countries with a drastic decrease in marital fertility: by 1840 it had already fallen to two-thirds of its level before 1800 and by 1900 was only about one half. The stagnation of population growth shown in Panel (B) confirms this theory. We must add that this early demographic change came earlier compared to richer and more educated countries like England and the Netherlands (Daudin et al. (2016)).

Many authors have attempted to address this puzzle. One of the reasons behind this fall is the decrease in nuptiality of the *Ancien Regime* which increased age at first marriage and celibacy as well as a result of a rise in life expectancy as shown in Panel (C) and a decline in mortality as shown in Panel (E). Moreover, Cummins (2013) points out that fertility decline in France was a result of declining levels of economic inequality specially in rural areas, associated with the 1789 Revolution: fertility drops are linked to lower economic inequality. However, socioeconomic status matters since the fertility reduction was intitiated by the upper classes. On the other hand, Daudin et al. (2016), explore the role of internal migration among French departments as a vector of information contributing to the sharp fall of fertility in the 19th century. This fall was stopped during the last quarter of the century, as described by Toulemon et al. (2008), as a result of efforts by the new Republican state attempt to regulate the family sphere, defying the influence of the Church on this ground and lead an active role in a pro-natalist movement following the 1870 defeat against Germany (Porter (2006)) that lasted at least two decades.

On the other hand, cohort indicators are presented in Figure 2.2. Panel A shows for a selected group of birth cohorts, the cohort-fertility profiles resulting from the GIP method. All points are estimated using the GIP method (observed and estimated). The fall in

fertility rates, as well as the shift in the age of the reproductive years for women, can be observed in the graph. For instance, for younger cohorts (born in 1940 and 1980), dots represent observed data using the GIP method suggesting slightly higher rates compared to estimated values. Panel B (Cohort mean fertility rate) and Panel C (Cohort mean age at birth) where red dots represent observed data, confirm these trends. Panel D (Cohort mean life expectancy) sustains also the hypothesis that a shift in the age of reproductive years is closely linked to the rise of cohort life expectancy.

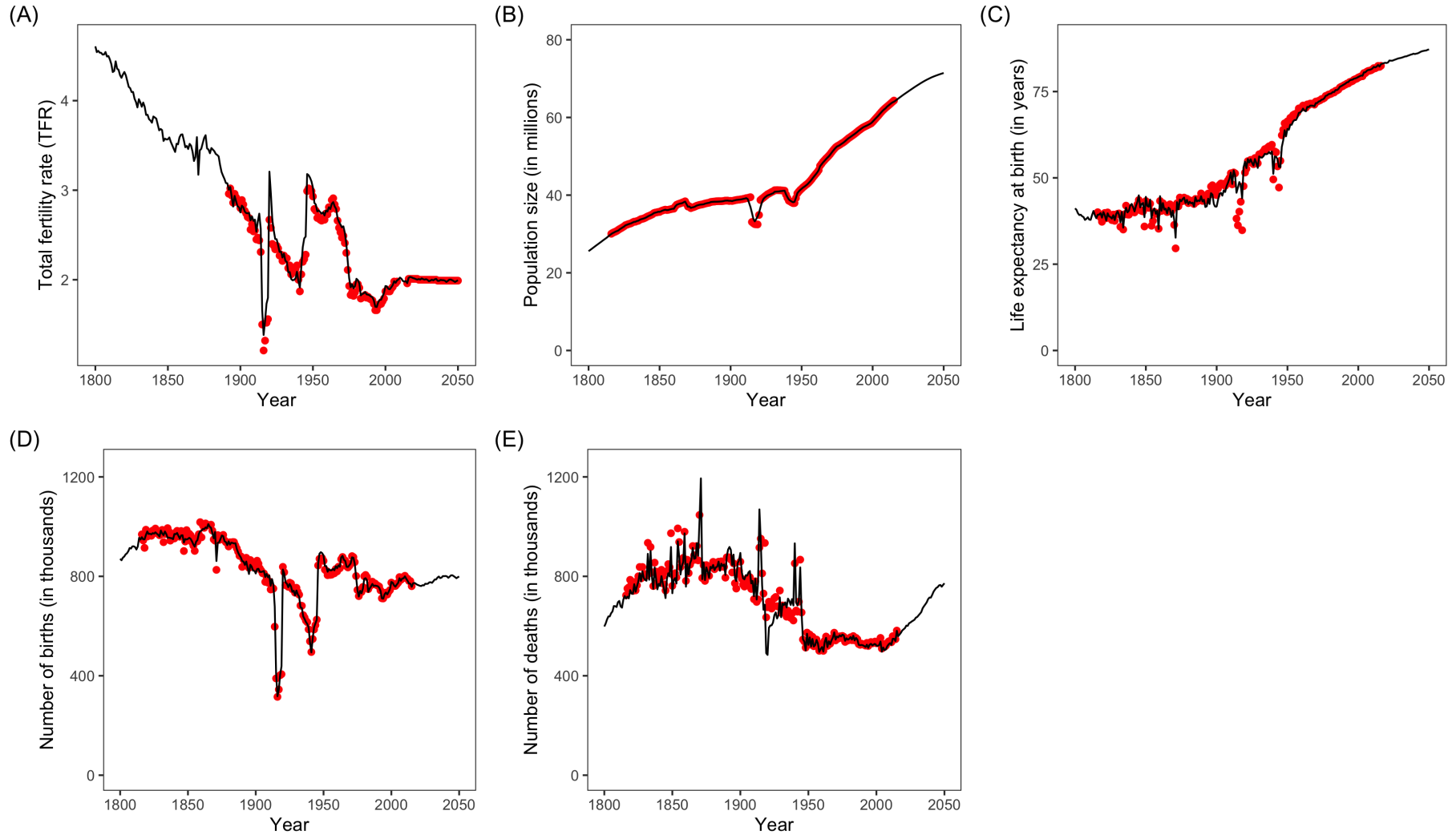


Figure 2.1: Periodic Demographic indicators. Estimated fertility rates in France from 1800 to 2050. (A) Estimated total fertility rates (TFR) —solid black line— and observed total fertility rates —red dots— for the period 1800–2050. In-sample performance of the GIP model to existing demographic data. France: Selected year between 1816 and 2015. (B) Total population, (C) Life expectancy at birth, (D) total births, and (E) total deaths. *Notes:* Black solid lines depict estimated data and red dots depict actual data. *Source:* Authors estimations and Human Mortality Database (HMD).

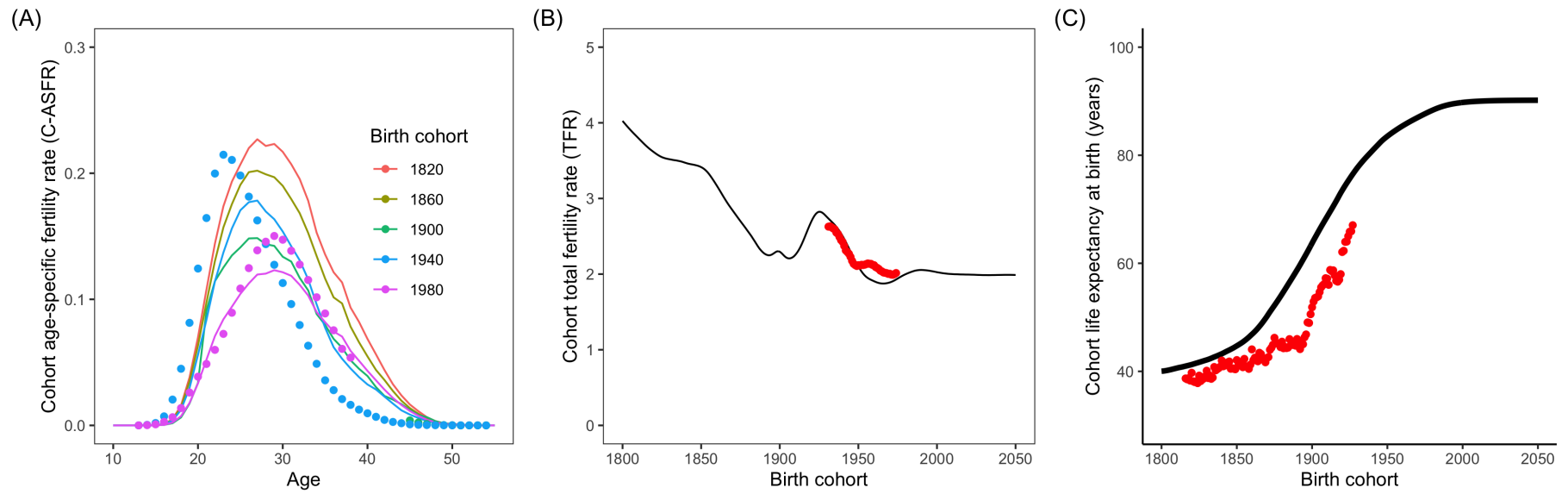


Figure 2.2: **(A)** Estimated age-specific fertility rates across selected birth cohorts. **(B)** Estimated cohort total fertility rates (TFR) -solid black line- and observed total fertility rates -red dots- for the period 1930-1975 **(C)** Cohort Life Expectancy at birth-solid black line-and observed total fertility rates -red dots- for the period 1816-1927 *Source:* Authors estimations and Human Fertility Collection (HFC).

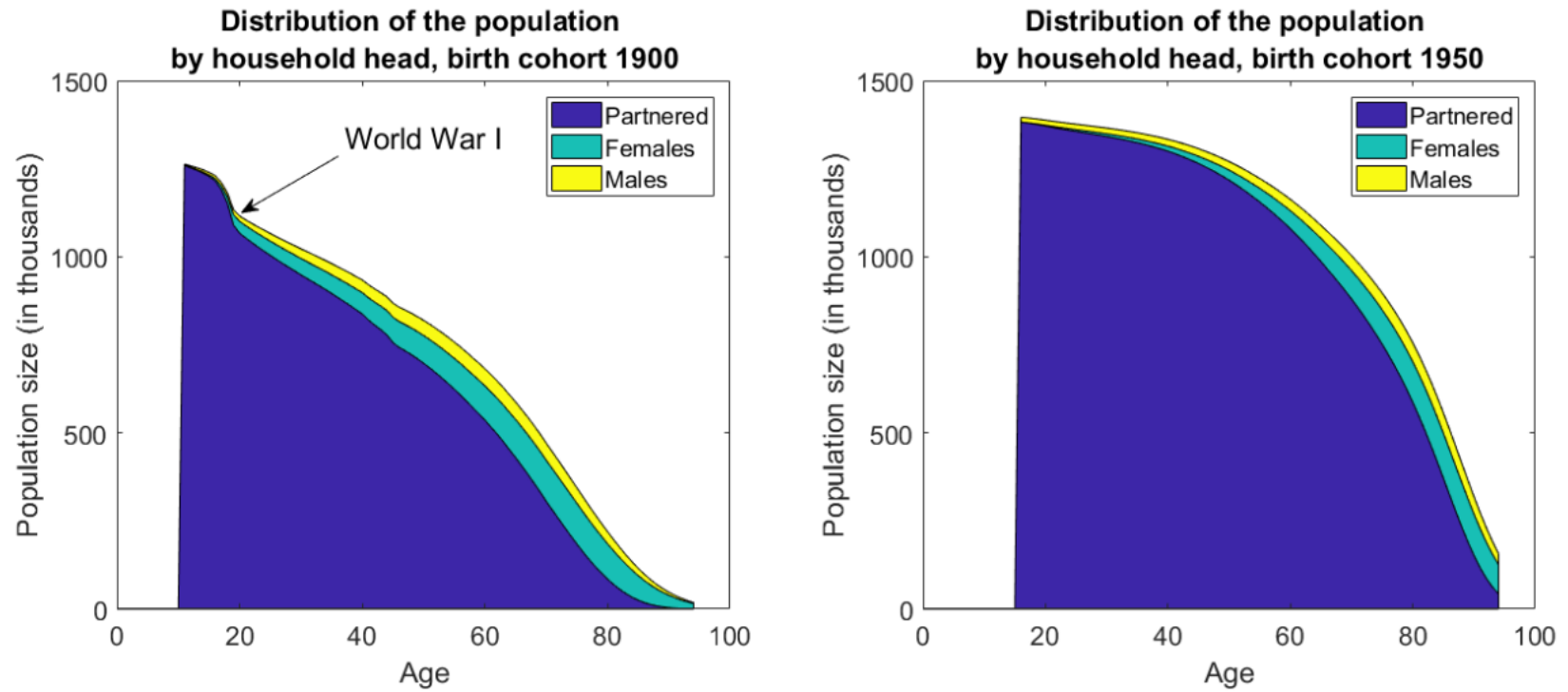


Figure 2.3: Distribution of the population by household head for birth cohort 1900 & 1950. *Source: Based on author's calculations*

Household formation

The main original feature of the model is to aim to reconstruct a demographic family structure. Figure 2.3 displays population by household head for birth cohorts born in 1900 and 1950. As stated before, households are formed at age A_{t-a} where $A_{t-a} = \max \{E_{t-a}^f, E_{t-a}^m\}$ either by a single male, by a single female, or by a couple. Both sexes are matched at age E without considering any other characteristic but gender. The total number of initial couples equals the minimum population size between males and females at age E. All non-partnered individuals (numerous gender) are assumed to stay single during the whole life. If the single is a male, he will not have to raise children. If the single is a female, she will have children out-of-wedlock. After age E, households can also be formed by widows and widowers.

Concerning education statistics, the calculation of the number of years of education by gender was based on our own calculations using data from IPUMS-International for France and from the French Ministry of Education by cohort and year starting in 1863, before which we assume a stability hypothesis of 4 years of education. Trends for men and women are plotted in Fig. 2.4. To compute the age at which students finish their education, we add 7 years to those estimates. School became mandatory from the age of 6 until 13 years old for both boys and girls after the Jules Ferry Law of 1882. Figure 2.4 shows the average years of schooling in France from 1860 to 2060, which is obtained combining data from IPUMS-International and WIC data for France. The mean-years of education for each gender and birth cohort were calculated using the WIC Human Capital database Gailey and Lutz (2019). Moreover, government spending concerning education was taken from UNESCO. Before 1860 we interpolate the values, assuming that the average number of years of education in 1750 is 0. After 2060 we assume that the average years of schooling stays constant.

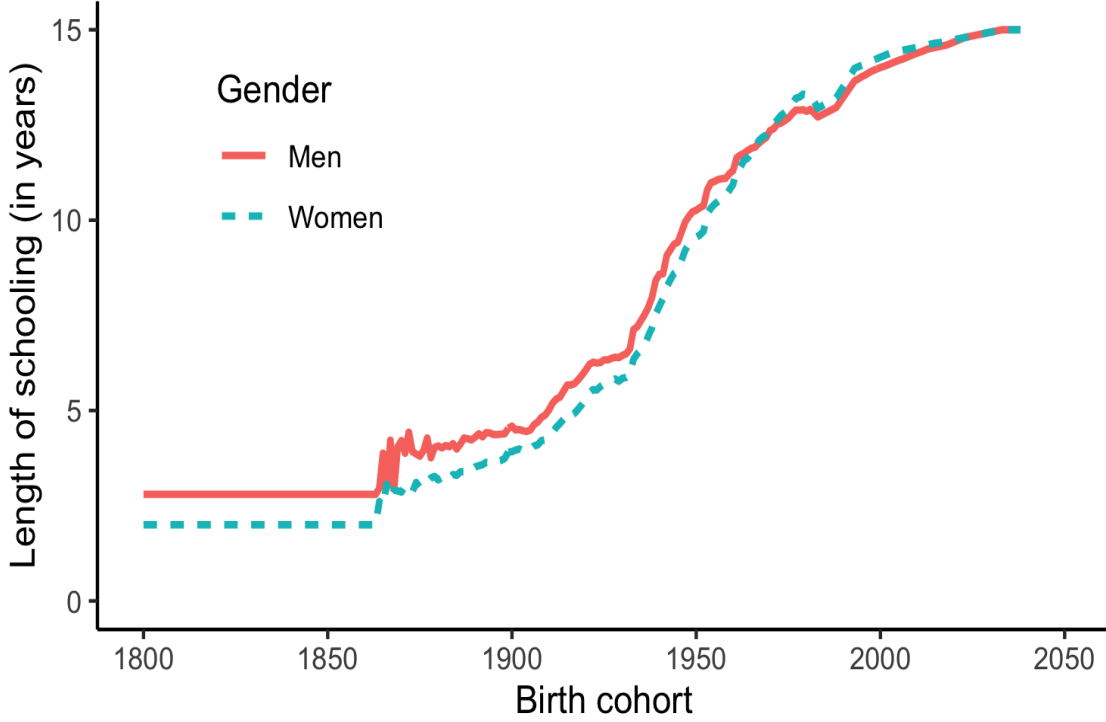


Figure 2.4: Average years of schooling in France (1860-2060). *Source: Data from IPUMS-International and WIC data for France.*

2.3 The economic model

This section takes information on demography included in section 2.2 to construct an Overlapping Generations Model (OLG) presented below. Three subsections will walk us throughout the model: Life-cycle behaviors, Aggregate Variables and Data & Calibration. The details concerning calculations of the model are in the Appendix (section 2.6).

2.3.1 Life-cycle behaviors

At time t , a household whose heads are of age a is composed of $1 + \mathbf{1}_{s_{t,a}}$ adults and $\eta(\mathbf{s}_{t,a}) \in \mathbb{R}^+$ dependents, children and orphans. The consumption adjusted size of the household is given by function $H(\mathbf{s}_{t,a})$ that writes:

$$H(\mathbf{s}_{t,a}) = \sqrt{1 + \mathbf{1}_{s_{t,a}} + \eta(\mathbf{s}_{t,a})}. \quad (2.6)$$

The instantaneous utility allows us to measure consumption per capita within the household taking into account since it is weighted with $H(\mathbf{s}_{t,a})$ as in Browning and Ejrnaes

(2009) or Braun et al. (2009) among others, and leisure time of adults. It writes:

$$U(\mathbf{s}_{t,a}) = H(\mathbf{s}_{t,a}) \left[\ln \left(\frac{c_{t,a}}{H(\mathbf{s}_{t,a})} - C \right) + \alpha_x \ln \frac{ch_{t,a}}{H(\mathbf{s}_{t,a})} \right] + \alpha_z (\ln z_{t,a}^g + \mathbf{1}_{s_{t,a}} \ln z_{t,a}^{-g}), \quad (2.7)$$

where $c_{t,a}$ and $ch_{t,a}$ are the total household consumption of private goods and home produced goods, respectively, and $z_{t,a}^g$ is the leisure time of the adult of gender g . Moreover, C is the subsistence level of consumption that helps explaining the decline in labor supply (Restuccia and Vandenbroucke, 2013), while $\alpha_x > 0$, and $\alpha_z > 0$ are preference weights. Home goods are produced using a mix of the time of the adults of the household and expenditures (Aguiar and Hurst, 2005); the production function is the following:

$$ch_{t,a} = (x_{t,a})^\gamma \left((h_{t,a}^g)^{\sigma(t-a)} + \mathbf{1}_{s_{t,a}} (h_{t,a}^{-g})^{\sigma(t-a)} \right)^{\frac{1-\gamma}{\sigma(t-a)}}, \quad (2.8)$$

where $x_{t,a}$ are the expenditures and $h_{t,a}^g$ is the time spent in home production. The parameters of the production function, which describe the degree of substitutability between inputs, satisfy $\gamma \in (0, 1)$ and $\sigma(t-a) = 0.975 - 0.035 * (E_{t-a}^f - 2) > 0$. The CES production function has an elasticity of substitution of σ , where γ is 0.80, a share parameter on capital $\dagger$ where $\alpha\gamma=0.4350$ and a capital depreciation rate of $\delta=0.04$.

The budget constraint of the household describes the evolution of the financial wealth that is a community property of household' adults, and which is denoted $k_{t,a}$, writes:

$$k_{t+1,a+1} = R_t(s_{t,a}) k_{t,a} + (1 - \tau_t^L) \left[w_t \epsilon_a (E_{t-a}^g) l_{t,a}^g + \alpha (l_{t,a}^g) \pi_{t,a}^g \right] + (1 - \tau_t^L) \mathbf{1}_{s_{t,a}} \left[w_t \epsilon_a (E_{t-a}^{-g}) l_{t,a}^{-g} + \alpha (l_{t,a}^{-g}) \pi_{t,a}^{-g} \right] - (1 + \tau_t^c) (x_{t,a} + c_{t,a}), \quad (2.9)$$

where $R_t(s_{t,a})$ is the return on annuitized wealth that satisfies:

$$R_t(s_{t,a}) = \frac{1 + (1 - \tau_t^K) r_t}{p_{t,a}^g + \mathbf{1}_{s_{t,a}} p_{t,a}^{-g} (1 - p_{t,a}^g)} \quad (2.10)$$

where r_t is the interest rate, τ_t^K is the capital income tax rate and the denominator is the probability that at least one adult of the household survives till period $t + 1$, which is used to compute the fair annuity premium Yaari (1965). Labor income is given by the product of w_t the wage per unit of efficient labor, the labor productivity at age a that

depends on the length of education $\epsilon_a(E_{t-a}^g)$, and the labor supply $l_{t,a}^g$. Pension income is the product of a rule on age a older-worker labor supply that writes:

$$\alpha(l_{t,a}^g) = \begin{cases} 0 & \text{if } a < 55(\text{age}), \\ \max\left\{0, 1 - \frac{l_{t,a}^g}{L}\right\} & \text{if } a \geq 55(\text{age}), \end{cases} \quad (2.11)$$

and some pension points, denoted $\pi_{t,a}^g$, that are described below. Labor and pension incomes are taxed at rate τ^L , while expenditures are taxed at rate τ^c . Pension points' dynamics is given by:

$$\pi_{t+1,a+1}^g = [\alpha(l_{t,a}^g) + R_t^p(1 - \alpha(l_{t,a}^g))] \pi_{t,a}^g + \rho w_t \epsilon_a(E_{t-a}^g) l_{t,a}^g, \quad (2.12)$$

where R_t^p is the productivity growth factor and $\rho > 0$. Finally, the total tiADe of each adult is normalized to 1 and it's time allocation satisfies:

$$l_{t,a}^g + z_{t,a}^g + h_{t,a}^g + \bar{\phi} \frac{\phi_g}{\phi_g + \mathbf{1}_{s_{t,a}} \phi_{-g}} \eta(\mathbf{s}_{t,a}) = 1, \quad (2.13)$$

where $\phi_f > \phi_m > 0$.

The problem of household $\mathbf{s}_{t,a}$ is to find $\{c_{t,a}, ch_{t,a}, x_{t,a}, l_{t,a}^g, z_{t,a}^g, h_{t,a}^g\}$ that solve:

$$V(\mathbf{s}_{t,a}) = \max\{U(\mathbf{s}_{t,a}) + \beta \mathbb{E}_t[V(\mathbf{s}_{t+1,a+1}) | \mathbf{s}_{t,a}]\} \quad (2.14)$$

subject to constraints (2.8), (2.9), (2.12), (2.13), $l_{t,a}^g \geq 0, z_{t,a}^g \geq 0, h_{t,a}^g \geq 0$, and for $k_{t,a}$ and $\pi_{t,a}^g$ given, $\beta \in (0, 1)$ is the pure discount, where $\mathbb{E}_t$ is the expectation operator. First order conditions are provided in Appendix A.

2.3.2 Aggregate variables

Let us denote by $c(\mathbf{s}_{t,a}), ch(\mathbf{s}_{t,a}), x(\mathbf{s}_{t,a}), l^g(\mathbf{s}_{t,a}), z^g(\mathbf{s}_{t,a}), h^g(\mathbf{s}_{t,a}), k(\mathbf{s}_{t,a})$ and $\pi^g(\mathbf{s}_{t,a})$ the optimal solutions for the household of type $\mathbf{s}_{t,a}$ and by $C_t, CH_t, X_t, L_t^g, Z_t^g, H_t^g, K_t$ and Π_t^g their respective aggregate counterparts that are determined by summing over households types such that, e.g.,

$$C_t = \int m(\mathbf{s}_{t,a}) c(\mathbf{s}_{t,a}) dm(\mathbf{s}_{t,a}), \quad (2.15)$$

where $m(\mathbf{s}_{t,a})$ is the mass of households of type $\mathbf{s}_{t,a}$. Aggregate efficient labor, denoted L_t , is given by:

$$L_t = \int m(\mathbf{s}_{t,a}) [\epsilon_a(E_{t-a}^g) l^g(\mathbf{s}_{t,a}) + \mathbf{1}_{s_{t,a}} \epsilon_a(E_{t-a}^{-g}) l^{-g}(\mathbf{s}_{t,a})] dm(\mathbf{s}_{t,a}). \quad (2.16)$$

The production of private goods is described by the following Cobb Douglas production function:

$$Y_t = K_t^{\alpha_Y} (A_t L_t)^{(1-\alpha_Y)}, \quad (2.17)$$

where $\alpha_Y > 0$ and A_t is the exogenous labor augmenting technical progress. The government budget is supposed to be balanced and writes:

$$\tau_t^C (C_t + X_t) + \tau_t^K r_t K_t + \tau_t^L w_t L_t = G_t, \quad (2.18)$$

where G_t is an unproductive public expense.

2.3.3 Data and Calibration

In this section we first describe the input data used in the overlapping generations model: data labour supply on the evolution of days and hours worked by gender and activity rates during the last two centuries, data on wage gap, national accounts data used to calculate labour-augmenting technological process and public finance data. We conclude the section by briefly explaining the calibration strategy and the model parameters.

Labour supply

Time in paid labor was estimated by gender from 1816 to 2018 using difference sources and assumptions as shown in Figure 2.6. Time in paid labor is used to calibrate parameters $(\sigma t - a, C)$. Derivations for each gender ‘g’ are calculated for time in paid labour dividing *Per capita annual hours worked by gender* by statutory annual hours worked (12 hours daily shift for a 7 days working week is assumed). On this respect, *Per capita annual hours worked* by gender are calculated multiplying the *Number of hours annually* worked by gender by the share of effective active population among those aged 14-65 years old (productive years). *Number of hours worked annually by gender* depends on working days per week, the sum of full-time working hours by age group and the share of the age group by gender out of those aged 14-65 years old.

Activity rates for women and men were taken from Marchand and Thélot (1990) for the period 1821-1891. Moreover, activity rates for both genders for 1896-1955 were taken from Villa (1997). Data for the period 1956–1974 came from OECD Statistics (2019) on

2.3. THE ECONOMIC MODEL

Short Term Labour Market Statistics. Finally, sum of total hours worked for full-time and part-time workers for the period 1975–2018 extracted from OECD Statistics (based on national definitions). Moreover, the share of active population was taken from Piketty and Zucman (2014) for the 1960-2010 period.

	Age 14-15	Age 16-17	Women	Men	Days
1848	12h	12h	12h	12h	7d
1874-1876	10h	11h	12h	12h	7d
1892	10h	11	11	12	7d
1900	10h	11h	11h	11h	7d
1902	10h	10h30	10h30	10h30	7d
1904	10h	10h	10h	10h	7d
1905/1906 Laws	8h/10h				6/7 d
April 1919 Law	8h				6 d
1936-2000	8h				5 d
2000-	7h				5 d

Table 2.1: Working days and daily hours for adults and children (1848-1905). Source: Marchand and Thélot (1990)

Table 2.1 gives an overall picture of the evolution of working days and hours in the second half of the XIX Century. In 1848, a decree of the young Second Republic attempted to establish a 10 hour working day in Paris, an 11 hour outside Paris failed, and a maximum 12 hours daily shift was maintained. It was not until 1900 with the Millerand Law organised a transition for both men and women to 10 hours in the following way: the 1900 law established working days of 11 hours, the 1902 law reduced it to 10h30 hours and finally the 1904 law to 10 hours.

The 1892 Law created some improvements for women and children but also created a Working Inspection to oversee their conditions. According to french legislation adopted in 1892, children aged 13 years old were not allowed to work. On the other hand, children

13-16 years old were allowed to work 10 hours a day, previously from 1874 to 1896, they had been allowed to work up to 12 hours a day. Moreover, 16-17 year olds as well as women worked 11 hours a day compared to the 12 hours shift done by men.

As observed in Table 2.1, 1905 and 1906 Laws created the first foundations for a 8h working week and Sunday rest: 10 hours for every person older than 18 years old and 8 hours for adults younger than 18 years old, including mine workers and excluding some occupations such as maids and agricultural workers. Later on, 23rd April 1919 Law after World War I generalized the 8 hours working days and rest on Sundays Marchand and Thélot (1990). Mandatory rest on Sunday was in partly due to growing pressure and lobbying from the Catholic Church and religious groups since the second half of the XIXth Century stating that Sundays were religious days that were not supposed to be worked (Brejon de Lavergnée (2009)). The 40 hours and 5 days working week, which was a major victory of the *Front Populaire* in 1936 remained the normal until 2000. In 2000, under the Jospin government, the "Aubry Laws" moved to a 35 hours working week.

The wage gap

The reconstruction of the gender wage gap is based on information on observed wage gaps in France from 1951–2015 on calculations using INSEE data (Enquête Emploi). In 2015, full-time working women earned 83.5% of men salaries, according to these calculations. For the period 1820–1900, the data is reconstructed by linearly interpolating between historical wage gaps reported by Blank and Goldin (1992) for the United States, given that average values are similar. Between 1900 and 1951, we linearly interpolate between the two data points. We keep constant the values reported for 1820 before 1820 and for 2015 and after 2015.

These calculations match those of the first piece of work on gender wage gap in France by Guilbert (1966)) which states that inter-industries gender wage gap in 19th century for France, was of 63% as women earned around 37% of men salaries, with some differences between sectors. This goes on the same line of Wishnia et al. (1993) who asserted

that systematic gender pay gaps reflected the hierarchical sex-typing jobs since women in textile industry for instance the same basic job title as men earned a third to a half less because they were relegated to smaller machines or to ancillary positions. In addition to this, Guilbert (1966) insists on the fact that before 1950, despite of the effect of World War I and World II on empowering women and including them actively in the labour force, they were not thought to be entitled to earn a full salary and rather a complementary salary called "salaire d'appoint" as they were supposed to be supported by their husband, concubine or father. From 1950, by law only a 10% reduction could be applied to women compared to the salary earned by men for the same job.

Labor-augmenting technological progress

The labor-augmenting technological progress is calculated using historical information on national accounts, hours worked, and educational attainment and is considered an exogenous input in the model.

The formula for calculating the labor-augmenting technological progress calculated according to Barro and Sala-i Martin (2000) is the following:

$$\hat{A}_t = \sum_{s=t-2}^{t+2} \exp \left\{ \log(Y/N)_s - \frac{\alpha_s}{1 - \alpha_s} \log(K/Y)_s - \log(L/N)_s \right\} \quad (2.19)$$

for $t = (1822, \dots, 2008)$, where α_s is kept constant and equal to 0.3, which is roughly the average capital share over the period 1820–2010. From (2.19) we derive the growth rate of the labor-augmenting technological progress $1 + \hat{g}_t^A = \hat{A}_{t+1}/\hat{A}_t$. We assume that $\hat{g}_t^A$ is zero for $t < 1821$ and 0.4% for $t > 2008$ since we don't have information before and after these dates. As labour-augmenting technological process affects labour supply, we take 0 for calculations before 1821 to cancel given the lack of information and 0.4% from 2008 as this is the average of the decade.

The information used to calculate equation 2.19 is taken from diverse sources. For calculating output per capita Y/N , data on per capita national income taken from series in Piketty and Zucman (2014) for the period 1820-2010. Moreover, for calculating the

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capital-to-output ratio K/Y , data taken from (Bergeaud et al. (2016) for the period 1890–2010 combining series concerning Capital Intensity (KI) defined as the ratio of total capital stock over total hours and Labour productivity (LP) corresponding to the ratio of GDP over total hours worked. Before 1890 K/Y is kept constant at the level of 1890. Moreover, per capita stock of human capital is represented by L/N .

Since we are not interested in specific economic shocks but on trends, we remove extreme growth rates by calculating a centered moving average of order $m = 4$, which roughly corresponds to a decade,

$$1 + g_t^A = \frac{1}{2m + 1} \sum_{s=t-m}^{t+m} (1 + \hat{g}_s^A). \quad (2.20)$$

From (2.20) we constructed the labor-augmenting technological progress at time t (A_t) as

$$A_t = \prod_{s=1820}^t (1 + g_s^A) \text{ with } A_t = 1 \text{ for all } t \leq 1820. \quad (2.21)$$

Per capita stock of human capital is obtained by multiplying three factors: a sum of population ratio by gender out of total population, average productivity per workers by gender and per capita annual worked hours by gender.

$$\frac{L_t}{N_t} = \sum_{g \in \{m, f\}} \frac{N_{t,g}}{N_{t,f} + N_{t,m}} \times \left(\begin{array}{c} \text{Average} \\ \text{productivity} \\ \text{per worker} \end{array} \right)_{t,g} \times \left(\begin{array}{c} \text{Per capita} \\ \text{annual hours} \\ \text{worked} \end{array} \right)_{t,g} \quad (2.22)$$

The labor productivity is a function of age and the length of education denoted $\epsilon_a(E_{t-a}^g)$, which satisfies:

$$\epsilon_a(E_{t-a}^g) = \exp \left\{ \theta_h (E_{t-a}^g - 7)^{\gamma_h} + \beta_1 (a - E_{t-a}^g) + \beta_2 (a - E_{t-a}^g)^2 \right\} \quad (2.23)$$

The first term inside braces on the right-hand side $\theta_h (E_{t-a}^g - 7)^{\gamma_h}$ stands for the returns on education taken from Cervellati and Sunde (2013) and Hazan M (2009), where $\gamma_h = 0.6$ and $\theta_h = 0.35$. Concerning the impact of experience on labor income, $\beta_1 (a - E_{t-a}^g) +$

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$\beta_2(a - E_{t-a}^g)^2$ is a standard Mincerian equation, where the parameters $\beta_1 = 0.0578$ and $\beta_2 = -0.0008$ are obtained using french data.

In addition to this, average productivity per worker at time t by gender g is calculated as the sum across age of the average productivity of each worker by age and gender, given her/his education, divided by the total number of workers of each gender. Per capital annual hours worked are taken from the time in paid labor data which start in 1816.

Public finance

The model required input data on public consumption, indirect taxes, labor income taxes, and capital income taxes. Since it is assumed that the government runs on a balanced budget, the total cost of financing public consumption at time t is distributed across indirect taxes, labor income taxes, and capital income taxes at time t according to the relative weight that each tax represents in the total taxes collected at time t .

$$\frac{G_t}{Y_t} = \frac{G_t}{NI_t} \frac{NI_t}{Y_t} \mathbf{1}_{\{t \leq 1975\}} + \frac{G_t}{Y_t} \mathbf{1}_{\{t \geq 1980\}} \quad (2.24)$$

Public consumption spending to national income for the period 1820–1975 is taken from Flora (1980). Between 1975 and 1980 the data is linearly interpolated. Public consumption spending to output for the period 1980–2010 is taken from Piketty and Zucman (2014). Output (Y) is calculated by adding to National Income (NI) to the depreciation of capital, both also taken from Piketty and Zucman (2014).

$$Y_t = NI_t + (NI_t) \frac{(\delta K)_t}{NI_t} = NI_t + (\delta K)_t. \quad (2.25)$$

Concerning fiscal data, data on taxes from 1896 to 2010 was also collected from Piketty and Zucman (2014), before 1896 the distribution of taxes is kept constant at the level of 1896. In the same line, after 2010 the distribution of taxes is kept constant at the level of 2010.

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As for the pension system, in order to properly model the accumulation of capital, we assume individuals can accumulate pension rights (points) that will be transformed into pension benefits upon retirement. Given that the government runs a balanced social security, social contributions taken from Piketty and Zucman (2014) starting in 1890 are adjusted annually to finance all pension benefits claimed. The assumed accrual rates of the pension system by birth cohort are:

$$\alpha(l_{t,a}^g) = 0.50 \begin{cases} 0 & \text{for } t - a < 1880, \\ \frac{1}{40} \frac{t-a-1880}{20} & \text{for } 1880 \leq t - a < 1900, \\ \frac{1}{40} & \text{for } 1900 \leq t - a < 1960, \\ \frac{1}{40} - \frac{0.25}{40} \frac{t-a-1960}{60} & \text{for } 1960 \leq t - a < 2020, \\ \frac{0.75}{40} & \text{for } t - a \geq 2020. \end{cases} \quad (2.26)$$

The underlying value of 0.50 corresponds to the pension replacement rate.

2.3.4 Reconstructing the economy

Thanks to the output of our model we are able to reconstruct the french economy from the early 19th century and compare it to available series for cross-checking our calculations. Figure 2.5 to Figure 2.9 show the evolution of three aggregate economic variables from 1820 to 2010 obtained with our model: (i) (Per capita income), (ii) Hours worked by women and men (on the labour market) and (iii) Hours worked by women and men at home (unpaid labor).

As depicted in Figure 2.5, we observe that the levels of per capita income match those of Bergeaud et al. (2016) and Jordà et al. (2019). As the evolution of per capita income is closely related to the decline in fertility from a "Malthusian" to a modern economy, in a context where France was a pioneer european country when it comes to demographic transition as fertility rates started to decrease as early as the late 18th century as stated before. Some small differences are observed between our model and Bergeaud et al. (2016) due to some minor differences in calculations on exogenous productivity growth. While

for reconstruction of per capita output and income Bergeaud et al. (2016) use exclusively total hours worked, we also use educational differences and differences in age-productivity, which also explains these minor gaps.

Moreover, Figure 2.6 displays the evolution of paid labor by gender between 1800 and forecasts its values until 2100. Dots represent the observed data concerning paid labour during this period, whereas the red and green lines represent the output of our model. Differences during the late 19th century can be attributed to the lack of exhaustive data concerning labour force participation in factories, especially for women who were considered second class workers. Not surprisingly, men devoted 80% of their available time to paid labor in 1800 while women only devoted 40% of their time to market production. Concerning paid labor, Figure 2.7 displays the evolution of labor income share by gender from early 19th century until nowadays. Moreover, it is important to note that since we are using a Cobb-Douglas production function with a constant capital share of 0.33. For this reason, the sum of the two lines gives a labor income share of 0.67 between men and women. We observe that after attaining the major gender gap around 1880, a steep increase in female labor income share that continues rather steadily until WWII despite a decrease between WWI and WWII. After a little more than a decade downfall after 1950 of female labor share, a sustained rise in female labor income is observed until nowadays. These trends match for instance the evolution of unpaid labor (Figure 2.9) as it coincides with periods where the labor income share grew for women as they devoted more time to the market economy and less to home production. These trends are completed by Figure 2.8 which displays income per capita by gender detrended from exogenous gains. Indeed, when the labor income share gap narrows down, we observe an increase of income per capita among women. This phenomenon is especially observed between 1880 and the end of WWII while looking at both the steep increase starting in the 1880's in Figure 2.8 and a narrower gap especially at the end of WWI. During the following decades, per capita income for both genders follows in general trends the same pattern but with a greater decrease for men after WWII which explains this narrowing gap that took place in the 1950's as seen in Figure 2.7.

On the other hand, Figure 2.9 recreates the evolution of unpaid labor by gender during the same period which is a direct output and an original trait of our model. As one might expect, the gender division of shores is inverted: men spent in 1800 around 10% of their available time in home production, whereas more than 40% of women's available time was associated to unpaid tasks at home. These results match those of d'Albis et al. (2016), who thanks to french time surveys, compute the evolution of market and domestic production per gender between 1985 and 2010. The authors state that domestic production went from 43 % to 46 % between 1985 and 2010 for women between 25 and 55 years old. As women started to increasingly participate in the labour market, an effect of substitution took place drawing them away from domestic shores they entirely performed on their own in the past. This can be observed in Figure 2.6 from the 1980's, as well as a progressive involvement of men in unpaid labor during that period.

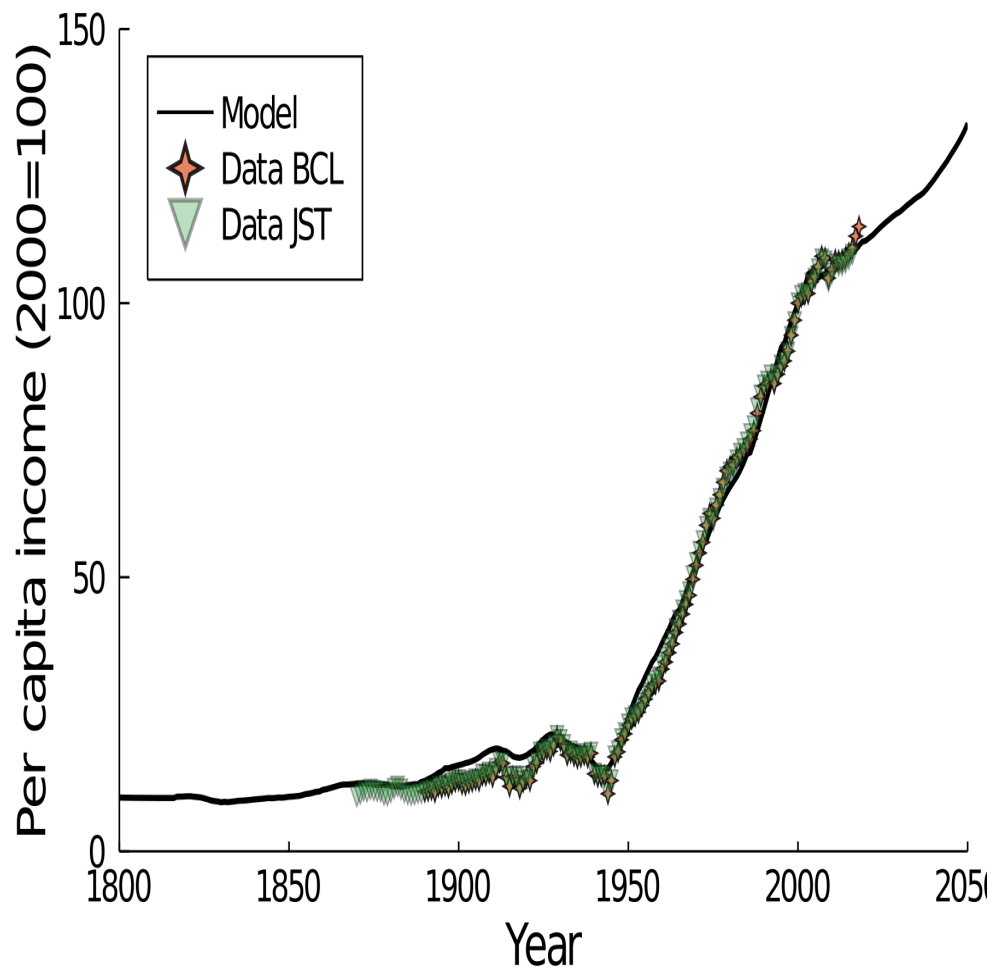


Figure 2.5: Per capita income in France (1800-2050).

Source: based on author's calculations and estimations from Bergeaud et al. (2016) and Jordà et al. (2019)

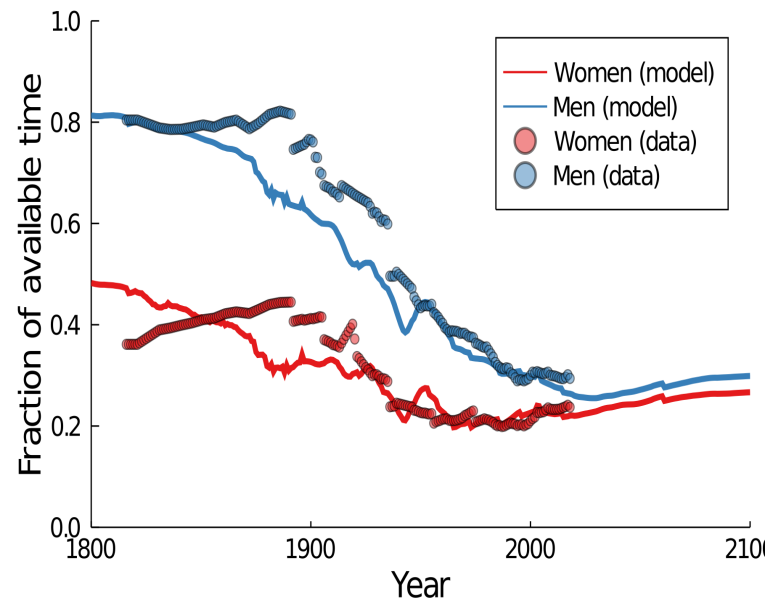


Figure 2.6: Time in paid labor in France (1800-2100). *Source: Author's calculations and compared to data from Marchand and Th  lot (1990), Villa (1997) and OECD Statistics (2019).*

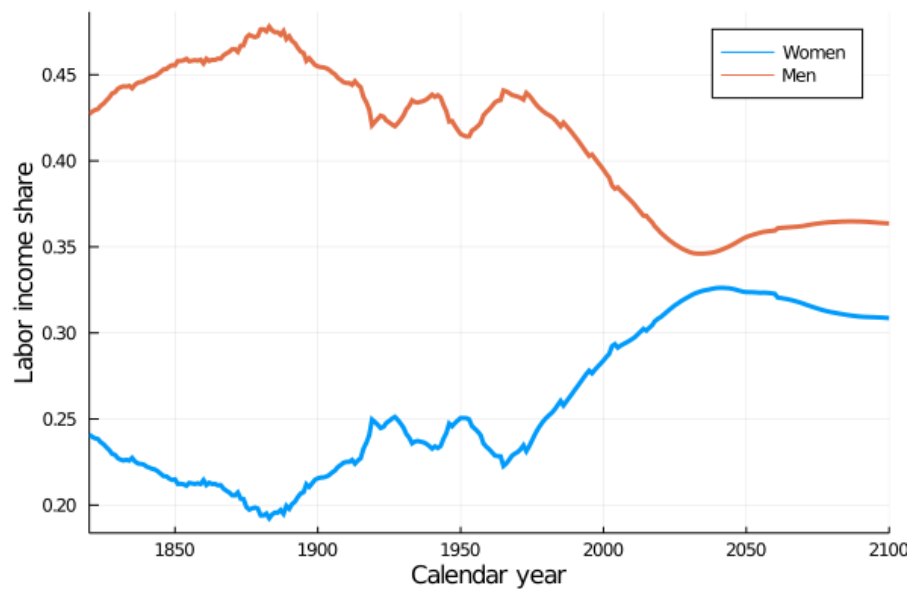


Figure 2.7: Labor income share by gender. Since we are using a Cobb-Douglas production function with a constant capital share of 0.33, the sum of the two lines should give a labor income share of 0.67. *Source: author's calculations*

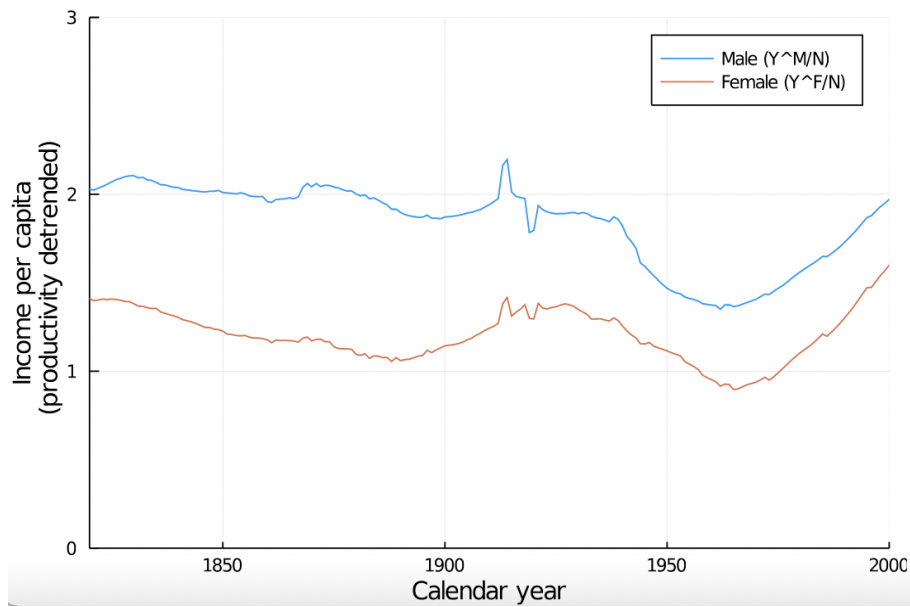


Figure 2.8: Income per capita by gender detrended from exogenous productivity gains..*Source: Author's calculations*

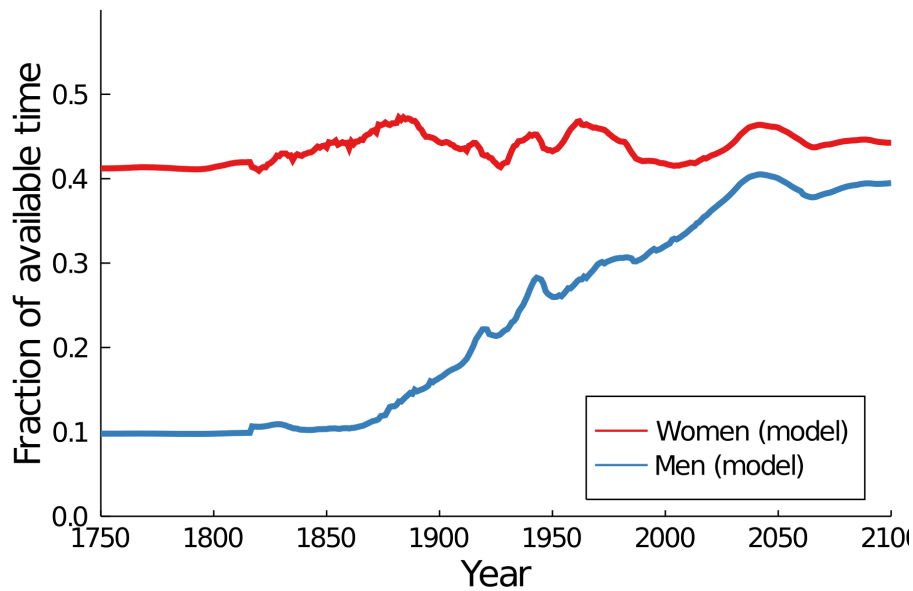


Figure 2.9: Time in unpaid labor in France (1800-2100)..*Source: Author's calculations*

2.4 Results

2.4.1 Contribution of demographics and education to GDP per capita

In order to assess the influence of demographic variables on economic growth, we create several scenarios where we hold constant either fertility, mortality and education. Figure 2.10 displays the results of these different counterfactual scenarios allowing us to compare them to the benchmark results of our main model. Consequently, we observe that keeping fertility and education at 1820's levels, would have lead to much lower levels of GDP per capita: around 50% less for education and one third less for fertility. This goes in line with Malthusian theory which states that exponential population growth leads to lower GDP per capita. Conversely, if mortality rates had stayed at the high levels of the early 19th century, GDP per capita would have been higher (around 10%) as a rise in life expectancy is expected to lead to higher population growth and diluting the benefits of growth.

Lower fertility also allowed women to participate in the labour market, which also explains the gap between our benchmark and the scenario hold fertility constant especially from 1850's onwards. On this vein, Epstein (2012) discusses the work of Anne Cova on the diversity of feminist movements in the late 19th century and their political and social views on motherhood and the role women should play in society. While comparing historical neo-malthusian feminism fostered by well-known figures such as Madeleine Pelletier or Nelly Roussel to for instance more moderate feminist movements reformist feminists, the author underlines the very innovative debate for the time that motherhood and sexuality should be distinguished. The first advocated for feminine freedom in terms of reproduction choices (contraception, abortion) as well as to remain single without be socially condemned. However, this must be understood in a context of low fertility rates after a sustained decreasing trend from the late 18th century as stated earlier during the aftermath of the Franco-Prussian war, even feminist groups such as the reformists defended the view of women as guarantors of the nation's demographic power. Moreover, it

should be added that when adding migration to scenarios (not displayed), net migration effect is very low.

As demographic transition is composed of lower fertility and an increase in life expectancy through lower mortality, the interaction of these two variables is a key element to understand the effect of demography on growth. In this vein, Acemoglu and Johnson (2007) and Cervellati and Sunde (2011) underline the positive link between higher life expectancy and economic growth. However, Cervellati and Sunde (2011) state that this depends on the stage the demography transition and namely the fertility transition is on. Moreover, the extent to which low education levels of the early 19th century, match recent findings on the relationship of education and fertility decline. Diebolt et al. (2021), analyze 19th century data point out the existence of a child quantity-quality trade-off in France, in line with Galor and Weil (2000). In addition to this, as predicted by Diebolt and Perrin (2013) a rise in education levels among women through higher literacy rates lead to lower fertility levels, suggesting the extent which female endowment in human capital has played a capital role in fertility transition and thus in demographic transition as suggested by Malthusian theories as GDP per capita rises when population declines.

The education-fertility decline tandem takes us the debate on impact of education and thus the influence of innovation and technical progress on the transition from stagnation to growth has been going on for more than half a century. Widespread views on the role of innovation in the transition from stagnation to growth go back as far as before the "Glorious Thirties", have commonly pointed out innovation as the main driver behind economic growth as suggested by Fairchild (1939) in line with Schumpeterian principles. When looking at Figure 2.10, our results point out that without any changes in education, GDP per capita would be lower compared to both scenarios were no changes in fertility nor in mortality took place, suggest major underlying dynamics between these variables. Our results match conclusions by Diebolt et al. (2021), which underline that as much as demographic transition is considered an essential component to explain the evolution from stagnation to growth in unified growth models, female empowerment through human capital accumulation explains much of the fertility decline.

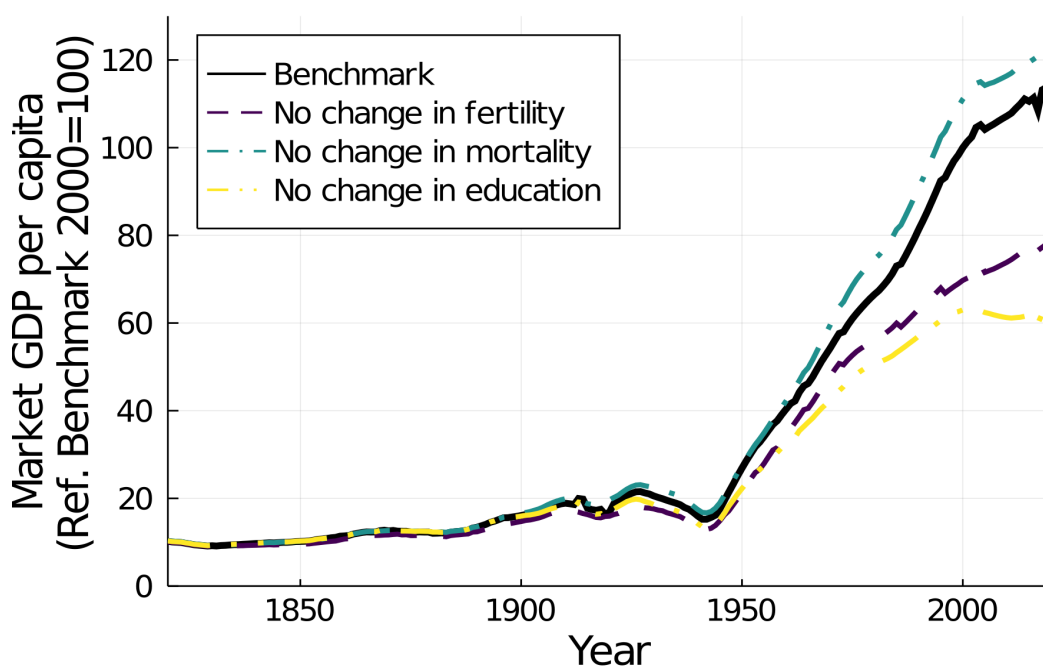


Figure 2.10: Three counterfactual scenarios holding either fertility, mortality or education constant at 1820 levels to assess the effect of effects of demographics and education on market per capita GDP. *Source: author's calculations*

2.4.2 Including home production in growth measurements: resizing women's contribution

An original feature of our model is being able to distinguish market and domestic production by gender. Domestic production being unpaid shores such as cooking, cleaning and in general taking care of the household. We compare market GDP (Figure 2.11) and augmented GDP which comes to domestic production (Figure 2.12) to wealth creation in GDP standard measurements. On one hand, Figure 2.11 displays women's contribution to GDP per capita: a "First Female Revolution" is observed from 1880 with a dramatic rise in female labour force participation, which coincides with industrial revolution and women labour force participation in factories at lower wages than men. Moreover as described earlier, Epstein (2012) highlighting Anne Cova's work explains that this dramatic increase during this decade can also be apprehend to certain extent as the result of political as-

pirations of diverse feminist movements going from more moderate to more radical such as neo-malthusian feminists. Despite differences on their views on motherhood, all these groups fought for a more inclusive role for women outside the house. This rise continued steadily as expected during WWI and WWII when women became part of the war effort reaching peaks of contribution at this time, followed by a decline during the Thirty Glorious. In this vein, Divay (2001) highlights the work of Françoise Battagliola who performs a sociological analysis of the evolution of female work from the 19th century until the end of the 20th century. Using census from 1851 and 1866, the author disentangles the difficulty at the time of tracing the thin line between purely domestic production for the family and paid work done at home as it occurred with seamstresses. For this reason, on the eve of the industrial area the participation of women to the labor market had already begun and these activities were far from being forgotten afterwards as motherhood often pushed women to quit factories and turn to these latter.

Finally, a "Second Female Revolution" displayed another sustained rise in female labour force participation from the 1970's until 2018 reaching almost converging with men at 50 % of overall contribution. Conversely, Figure 2.12, shows a sustained decreasing pattern underlining the decline of around one third of women's contribution to domestic work during the last two centuries. As a consequence, Figure 2.13 shows a similar pattern compared to Figure 2.11 but with a much less steep increase in the 1970's driven by this sustained drop in domestic contribution. Interestingly, augmented GDP underlines in recent years similar contribution levels to those performed by women during war efforts of WWI and WWII.

Not surprisingly, when comparing Figure 2.14 and Figure 2.15, contribution from women is overall the double when including domestic production and keeping per capita contribution at 1880's level. When comparing benchmark (solid black line) and market GDP per capita if contribution of women remained at level of 1880 (black dashed line), we observe that market GDP per capita in the benchmark is almost one third higher in the 2010 compared to the 1880 counterfactual (Figure 2.14). This underlines the increase of women's contribution to market economy starting in the 1970's. Conversely, when taking a look

to Figure 2.15, contribution of women to augmented GDP keeping 1880 levels, is quite similar to the benchmark with somewhat higher values from 2000 within the benchmark. Overall, this suggests that there was a trade off in women's contribution to market and domestic production in line with the sustained decline in household production shown in Figure 2.12 since the 1880's, linked to the "First Female Revolution" as stated before in terms of female labour force participation (Figure 2.11).

This last assertion matches conclusions from d'Albis et al. (2021) and Pailhé et al. (2021) who both mobilise data on time use from 1985 to 2010 on time use to study this trade-off. On one hand, d'Albis et al. (2021) state that in France GDP per capita from 1985 to 2000 in standard terms is overestimated, whereas from 2000 to 2010 is underestimated when compared to augmented GDP per capita levels. In the same vein of our paper, authors add domestic production to market production in order to create an "augmented indicator" either overestimating or underestimating wealth creation through GDP measurements. The central hypothesis being that social changes such as a greater participation of women to the labour force induce an outsourcing of domestic production overestimating growth measured by the standard GDP indicator. The intuition behind this explanation is that this overestimation of growth is explained by a commodification of domestic production. Similarly Pailhé et al. (2021), declared that after a pronounced rise in time devoted by men to home production starting in the 1980's, from 2006 in countries like France or Sweden men's housework remained stable whereas women's time on housework slightly decreased . Authors underline that traditionally feminine chores such as cooking are still performed by women in the 2010's. Therefore, these conclusions are in line with Figure 2.13 and we conclude that a less steep curve compared to Figure 2.11 before 2000 is explained by the outsourcing of domestic chores and an increase of market labour force participation among women. After 2000, we observed indeed a slightly higher values (Figure 2.13) compared to strictly market contribution in Figure 2.11.

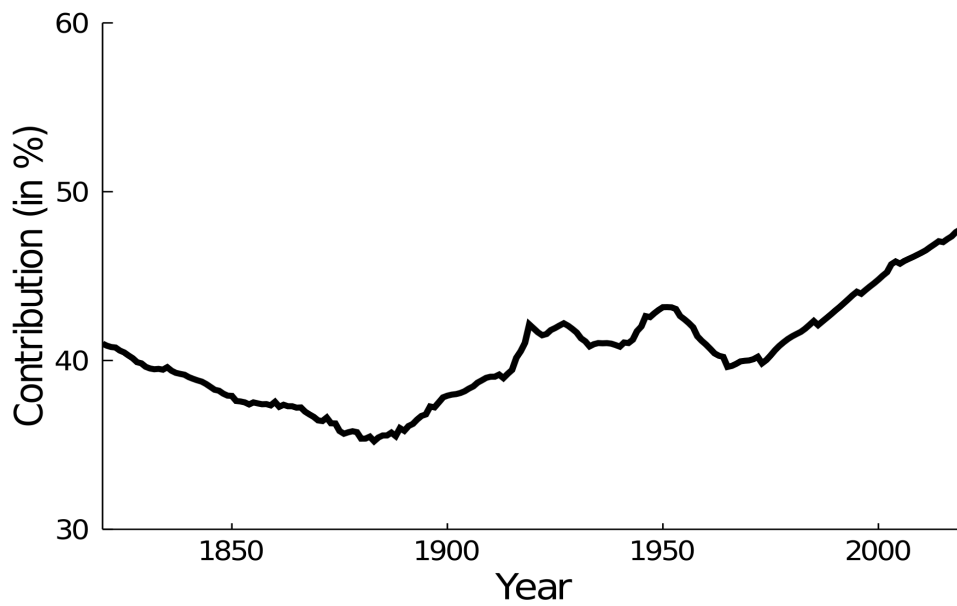


Figure 2.11: Women's contribution to market growth. *Source: author's calculations*

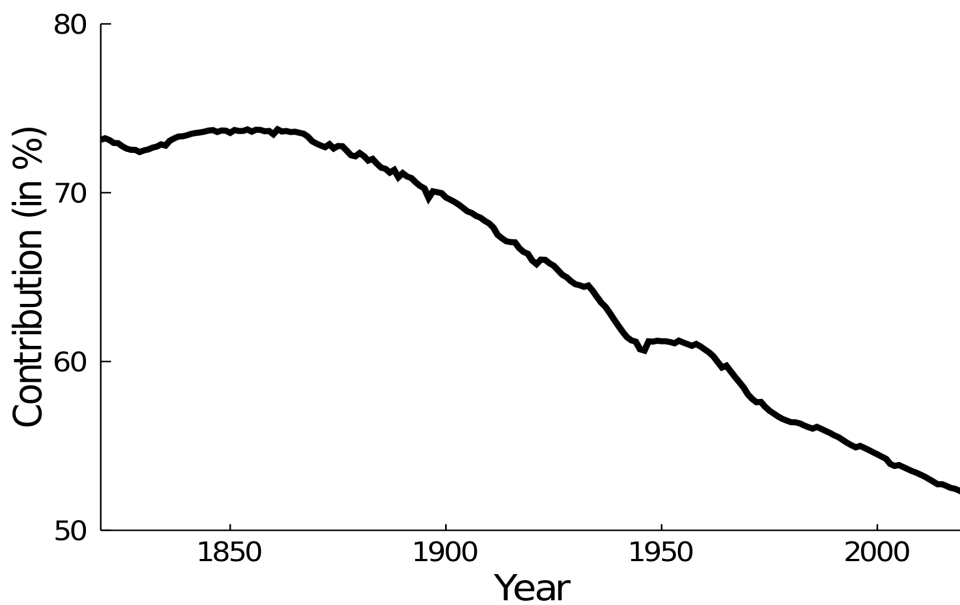


Figure 2.12: Women's contribution to home production (1820-2020). *Source: author's calculations*

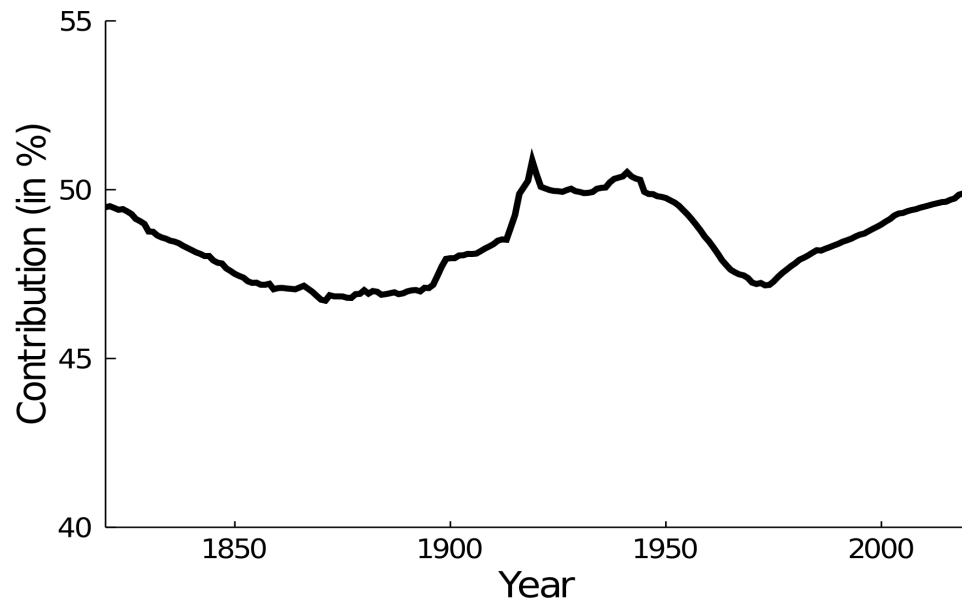


Figure 2.13: Women's contribution to augmented GDP (1820-2020). *Source: author's calculations*

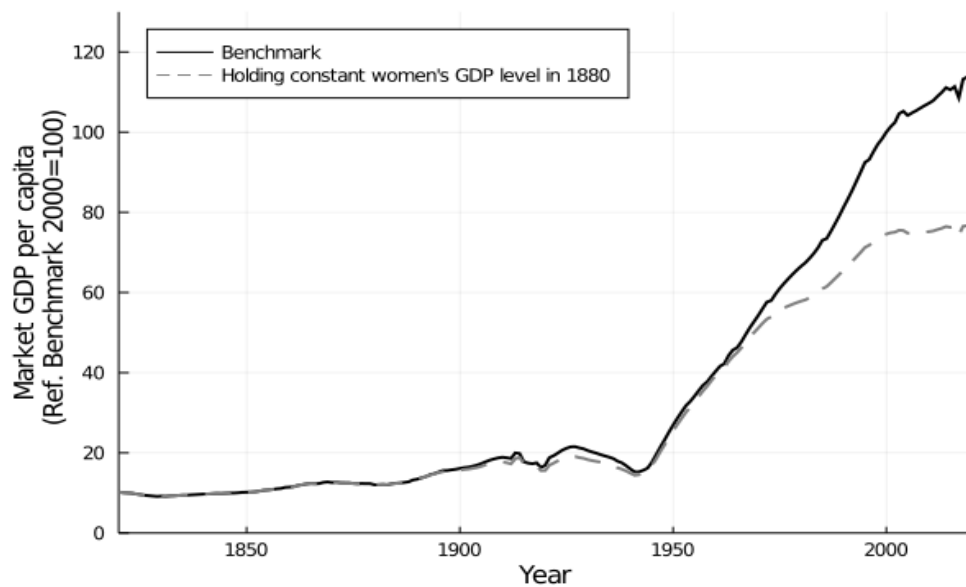


Figure 2.14: Women's contribution to market production when keeping contribution at 1880 level. *Source: author's calculations*

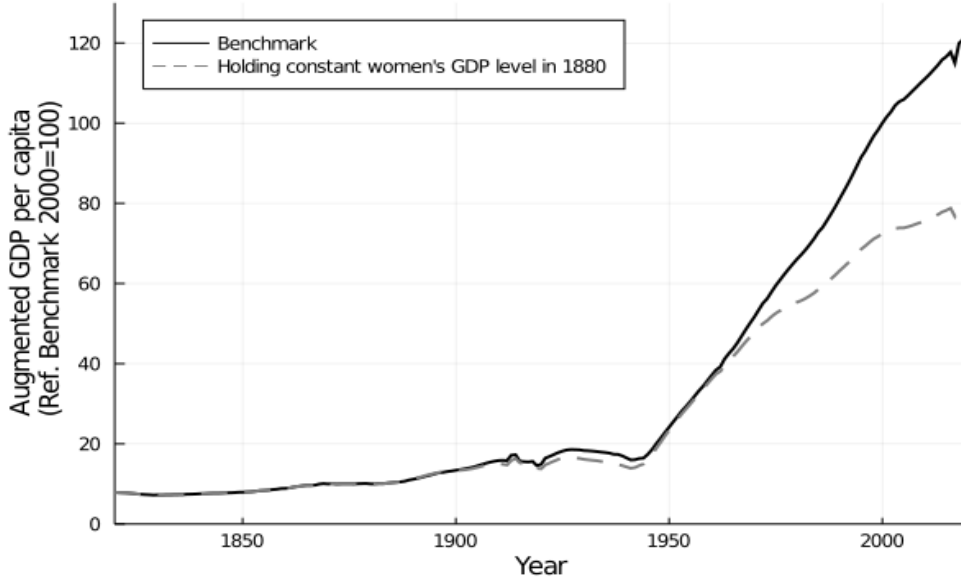


Figure 2.15: Women's contribution to augmented GDP per capita when keeping contribution level at 1880 level. *Source: author's calculations*

2.4.3 Intergenerational equity & gender: two centuries of reversing traditional trends

In this section, we calculate indicators by adding cumulative labor supply or income (either lifetime labor, lifetime asset, social security wealth and overall lifetime income) throughout the entire life of each cohort. Left hand side panels display per capita values adjusted for the cohort survival, whereas right hand side panels account for cohort total values. More precisely, the per capita value of variable X is given by:

$$\sum_{a=0}^{\Omega} \left(\prod_{z=0}^a p_{t+z,a}^g \right) \int X_{t+a,a}^g(s_{t+a,a}) d\Phi(s_{t+a,a} | s_{t+a,a} \neq -g) \quad (2.27)$$

whereas the cohort lifetime value is:

$$\sum_{a=0}^{\Omega} N_{t+a,a}^g \int X_{t+a,a}^g(s_{t+a,a}) d\Phi(s_{t+a,a} | s_{t+a,a} \neq -g) \quad (2.28)$$

where the probability function $\Phi(s | s \neq -g)$ represents the proportion of people of gender 'g' that are in couples and alone at each age.

Lifetime labour supply by gender: a trade-off of unpaid and paid work

Figure 2.16 to Figure 2.18 depict the total number of hours worked by each birth cohort. Figure 2.16 represents lifetime labour supply devoted to both paid and unpaid work, whereas Figure 2.17 displays lifetime labour supply concerning paid work and Figure 2.18 lifetime labour supply for unpaid work. Each figure contains two panels (A and B). Panel A shows per capita lifetime labor supply of each birth cohort, calculated as the total sum of the hours worked at each age multiplied by the survival probability to each age. Thus, Panel A gives the total sum of the survival weighted of the hours worked across age (assuming individuals worked during the whole expected period) by each birth cohort. It should be noted that this measure is not affected by the cohort size, and calculations include the rise of life expectancy within cohorts. On the other hand, Panel B presents cohort lifetime labor supply: hours worked by each birth cohort. As this measure is affected by the population size, it represents more accurately the effect of the war effort, the baby-boom after WWII and the baby-bust generation.

When looking at Figure 2.16, it is worth noting that for panel B only male cohorts born before 1850 contributed more to total labor than females. In contrast, female cohorts born between 1875 and 1900 provided significantly more labor than male cohorts born during the same period. This last assertion is probably the result of the war effort both at home and part of the industrial production attributed to women during WWI as confirmed by Figure 2.17 and Figure 2.18. In addition to this, when comparing Panel A to Figure 2.2, we see that cohort life expectancy around the industrial revolution was close to 40 years of age in France, which implies that more than half of their lives were spent working. Indeed, if we add to those working years both the time that a child could not work (6-7 years of age) and schooling years we reach life expectancy expected at the time.

Conversely, for cohorts born after 1950 (Figure 2.16), which display a life expectancy of above 80 years of age, time spent working represents less than half of the total length of life. A trend that also underlines that after completing education (around 20 years old), leisure becomes more pronounced. These results match those of Lee (2001) that state that between 1850 and 1990, the expected length of retirement increased by more

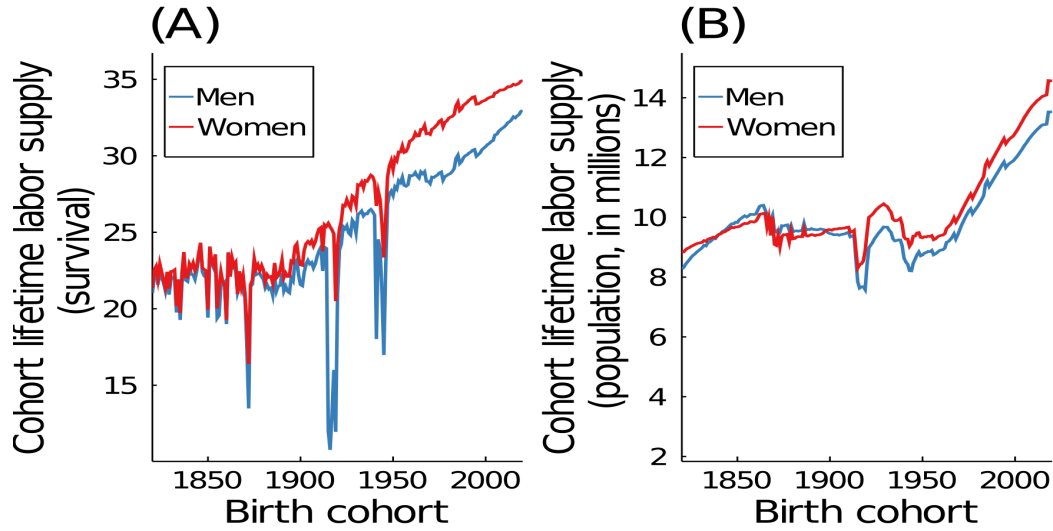


Figure 2.16: Lifetime labor supply devoted to both paid and unpaid work by cohort and gender 1820-2018. Source: authors' calculations

than six-fold and represented up to 30% of male length of life after entry into the labor force, especially driven by a fall in mortality. On this matter, Hazan M (2009) states that longevity has had an impact on labour supply and growth through a greater return on net capital investment rather than mortality itself and not through mere additional years of work. Moreover, this increase in capital that made leisure more valuable is in line with our results on the increasing importance of leisure after completing education. Cervellati and Sunde (2013), also concludes that higher life expectancy leads to higher schooling and a reduction in lifetime labour supply through a greater return of time worked. Finally, for younger cohorts born from the 1960's total female work participation (Figure 2.16) has been consistently higher than work participation among males, a trend mainly driven by unpaid work (Figure 2.18) and partly by convergence in paid work (Figure 2.17).

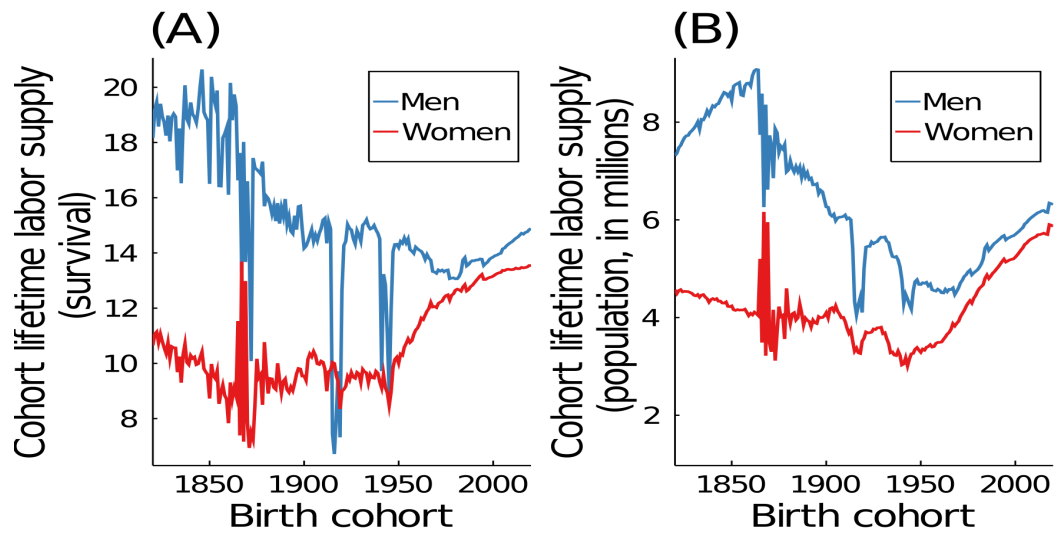


Figure 2.17: Total Lifetime labor supply devoted to paid work by cohort and gender.
Source: author's calculations

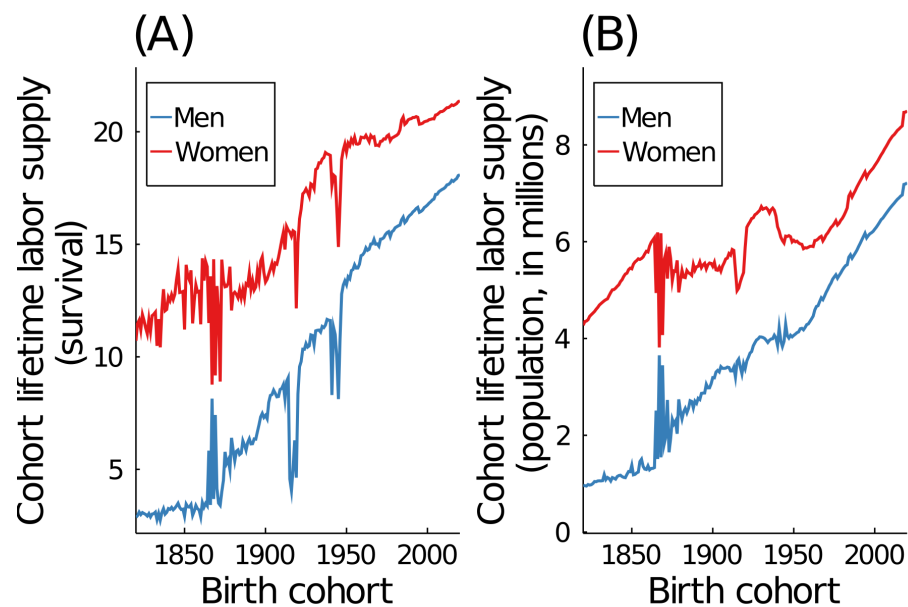


Figure 2.18: Total Lifetime labor supply devoted to unpaid work by cohort and gender.
Source: author's calculations.

Lifetime income by gender: two centuries of progressively closing the gaps

Figure 2.19 displays lifetime labor income, lifetime asset income, social security wealth and lifetime income for generations born between 1800 and 2000. All profiles are detrended from exogenous productivity gains.

For Figure 2.19, each type of income contains two panels (A to B). Left-hand side panels show per capita lifetime labor income for cohorts born over 200 years, calculated as the total sum of income at each age multiplied by the survival probability to each age. Thus, panels on side A give the total sum of the survival weight of the different types of income across age groups by each birth cohort. It should be noted that this measure is not affected by the cohort size. On the other hand, panels B present each type of cohort lifetime income (labor income, asset income, social security income, total income) cohort by cohort taking into account population size since total sums of income are multiplied by the number of individuals within each cohort.

In general terms, from a gender perspective, trends are rather clear: a historical gap can be observed concerning lifetime labor income and lifetime income between men and women, as women did not enter massively the market economy until the second half of the 19th century. A drop for men is observed for adult cohorts born during WWI and WWII. Conversely, lifetime income of women born during those periods is higher or equal compared to that of men. Social security wealth income has a changing trend: a clear first gender gap is observed cohorts born during the *Belle Epoque*, a trend that was inverted dramatically for cohorts born during WWI and that has continued until nowadays. Higher social security wealth among women after WWII can be explained probably due to maternity leave cash transfers that came with the creation of the French National Security. On the other hand, asset wealth is more evenly distributed among genders, even if higher values are displayed for women due to marriage share of wealth and the fact that they live longer compared to men.

In addition to this, from a generational perspective, overall we observe that WWI and WWII were the common events in Panels A1 to B4 that affected cohorts who were in their

productive years. Concerning life time income and lifetime labour income, baby-boomers and subsequent generations seem to increasingly live better than previous generations. However, this does not hold for life asset income and social security wealth. For asset income, we observe a rather increasing trend, besides substantial drops in particular for men born during WWI and WWII throughout the 20th century. Concerning social security wealth, a sustained fall started from late baby boomer generations up to cohorts born in 2000. Lifetime income results contradict the hypothesis stating that baby boomers have been better off than younger generations.

2.4. RESULTS

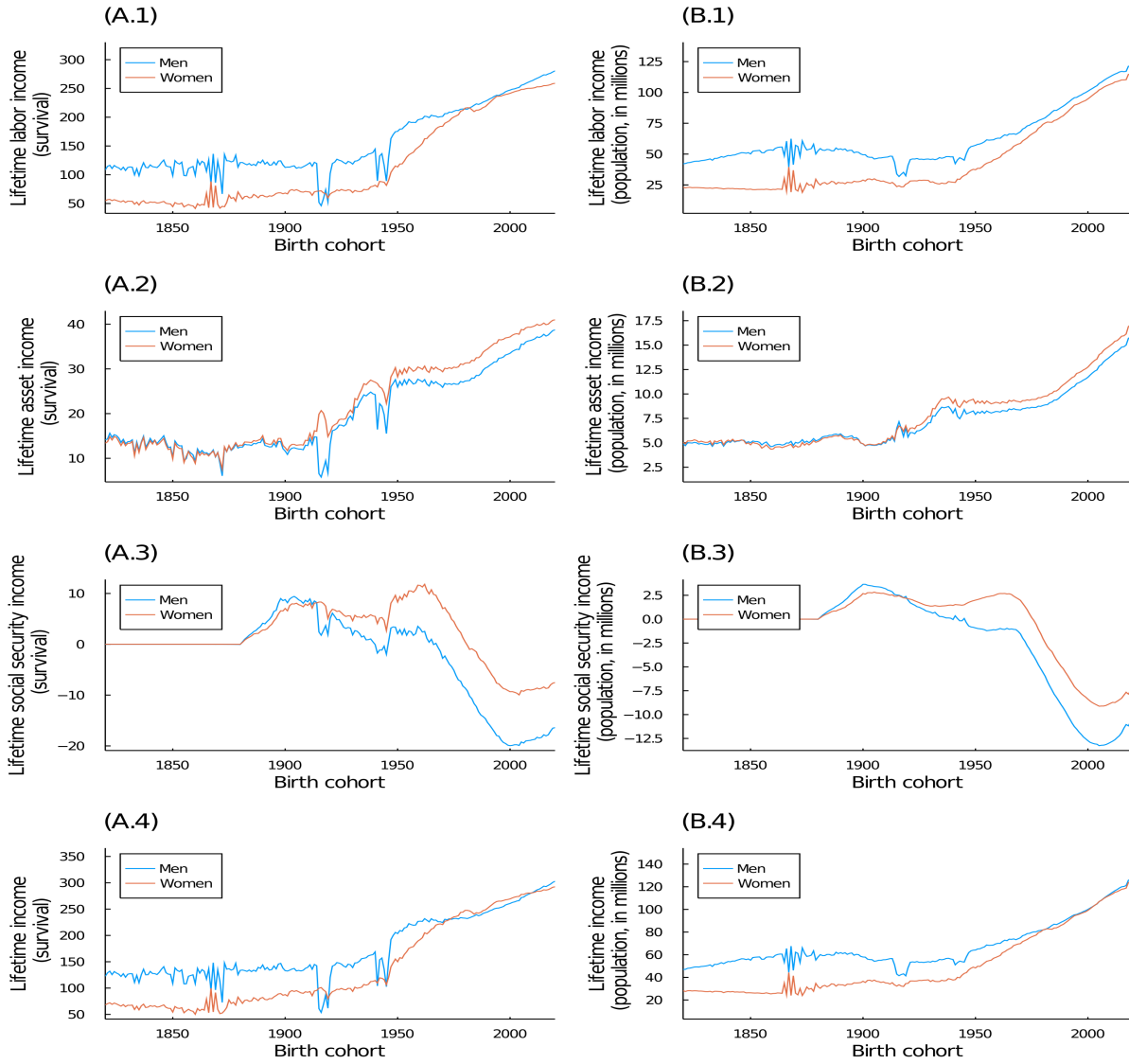


Figure 2.19: Types of lifetime income by cohort where each figure contains two panels. Left-hand side panels are calculated as the total sum of income at each age multiplied by the survival probability at each age. Right-hand side panels represents the sum of each type of cohort lifetime income birth cohort taking into account population size. Source: Author's calculations

2.4.4 Contribution of demographics and education to labor income: a mostly feminine narrative

Figure 2.20 displays three scenarios by gender where, as done previously for GDP per capita, we hold constant either fertility, mortality or education at 1820 level to assess the effect of these latter on lifetime labor income. Results concerning demographics underline, unsurprisingly, to which extent fertility evolution affects particularly women lifetime labor income. In fact, holding fertility constant has a much stronger impact for women than for men, in particular for women born after WWII (Figure 2.20). By the year 2000, women would have only perceived 80% of earnings compared to the benchmark if fertility rates had not evolved from the 19th century. However, despite the difference for men being overall almost null, cohorts born during the Thirty Glorious are somewhat above the benchmark due to the need for men to work more outside the house for every extra child. Moreover, when holding mortality constant, we observe in general terms a similar effect for men and women, despite somewhat lower values for men from the 1970's.

However, while holding education constant we observe a greater effect in particular for women. Keeping education at 1820 levels implies that for cohorts born in 2000, women would have earned only 18% of lifetime labor income compared to benchmark values. In contrast, when keeping education at 19th century levels, this figure for men would have represented 80% of lifetime labor income of actual values accounted within the benchmark. These results along with the fertility scenario just described above, match results from Figure 2.10 confirming the results by Diebolt and Perrin (2013) and Diebolt et al. (2021) concerning the fertility-education tandem for women, regarding to fertility decision.

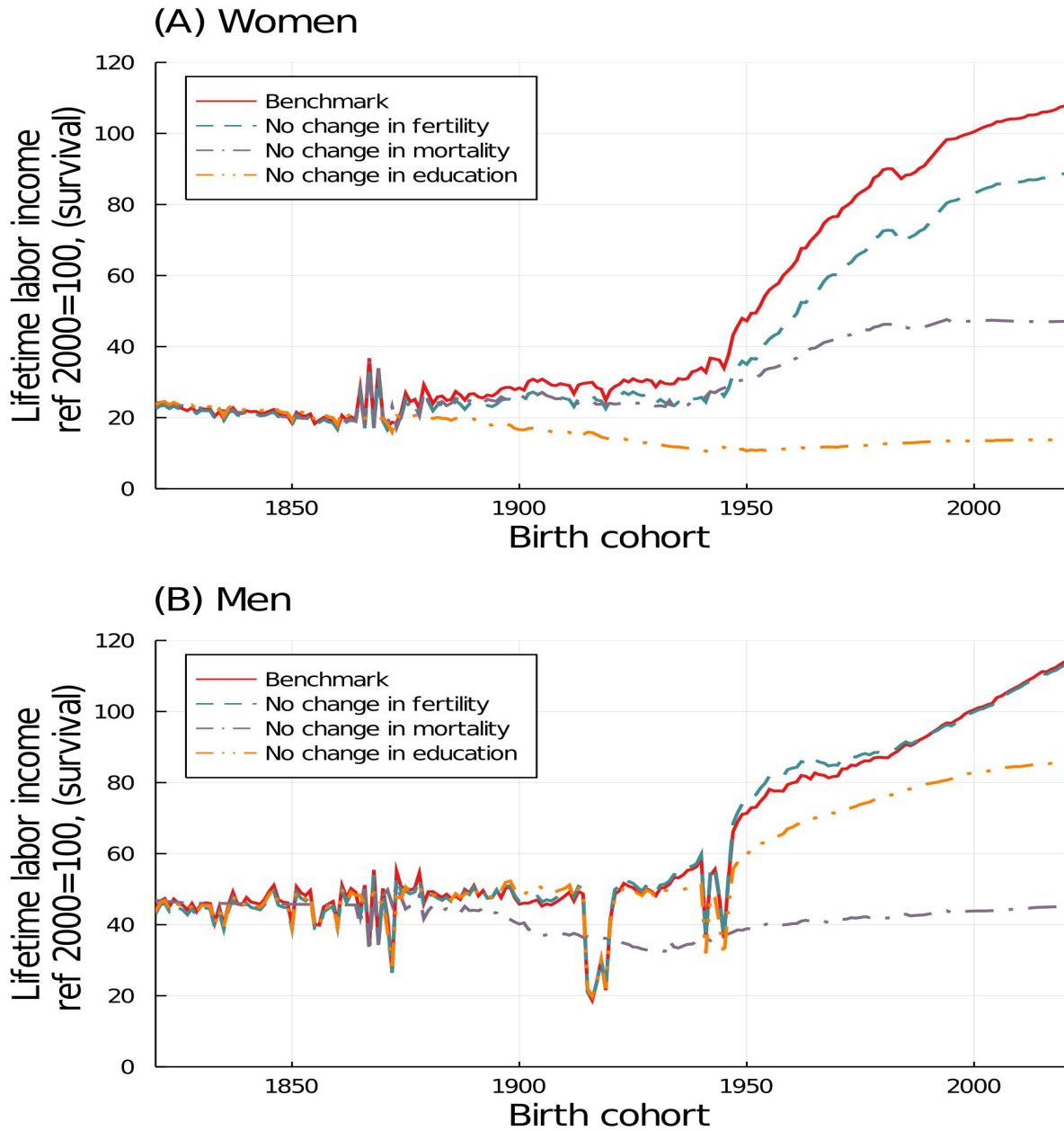


Figure 2.20: Lifetime labor income by gender and holding constant either fertility, mortality and education at 1820 level. Values are detrended from exogenous productivity gains. Source: author's calculations

2.5 Conclusion

Demographic transition in France has aroused increasing interest among academics as it was the first country to undergo a drop in fertility as early as the late 18th century, compared to richer neighbouring countries such as Germany, England or the Netherlands. The introduction of demography in classic convergence models has allowed during the last decades a better understanding of the effects of this phenomenon on growth. As much as demographic transition is the result of both a decline in fertility, and an increase in life expectancy, we focused specifically on the fertility transition. As our main research question revolves around the gender inequalities between female and male labor gender participation, to both market and domestic economies throughout the last two centuries: the fertility transition growth and gaps arising from this latter is our main research question.

Our paper contributes to literature on demographic and gender economics by an OLG model with heterogeneous family structures and education levels as in Sánchez-Romero et al. (2018) and with realistic demography as in d’Albis (2007). Having gendered agents can be seen as a considerable novelty compared to classic OLG models with unisex agents. As stated before, this was already featured in Galor and Weil (1996), without, however calculating a gender contribution to growth, or empirically using realistic demography. Our simulation of the french economy matches seminal work on historical reconstruction on France such as Bergeaud et al. (2016).

Results shed light on the evolution of the contribution by gender to both market and domestic work, as well as the sum of both known as augmented growth. One original feature of the model is to simulate the evolution of time devoted to unpaid labour to compare it with the reconstruction of time devoted to paid labour, underlining the convergence in the last two centuries. Moreover, counterfactuals holding constant either mortality, education or fertility allow us to measure the impact of each of these variables on economic growth.

Counterfactuals holding constant fertility, mortality and education from the early 19th

century underline the strong roles of fertility and education on the evolution of market GDP growth. In line with Malthusian theories on GDP per capita, no change in mortality from 1820 would have lead to a higher GDP per capita compared to the benchmark of our model. However, as much as the role of education and technological innovation are considered the main drivers of growth in classic economic models, our results confirm conclusions by Diebolt and Perrin (2013) underlining the simultaneous effect of fertility and education. The main intuition is that a rise in education levels through higher literacy lead to a fertility decline in France during the last half of the 19 century. This assertion is completed by a child-quantity trade off underlined by Diebolt et al. (2021) which could explain the similar results when holding in particular either fertility or education constant during the 19th century.

Since our main interest lies on the differences between genders, in particular for women, to both market and home production, our main results focus on the evolution of these trends. Two "female market production revolutions" are observed (aside from the widely discussed war efforts during WWI and WWII) : a much less documented 1880's turning point that we call "First Revolution" and a much more discussed post 1968 social movements that we call "Second Female Revolution". After a sustained fall during the early 19th century, 1880 was a turning point in women contribution to market growth as a sustained increase took place until the end of WWI, followed by a small fall and a recovery during WWII. During post-war years a drop was observed until the 1970's, when a rising involvement of increasingly educated women in labour force participation took place. Conversely, female contribution to home production has decreased steadily from 1820 reaching a stabilization in recent years. Augmented GDP (the sum of market and home production) follows a similar, though smoother pattern. A substitution between market labour force participation and household production as pointed out by d'Albis et al. (2016) explains the evolution of these trends, in particular during the last five decades.

Calculations on lifetime labour supply by cohorts suggest that, when including unpaid work, the overall contribution of women compared to men has been higher during the last

two centuries. An increasing convergence is observed within both genders, for both paid and unpaid work. On the other hand, when looking at lifetime income by cohorts from different angles: labor income, asset income, social security wealth and overall lifetime income, gender and generational gaps are observed. The highest gap observed within both genders during the last two centuries is around lifetime labor income and overall lifetime income placing men as higher earners than women except during WWI and WWII. However, traditional theories pointing to baby-boomers as better off cohorts seem challenged since overall lifetime income has had a sustained increase for cohorts born between 1950 and 2000. Conversely, social security wealth is higher among women, starting with baby-boomers and within subsequent generations. This last assertion provides a clue for future research on inter-generational equity.

When focusing on the drivers of lifetime labor income by gender, we confirm that fertility and education have been the key factors behind the dramatic rise since the late 19th century of labour force female participation to the market economy. As much as education and technological process have often been pointed out as the main drivers of economic growth, these results shed light on the importance of fertility transition for female labor participation and growth. In this vein, the most innovative finding within this paper is to shed light on this 1880's "First Female Revolution" as a result of a substantial drop in fertility linked to a quantity-quality trade-off, as a consequence of greater access to education and the first wave of industrialisation. This finding gives further retrospective to the widely documented and discussed female participation to war efforts during WWI and WWII. Indeed, it suggests that this peak in participation during this period should not be solely attributed to both international conflicts, but also to a process that started in the late 18th century with this early fertility drop compared to European neighbours. However, in terms of gender inequalities, lifetime labor income gap by cohort only started to close steadily only after WWII. However, the main shortfall of our paper relies on the assumption of exogeneity between demographic trends, education and productivity. Our results should thus be considered as a benchmark and could be further extended by taking into account interdependency for future research.

2.6 Appendix

2.6.1 Reconstruction of fertility profiles

To reconstruct fertility profiles, we use a simplified version of a generalized inverse population projection method (GIP method).

The objective function used to solve the problem is:

$$\min_{\{\boldsymbol{\alpha}^D, \boldsymbol{\beta}^D, \boldsymbol{m}^D, \{\phi_i^D\}_{i=1,2,3}\}} F(\boldsymbol{\alpha}^D, \boldsymbol{\beta}^D, \boldsymbol{m}^D, \{\phi_i^D\}_{i=1,2,3}) \quad (2.29)$$

subject to $\alpha_t^D \in [-2.5, 1.0]$, $\beta_t^D \in [-2.5, 1.5]$, $m_t^D \in [-0.03, 0.03]$, $\phi_{t,i}^D \in [-0.1, 1.0]$ for all $i \in \{1, 2, 3\}$ and t .

The set of conditional survival probabilities at each age and time is modeled using the Brass method:

$$\text{logit}(p_{x,t}) = a_x - \alpha_t^D - \beta_t^D b_x, \quad L_{x,t} = 0.5(1 + p_{x,t}) \prod_{s=0}^{x-1} p_{s,t}. \quad (2.30)$$

where $\{a_x, b_x\}$ are two Brass logit model standards associated to high mortality and low mortality rates, respectively. The age-specific fertility rates are calculated as a linear combination of three different fertility profiles that capture the lowest total fertility rate (TFR), the highest TFR, and the fertility rate with the highest mean-age of childbearing in France

$$f_{x,t} = \sum_{i=\{1,2,3\}} \phi_{t,i}^D \hat{f}_{x,i}. \quad (2.31)$$

The specific objective function F to minimize is

$$\begin{aligned}
F(\boldsymbol{\alpha}^D, \boldsymbol{\beta}^D, \boldsymbol{m}^D, \{\phi_i^D\}_{i=1,2,3}) = & \lambda_N \sum_t \left(\frac{N_t - \hat{N}_t}{N_t} \right)^2 + \lambda_B \sum_t \left(\frac{B_t - \hat{B}_t}{B_t} \right)^2 + \\
& \lambda_D \sum_t \left(\frac{D_t - \hat{D}_t}{D_t} \right)^2 + \lambda_C \sum_t \sum_a \left(\frac{N_{a,t} - \hat{N}_{a,t}}{N_t} \right)^2 + \\
& \lambda_{LE0} \sum_t \left(\frac{LE_t(0) - \widehat{LE}_t(0)}{LE_t(0)} \right)^2 + \lambda_{LE65} \sum_t \left(\frac{LE_t(65) - \widehat{LE}_t(65)}{LE_t(65)} \right)^2 + \\
& \lambda_{q0} \sum_t \left(\frac{q_t(0) - \hat{q}_t(0)}{q_t(0)} \right)^2 + \lambda_{TFR} \sum_t \left(\frac{TFR_t - \widehat{TFR}_t}{TFR_t} \right)^2 + \\
& \lambda_\mu \sum_t \left(\frac{\mu_t - \hat{\mu}_t}{\mu_t} \right)^2 + \lambda_m \sum_t (m_t^D - \hat{m}_t^D)^2, \tag{2.32}
\end{aligned}$$

where N_t is the total population size in year t , B_t is the total number of births, D_t is the total number of deaths, $N_{a,t}$ is the population size of age a in year t , $LE_t(0)$ is the life expectancy at birth, $LE_t(65)$ is the life expectancy at age 65, $q_t(0)$ the infant mortality rate, TFR_t is the total fertility rate, μ_t is the men-age of childbearing, and m_t^D is the net migration rate. All the demographic data is generated with standard population projection techniques using Leslie matrices. The estimated variable using the demographic model is represented with a hat. The terms λ_j are the weight given to the demographic variables j on the objective function F . Unless otherwise said, we assume $\lambda_j = 1$, $\lambda_N = 200$, $\lambda_B = 10$, $\lambda_C = 20\,000$, and $\lambda_m = 100$.

2.6.2 First order conditions of the household problem

We assume our agents do not realize that increasing their labor supply today will increase their pension benefits in the future. This implies that neither the dynamics of the pension benefits nor $\alpha(l_{t,a}^i)$ have to be differentiated. For cases $i=g$, dummy $\mathbf{1}_{\mathbf{s}_{t,a}}$ needs to hold the condition to be 1 as it implies the household refers to a couple.

First-order conditions (FOCs).

$$c : \quad U_c(\mathbf{s}_{t,a}) = \beta E_t \left[\frac{\partial V(\mathbf{s}_{t+1,a+1})}{\partial k_{t+1,a+1}} \right] (1 + \tau_t^c) \quad (2.33)$$

$$x : \quad U_x(\mathbf{s}_{t,a}) = \beta E_t \left[\frac{\partial V(\mathbf{s}_{t+1,a+1})}{\partial k_{t+1,a+1}} \right] (1 + \tau_t^c) \quad (2.34)$$

$$h^i : \quad U_{h^i}(\mathbf{s}_{t,a}) = \beta E_t \left[\frac{\partial V(\mathbf{s}_{t+1,a+1})}{\partial k_{t+1,a+1}} \right] (1 - \tau_t^L) w_t \epsilon_a (E_{t-a}^i) - \theta_h^i + \theta_l^i \quad (2.35)$$

$$z^i : \quad U_{z^i}(\mathbf{s}_{t,a}) = \beta E_t \left[\frac{\partial V(\mathbf{s}_{t+1,a+1})}{\partial k_{t+1,a+1}} \right] (1 - \tau_t^L) w_t \epsilon_a (E_{t-a}^i) - \theta_z^i + \theta_l^i \text{ for } i \in \{g, -g\} \quad (2.36)$$

where

$$U_c(\mathbf{s}_{t,a}) = \frac{H(\mathbf{s}_{t,a})}{c_{t,a} - H(\mathbf{s}_{t,a})C} \quad (2.37)$$

$$U_x(\mathbf{s}_{t,a}) = \frac{H(\mathbf{s}_{t,a})\alpha_x\gamma}{x_{t,a}} \quad (2.38)$$

$$U_{h^i}(\mathbf{s}_{t,a}) = \frac{\alpha_x H(\mathbf{s}_{t,a})(1 - \gamma)}{h_{t,a}^i} \frac{(h_{t,a}^i)^{\sigma(t-a)}}{(h_{t,a}^i)^{\sigma(t-a)} + \mathbf{1}_{\mathbf{s}_{t,a}} (h_{t,a}^{-i})^{\sigma(t-a)}} \quad (2.39)$$

$$U_{z^i}(\mathbf{s}_{t,a}) = \frac{\alpha_z}{z_{t,a}^i} \quad (2.40)$$

Noticed that combining the marginal utilities and the FOCs we have that neither the time devoted to home production nor the leisure time can be zero. Therefore, the Kuhn-Tucker multipliers associated to home production and leisure are always positive; i.e., $\theta_h^i, \theta_z^i = 0$ for $i \in \{g, -g\}$. Hence, the difference stems from the time that each gender can optimally devote to paid work.

Envelope conditions

$$k : \quad \frac{\partial V(\mathbf{s}_{t,a})}{\partial k_{t,a}} = \beta E_t \left[\frac{\partial V(\mathbf{s}_{t+1,a+1})}{\partial k_{t+1,a+1}} \right] R_t(s_{t,a}) \quad (2.41)$$

Optimal demands and supplies Combining the FOCs and the envelope condition gives the following Hicksian functions (consumption and leisure demand and the supply of unpaid labor conditional on a given utility level):

$$c : \quad (1 + \tau_t^c) c_{t,a} = H(\mathbf{s}_{t,a}) \left[(1 + \tau_t^c) C + R_t(s_{t,a}) \left(\frac{\partial V(\mathbf{s}_{t,a})}{\partial k_{t,a}} \right)^{-1} \right] \quad (2.42)$$

$$x : \quad (1 + \tau_t^c) x_{t,a} = H(\mathbf{s}_{t,a}) \alpha_x \gamma R_t(s_{t,a}) \left(\frac{\partial V(\mathbf{s}_{t,a})}{\partial k_{t,a}} \right)^{-1} \quad (2.43)$$

Notice that whenever $s_{t,a} = c$, we have four different options

- I: $\theta_l^g = 0, \theta_l^{-g} = 0$ Both genders work in the market
- II: $\theta_l^g = 0, \theta_l^{-g} > 0$ Gender $-g$ has only unpaid work
- III: $\theta_l^g > 0, \theta_l^{-g} = 0$ Gender g has only unpaid work
- IV: $\theta_l^g > 0, \theta_l^{-g} > 0$ Both genders only work at home

For convenience let us define two additional functions:

$$X^g = h_{t,a}^g / h_{t,a}^{-g} \quad (2.44)$$

$$Z_{t,a}(X^g, \mathbf{s}_{t,a}) = \frac{(X^g)^{\sigma(t-a)}}{\mathbf{1}_{\mathbf{s}_{t,a}} + (X^g)^{\sigma(t-a)}} \quad (2.45)$$

The first function is the ratio of the time devoted to home production by both genders. The second function is the effective proportion of the total time devoted to home production by an individual of gender g who was born in year $t - a$.

- Case I: $\theta_l^g = 0, \theta_l^{-g} = 0$

$$h^g : \quad h_{t,a}^g = \frac{\alpha_x(1 + \tau_t^c)(1 - \gamma)H(\mathbf{s}_{t,a})}{U_c(\mathbf{s}_{t,a})(1 - \tau_t^L)w_t\epsilon_a(E_{t-a}^{-g})}(1 - Z_{t,a}(X^g, \mathbf{s}_{t,a})) \quad (2.46)$$

$$z^g : \quad z_{t,a}^g = \frac{(1 + \tau_t^c)\alpha_z}{U_c(\mathbf{s}_{t,a})(1 - \tau_t^L)w_t\epsilon_a(E_{t-a}^g)} \quad (2.47)$$

$$z^{-g} : \quad z_{t,a}^{-g} = \frac{(1 + \tau_t^c)\alpha_z}{U_c(\mathbf{s}_{t,a})(1 - \tau_t^L)w_t\epsilon_a(E_{t-a}^{-g})} \quad (2.48)$$

From these equations we have that when both genders have paid work $z_{t,a}^g / z_{t,a}^{-g} = \epsilon_a(E_{t-a}^{-g}) / \epsilon_a(E_{t-a}^g)$ and $X^g = \left(\frac{\epsilon_a(E_{t-a}^{-g})}{\epsilon_a(E_{t-a}^g)} \right)^{\frac{1}{1-\sigma(t-a)}}$. Thus, the gender with the highest education devotes more time to paid work, works less hours at home, and enjoys less leisure than the gender with the lowest education.

- Case II: $\theta_l^g = 0, \theta_l^{-g} > 0$

$$h^g : h_{t,a}^g = \frac{(1-\gamma)(1+\tau_t^c)H(\mathbf{s}_{t,a})}{U_c(\mathbf{s}_{t,a})(1-\tau_t^L)w_t\epsilon_a(E_{t-a}^g)}Z_{t,a}(X^g, \mathbf{s}_{t,a}) \quad (2.49)$$

$$h^{-g} : h_{t,a}^{-g} = \frac{(1-\gamma)H(\mathbf{s}_{t,a})(1-Z_{t,a}(X^g, \mathbf{s}_{t,a}))}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})(1-Z_{t,a}(X^g, \mathbf{s}_{t,a}))} \left(1 - \bar{\phi} \frac{\phi_{-g}(E_{t-a}^{-g})}{\phi_{-g}(E_{t-a}^{-g}) + \mathbf{1}_{\mathbf{s}_{t,a}}\phi_g(E_{t-a}^g)}\eta(\mathbf{s}_{t,a}) \right) \quad (2.50)$$

$$z^g : z_{t,a}^g = \frac{(1+\tau_t^c)\alpha_z}{U_c(\mathbf{s}_{t,a})(1-\tau_t^L)w_t\epsilon_a(E_{t-a}^g)} \quad (2.51)$$

$$z^{-g} : z_{t,a}^{-g} = \frac{\alpha_z}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})(1-Z_{t,a}(X^g, \mathbf{s}_{t,a}))} \left(1 - \bar{\phi} \frac{\phi_{-g}(E_{t-a}^{-g})}{\phi_{-g}(E_{t-a}^{-g}) + \mathbf{1}_{\mathbf{s}_{t,a}}\phi_g(E_{t-a}^g)}\eta(\mathbf{s}_{t,a}) \right) \quad (2.52)$$

- Case III: $\theta_l^{-g} > 0, \theta_l^g = 0$

$$h^g : h_{t,a}^g = \frac{(1-\gamma)H(\mathbf{s}_{t,a})Z_{t,a}(X^g, \mathbf{s}_{t,a})}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})Z_{t,a}(X^g, \mathbf{s}_{t,a})} \left(1 - \bar{\phi} \frac{\phi_g(E_{t-a}^g)}{\phi_g(E_{t-a}^g) + \mathbf{1}_{\mathbf{s}_{t,a}}\phi_{-g}(E_{t-a}^{-g})}\eta(\mathbf{s}_{t,a}) \right) \quad (2.53)$$

$$h^{-g} : h_{t,a}^{-g} = \frac{(1+\tau_t^c)(1-\gamma)H(\mathbf{s}_{t,a})}{U_c(\mathbf{s}_{t,a})(1-\tau_t^L)w_t\epsilon_a(E_{t-a}^{-g})}(1-Z_{t,a}(X^g, \mathbf{s}_{t,a})) \quad (2.54)$$

$$z^g : z_{t,a}^g = \frac{\alpha_z}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})Z_{t,a}(X^g, \mathbf{s}_{t,a})} \left(1 - \bar{\phi} \frac{\phi_g(E_{t-a}^g)}{\phi_g(E_{t-a}^g) + \mathbf{1}_{\mathbf{s}_{t,a}}\phi_{-g}(E_{t-a}^{-g})}\eta(\mathbf{s}_{t,a}) \right) \quad (2.55)$$

$$z^{-g} : z_{t,a}^{-g} = \frac{(1+\tau_t^c)\alpha_z}{U_c(\mathbf{s}_{t,a})(1-\tau_t^L)w_t\epsilon_a(E_{t-a}^{-g})} \quad (2.56)$$

- Case IV: $\theta_l^{-g} > 0, \theta_l^{-g} > 0$

$$h^g : \quad h_{t,a}^g = \frac{(1-\gamma)H(\mathbf{s}_{t,a})Z_{t,a}(X^g, \mathbf{s}_{t,a})}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})Z_{t,a}(X^g, \mathbf{s}_{t,a})} \left(1 - \bar{\phi} \frac{\phi_g(E_{t-a}^g)}{\phi_g(E_{t-a}^g) + \mathbf{1}_{\mathbf{s}_{t,a}} \phi_{-g}(E_{t-a}^{-g})} \eta(\mathbf{s}_{t,a}) \right) \quad (2.57)$$

$$h^{-g} : \quad h_{t,a}^{-g} = \frac{(1-\gamma)H(\mathbf{s}_{t,a})(1 - Z_{t,a}(X^g, \mathbf{s}_{t,a}))}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})(1 - Z_{t,a}(X^g, \mathbf{s}_{t,a}))} \left(1 - \bar{\phi} \frac{\phi_{-g}(E_{t-a}^{-g})}{\phi_{-g}(E_{t-a}^{-g}) + \mathbf{1}_{\mathbf{s}_{t,a}} \phi_g(E_{t-a}^g)} \eta(\mathbf{s}_{t,a}) \right) \quad (2.58)$$

$$z^g : \quad z_{t,a}^g = \frac{\alpha_z}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})Z_{t,a}(X^g, \mathbf{s}_{t,a})} \left(1 - \bar{\phi} \frac{\phi_g(E_{t-a}^g)}{\phi_g(E_{t-a}^g) + \mathbf{1}_{\mathbf{s}_{t,a}} \phi_{-g}(E_{t-a}^{-g})} \eta(\mathbf{s}_{t,a}) \right) \quad (2.59)$$

$$z^{-g} : \quad z_{t,a}^{-g} = \frac{\alpha_z}{\alpha_z + (1-\gamma)H(\mathbf{s}_{t,a})(1 - Z_{t,a}(X^g, \mathbf{s}_{t,a}))} \left(1 - \bar{\phi} \frac{\phi_{-g}(E_{t-a}^{-g})}{\phi_{-g}(E_{t-a}^{-g}) + \mathbf{1}_{\mathbf{s}_{t,a}} \phi_g(E_{t-a}^g)} \eta(\mathbf{s}_{t,a}) \right) \quad (2.60)$$

In cases II–IV X^g has to be calculated by combining the optimal results for $h_{t,a}^g$ and $h_{t,a}^{-g}$.

2.6.3 Additional figures

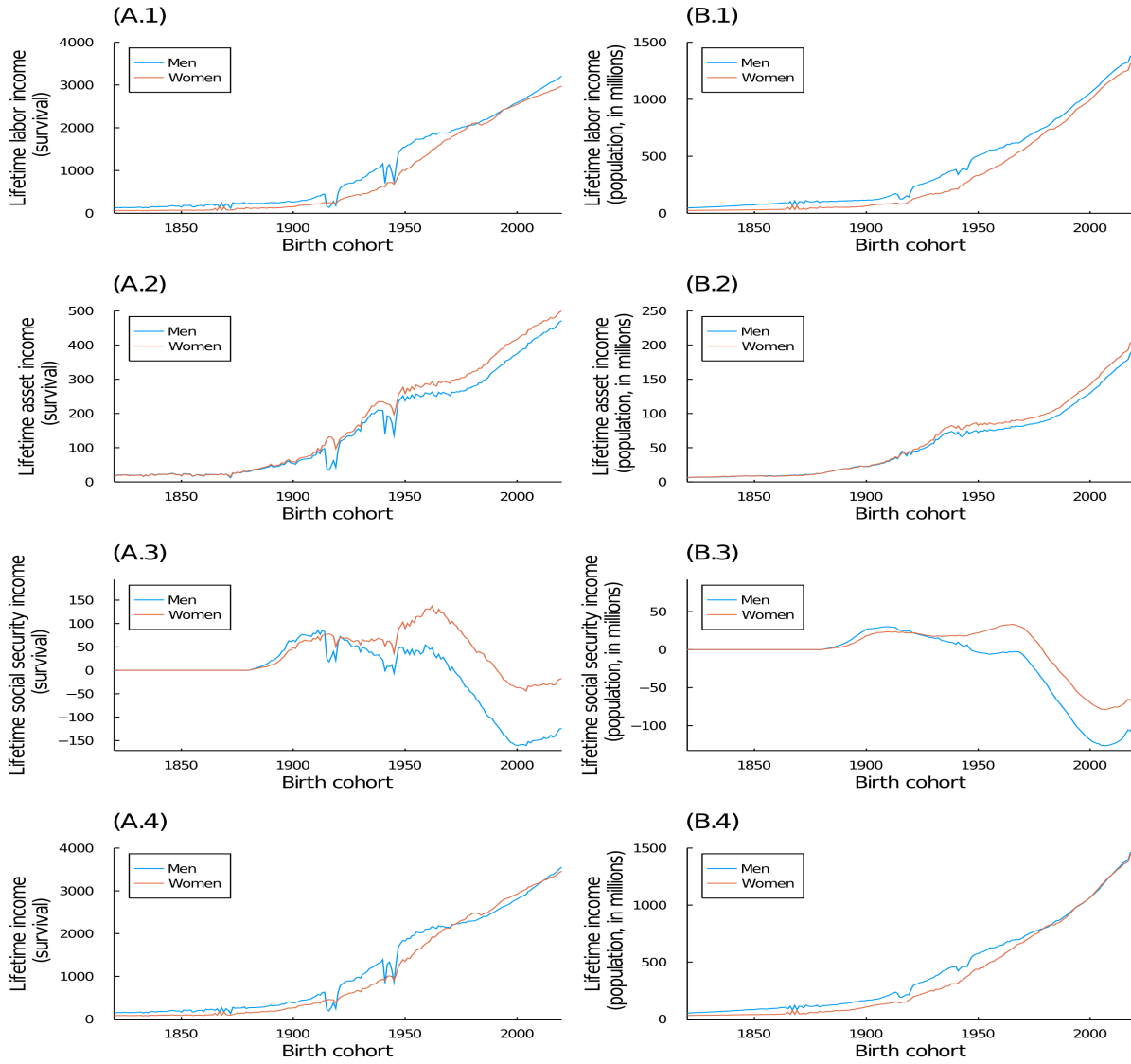


Figure 2.21: Types of lifetime income including exogenous productivity gains by cohort where each figure contains two panels. Left-hand side panels are calculated as the total sum of income at each age multiplied by the survival probability at each age. Right-hand side panels represents the sum of each type of cohort lifetime income birth cohort taking into account population size. *Source: Author's calculations*

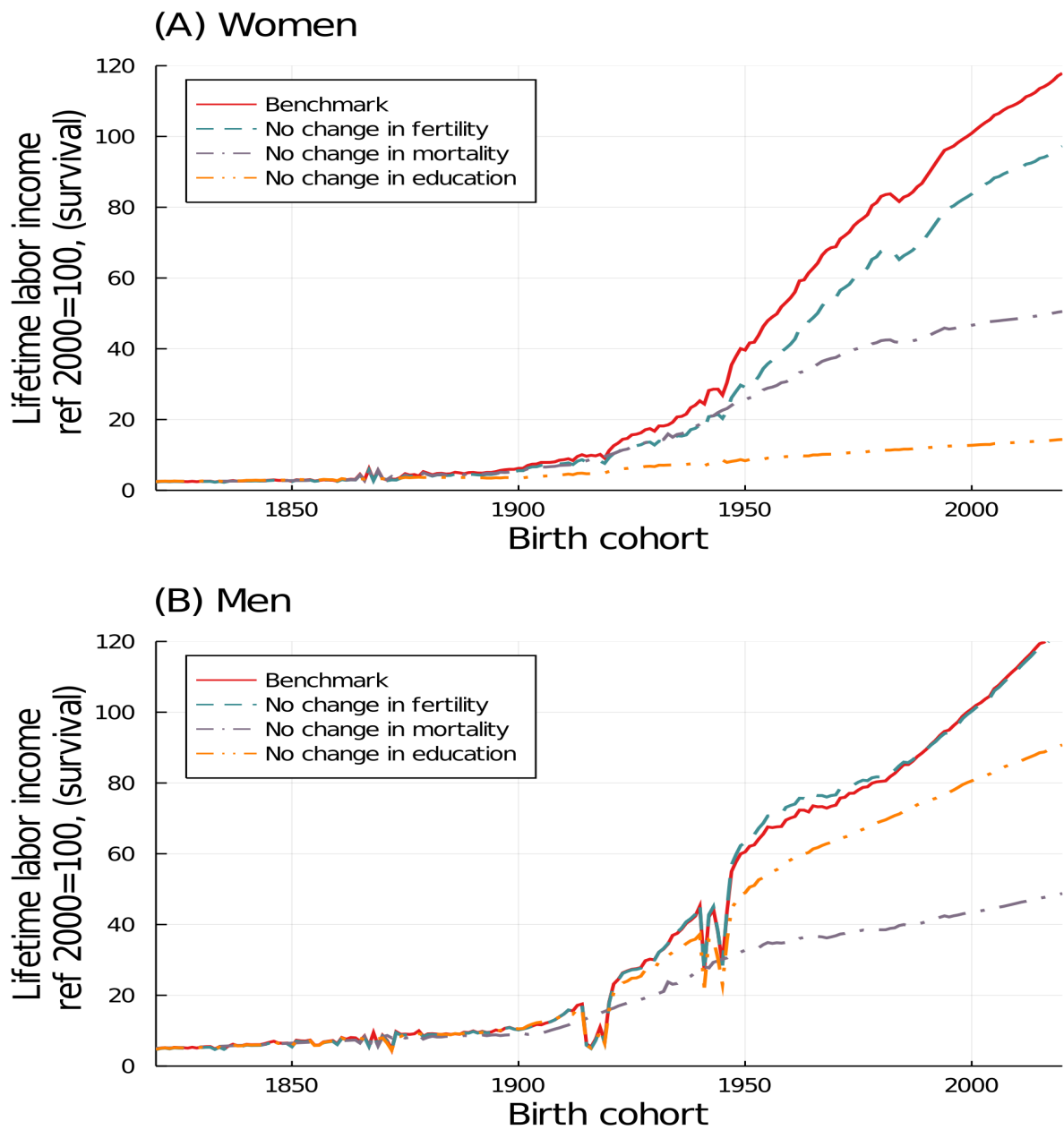


Figure 2.22: Lifetime labor income including exogenous productivity gains by gender and holding constant either fertility, mortality and education at 1820 level. *Source: author's calculations*

2.6.4 List of variables & parameters

Notation	Range values	Description	Status
Parameters			
t	0,1,2	Time	
a	0,1,.. $\Omega = 95$	Age	Exogeneous
g	$\in (f, m)$	Sex	Exogeneous
$p_{t+1,a+1}^g$	$\in (0, 1)$	Probability to survive (next period)	Exogeneous
$s_{t,a}$	$s_{t-1,a-1}, s_{t,a}$	Marital status	Exogenous
1_{st}	$\{0,1\}$	Dummy variable for $s_{t,a}$	
$\eta(s_{t,a})$	$\in \mathbb{R}$	Dependents, children, orphans	Exogenous
$H(s_{t,a})$		Household production function	Exogenous
$U(s_{t,a})$		Instantaneous utility function	
$c_{t,a}$		Total household consumption of market goods	
$ch_{t,a}$		Home-produced consumption goods	
$z_{t,a}^g$		Leisure time of adult gender g	
C	2.20	Subsistence level of market-goods	
α_x	$\alpha_x = 2.0$	Preference weight of home-goods	
α_z^g	$\alpha_z^g = 2.0$	Preference weight for gender g	
α_z^f	$\alpha_z^f = \alpha_z$	Preference weight for women	
α_z^m	$\alpha_z^m = \xi \alpha_z; \xi = 1.0 > 0$	Preference weight for men	
$x_{t,a}$		Expenditures (intermediate goods)	
$h_{t,a}^g$		Time spent in home production	
γ	$0.20 \in (0, 1)$	Substitutability degree in home production	
$k_{t,a}$	$k_{t+1,a+1}$	Evolution in financial wealth	
$R_t(s_{t,a})$		Return on annuitized wealth	
r_t		Interest rate	

τ_t^K		Capital income tax rate	
w_t		Wage per unit of efficient labor	Exogenous
E_{t-a}^g		length of education	Exogenous
$\epsilon_a(E_{t-a}^g)$		Labor productivity	Exogenous
$l_{t,a}^g$		Paid labor supply	Endogenous
$\bar{L}$	0.40	Maximum labor supply before retirement	Exogenous
$\pi_{t,a}^g$		Pension points	Endogenous
τ^L		Labor income tax rate	
τ^S		Social security contribution rate	
τ^c		Indirect tax rate	
R_t^p		Productivity growth factor	Exogenous
ϕ	0.14	Total time spent with children	Exogenous
β	1.02	Subjective discount factor	Exogenous
α_Y	0.33	Capital share	Exogenous
L_t		Aggregate efficient labor	Endogeneous
Y_t		Production of market goods	Endogeneous
α_Y	0.33	Capital share in production	
G_t		Unproductive public expense	Exogeneous

The parameter β is set at 1.02 in order to replicate the capital-to-output ratio of Piketty and Zucman (2014). The substitution parameter of the CES home production function is set at $\sigma_{t-a} = 0.975 - 0.035 \cdot (E_{t-a}^f - 2)$ in order to replicate the evolution of the difference in paid labor supply between genders.

Chapter 3

Non-Taxation of imputed rent: a gift to Scrooge?

3.1 Introduction

Imputed rent is defined as the rent a homeowner would have to pay if he was the tenant of the property. Since 1914, French authorities, as most developed countries between 1910 and 1980, used to include it in the income tax base. Nevertheless, it was finally removed in 1965 in France as a measure to foster access to homeownership. This period was indeed associated with the emergence of a middle-class of homeowners. However, some OECD countries such as Iceland, Luxembourg, the Netherlands, Slovenia and Switzerland still include it in their fiscal base and treat imputed rents as any other capital income.

The recent surge in housing prices that started in the early 2000s, combined with the dramatic drop in the homeownership rate of the lowest income decile (Laferrère et al., 2017), brought capital taxation and housing wealth, back to the center of the debate (Piketty and Zucman, 2014; Bonnet et al., 2021). According to Piketty and Zucman (2014), in spite of World Wars having significantly decreased wealth concentration in Europe, the top 1% in France currently owns 25% of total wealth. Within this context, including imputed rents in the tax base could be a redistributive tool (Landais et al., 2011). Not only do we present empirical evidence supporting this view, we also present intergenerational and demographic dimensions in our analysis.

First, non-taxation of imputed rents represents a fiscal spending ranging between 9 and 11 billions euros, which broadly corresponds to the tax receipts of the Property Tax from homeowners. It is also the first fiscal spending directed to homeowners. Second, provided that homeownership rates rise dramatically with age, non taxation of imputed rents is an important transfer from the young to the elderly. Third, this subsidy is mainly focused on the richest fiscal households who are full-right owners. Indeed, if the average subsidy is relatively small, it is very unevenly distributed. The tax scheme is mostly captured by the top income deciles among which 90% of the households own their homes. In contrast, concerning homeowners with a mortgage, this phenomenon is less striking as interest repayments reduce steeply these differences in average withdrawing 70% of the rental value of the taxpayers' residence. The fact that this subsidy is higher for owners casts some serious doubts about its capacity to promote homeownership within the lowest income deciles. As an alternative policy, we substitute the property tax which is based on outdated rental value and is not progressive with imputed rents taxation. This would turn homeownership more affordable for younger and poorer households with extremely low homeownership rates while increasing the cost of homeownership for the top income deciles.

3.2 Imputed rents exemption: a controversial subsidy

3.2.1 Assessing imputed rents in France: calculation and share of national net income

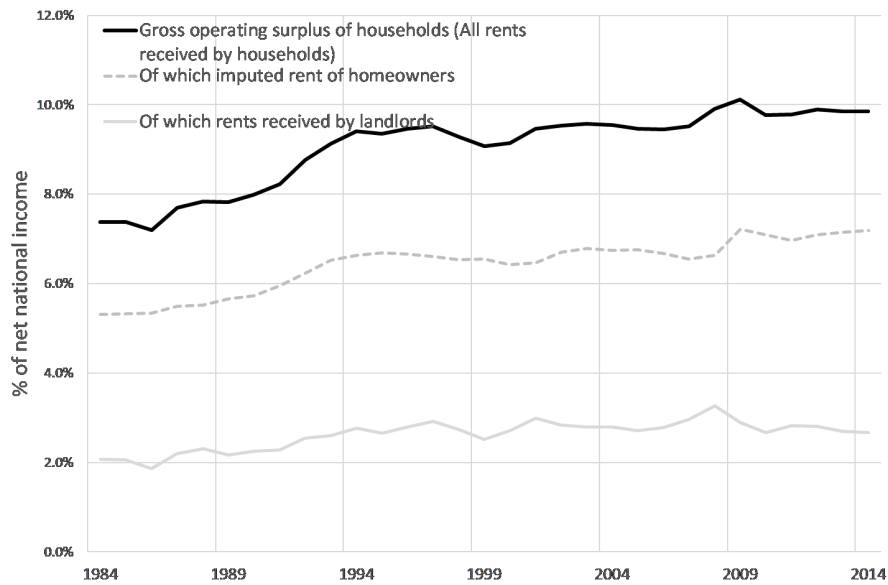
Imputed rents correspond to the value homeowners derive from living in their own dwelling. Goode (1960) defines net imputed rent as the rental value of a dwelling at market prices from which property taxes, depreciation, reparation costs, maintenance and loan interest payments are deducted. The gross imputed rent is usually computed thanks to the rental equivalent method which estimates the amount rent owners would have to pay in the private rental sector for a similar unit (De Haan and Diewert (2013)). In France, the Na-

tional Statistics Agency (INSEE) estimates imputed rents based on the French Housing Survey. Using the coefficients of hedonic regressions allows decomposing the rent of the private rental sector in order to predict the rent of homeowners units.

Combined with the rent paid by tenants in the private sector, imputed rents represent most of households' gross operating income in the national account. They are included in the computation of the GDP and represent a sizeable amount of the net national income. Indeed, as illustrated in Figure 3.1 and Figure 3.2, the share of imputed rents represents up to 7% of the net national income and more than 60% of the rental income in the private sector.

3.2. IMPUTED RENTS EXEMPTION: A CONTROVERSIAL SUBSIDY

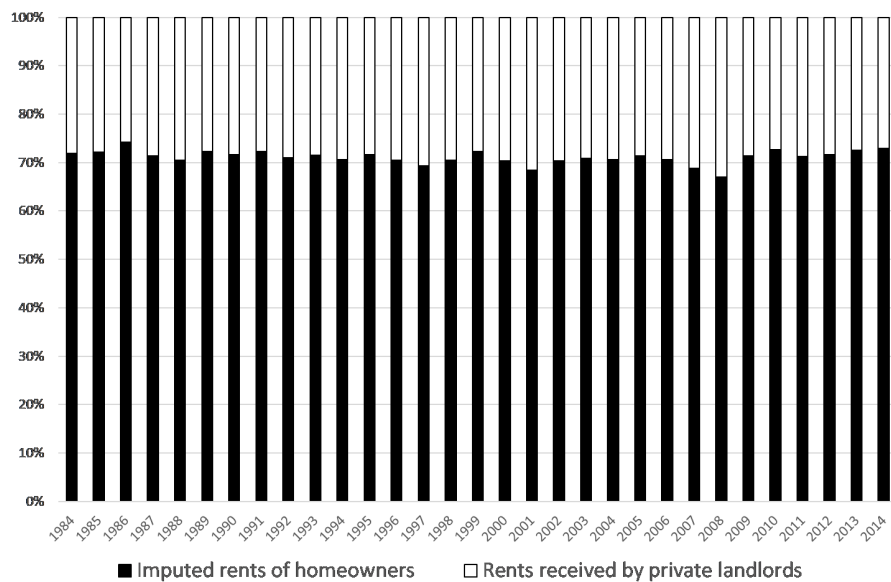
Figure 3.1: Gross operating surplus of households and gross rents



Source: Authors' computations from the French housing account 2014

Households' gross operating surplus, composed mainly by rents and imputed rents net of some expenditures as the property tax. Rent are before depreciation and taxation.

Figure 3.2: Share of imputed rents in total rents



Source: Author's computation from the French housing account 2014

Decomposed rents received by households between actual rents paid by tenants to their landlords and imputed rents of homeowners.

Given their sizeable amount, accounting or not for imputed rents might have important implications in the measurement of income inequalities. For example, Driant and Jacquot (2005) analyze the differences between income distribution when imputed rent is taken into account. They show that not accounting for imputed rent could lead to poverty overestimation and change households' position within income deciles. They also perform a similar exercise for the in-kind subsidy due to access to social housing units.

To summarize, the relevance of imputed rents taxation is non negligible, especially if compared to other types of domestic capital. This importance lies on their weight in our modern and urban economies.

3.2.2 Non imputed rents taxation is a subsidy toward homeownership

This section illustrates why non-taxation of imputed rent is a subsidy designed to support homeownership. Consider a household receiving a wage w paying income the tax rate $\tau(I)$ where $\frac{\partial \tau(I)}{\partial I} > 0$ and I denotes the household's fiscal income. This household owns a capital K it can either invest in an alternate asset and get a return $r \times A$ or buy a house for a price P where he can live and save a net Rent R . Without loss of generality, we assume that there are no capital gains $g_P = 0$. The variation of its net wealth will depend on its tenure choice. In case of homeownership, it will be:

$$\Delta W^0 = (1 - \tau(w)) \times w \quad (3.1)$$

In this equation, we account for the current situation where imputed rent is not taxed. The sole expenditure of the owner is its income tax based on its wage $\tau(w) \times w$. On the other hand, if he rents while investing in an alternate asset, he will get:

$$\Delta W^T = (1 - \tau(w + rA)) \times (w + rA) - R \quad (3.2)$$

The non-taxation of imputed rent generates an important difference between owners and tenants. One can illustrate this subsidy by assuming that the net return on housing and

the alternate investment is the same, i.e. $rA = rK = R$. In such a case, the subsidy provided to homeowners would be as follows:

$$subsidy = \Delta W^0 - \Delta W^T = \tau(w + R) \times R + (\tau(w + R) - \tau(w)) \times w \quad (3.3)$$

Or assuming that the impact of non taxation of imputed rent on the average tax rate of wage is negligible (i.e $(\tau(w + R) - \tau(w)) \times w = 0$):

$$subsidy = \tau(w + R) \times R \quad (3.4)$$

This simple definition is relatively close to the situation where the alternate investment is another house that is bought to be rented. Indeed, Goode (1960) argues that homeowners could choose to rent their house while owner occupation reveals that the returns of this status are higher than renting on the market. Moreover, when receiving the same wage, a homeowner will be better off than a tenant. The inclusion of imputed rent is thus in line with Haig (1921) and Blakey (1938)'s tax base definition¹. For Figari et al. (2017) their exclusion violates the principle of horizontal equity and results in a 'homeownership bias'. Several comments arise from this first definition of the subsidy. First, the magnitude of the subsidy is increasing with the net rent. This will thus favour homeowners living in expensive homes, for example, those living in large urban areas where prices are high or those having large houses. It will also favor households with the highest net equity. Consequently, the life cycle theory developed in Modigliani and Miller (1963) lead us to believe that non taxation of imputed rent will favour the oldest age groups. Second, the magnitude of the subsidy is increasing with the marginal tax rate τ and thus with the income of the owners when the income tax is progressive.

One might argue that homeowners are still taxed as they have to pay a property tax. However even accounting for property tax, the bias toward owner occupation persists. To illustrate this point, we can compare the homeowner receiving ΔW^O with a tenant who decides to become a landlord investing in housing. The tenant/landlord will have to pay a rent R while receiving only $(1 - \tau(w + R - \tau_p)) \times R - \tau_p$ where τ_p is the property tax. In

¹Any type of income that increases individuals' ability to consume should be included in the income tax base.

such a situation, depreciation and property tax cancel out. The resulting subsidy would thus be :

$$subsidy = \tau(w + R - \tau_p) \times (R - \tau_p) + (\tau(w + R - \tau_p) - \tau(w)) \times w \quad (3.5)$$

This is the definition of the subsidy that we will use in the main scenarii of the paper (scenarii 1,2,3). If the alternate investment is another asset only subject to the income tax, assuming that the impact of the average tax rate of the wage is negligible, the subsidy would:

$$subsidy = \tau(w + R - \tau_p) \times (R - \tau_p) - \tau_p \quad (3.6)$$

Several comments arise from this alternative definition. First, in France local property tax are based on outdated rental values. This generates important subsidies toward homeowner occupiers and landlords owning undervalued expensive homes. Second, local property tax is not progressive in France resulting in a subsidy that is still increasing with income and that might even be negative for low-income owners. Moreover, the property tax is paid regardless of the debt level. This alternate definition of the subsidy is relatively close to the redistributive effect of a reform where the property tax would be replaced by imputed rents taxation (scenario 4).²

To summarize, a homeowner will receive a positive subsidy if he is in a relatively high-income tax bracket and if the property tax is lower than the tax treatment of an alternate investment. The resulting bias for a medium/high-income household is significant. For example, Trannoy and Wasmer (2013) use a similar model to compute the difference in capital accumulation between an owner and a tenant with a marginal tax rate of 30%. Accounting for the cost of the mortgage, property tax, capital depreciation and considering an alternate investment with a safe return of 4%, they find that after twenty years, the owner would have twice as much wealth than the tenant, even if they both had the same income and capital at the beginning. They thus proposed to offer the possibility

²The change in taxation would be $\Delta \mathcal{T}_{axation} = \tau(w + R) \times (R) - \tau(w) \times (w) - \tau_p$

3.2. IMPUTED RENTS EXEMPTION: A CONTROVERSIAL SUBSIDY

of deducing tenant's rents from the taxable income while substituting housing allowance with a negative tax. We find that the property tax represents 8% of imputed rents while the average tax rate of productive capital is around 30%³. Furthermore, local property taxes are designed to finance local public goods which are essential for developing residential areas where houses keep acquiring real estate capital gains while the income tax represents the main redistributive tool at the national level. Conversely, imputed rents taxation would take into account the reimbursement status of taxpayers and will be included in the income tax base which is progressive with a redistributive scope. Moreover, until property values are not updated from their 1970's estimations, suburbs are overtaxed compared to city centers, owner-lessors who pay property taxes and their revenues are included in the tax income base, will not contribute properly to local property revenues within French cities.

According to Haig (1921) and Blakey (1938) tax base definition, any type of income that increases individuals' ability to consume should be included in the income tax base. From this perspective, including imputed rents in taxable income as any other income source is essential to accurately account for the total income tax base. For this reason, imputed rents was part of the fiscal base in France until 1965 and removed in order to foster home-ownership. In most developed countries during the period 1910-1980, the tax base for the personal income tax was, according to Piketty et al. (2013), defined in very comprehensive manner, particularly for capital income, and the tax base included imputed rent.

In this paper, we consider that non taxation of imputed rent should be treated as a tax credit defined by equation 3.5, and as such, can be accounted as a public spending in the same spirit of other favorable tax treatments that were put into place to promote home-ownership in France in the following decades. For example, the possibility offered between 2007 and 2009 to deduce interests paid on the loan for the primary residence is considered as a public spending and still represented a fiscal spending of 7 billion euros in 2010. In our framework, the reference situation from which the fiscal spending should

³Productive capital tax rate was around 58 % in 2013 (Artus et al., 2013) while imputed rent taxation was around 10%. A reform in 2017 created a flat tax of 30% for most capital income.

3.2. IMPUTED RENTS EXEMPTION: A CONTROVERSIAL SUBSIDY

be assessed corresponds to a situation where the tax treatment varies with occupation status. We illustrate such a situation in Table 3.2 accounting for the two main policies generally used to promote home-ownership⁴.

	Interest payments deduction for housing loans	Non-deduction of interest payments for housing loans
Imputed Rent Taxation	Neutral environment	Not favourable to owner-occupiers
Non Taxation of Imputed Rent	Very favourable to owner-occupiers	Favourable to owner-occupiers

Table 3.1: Definition of the neutral environment

France’s tax policy is favorable to homeowners and was briefly very favorable (after the aforementioned TEPA law or in the 1990s). However, many other countries have also a favorable or very favorable tax treatment of homeowners in particular the United States (see for example Sommer et al. (2013)) or the United Kingdom (see Figari et al. (2017) for an analysis of several European Countries).

3.2.3 Limits of non taxation of imputed rent

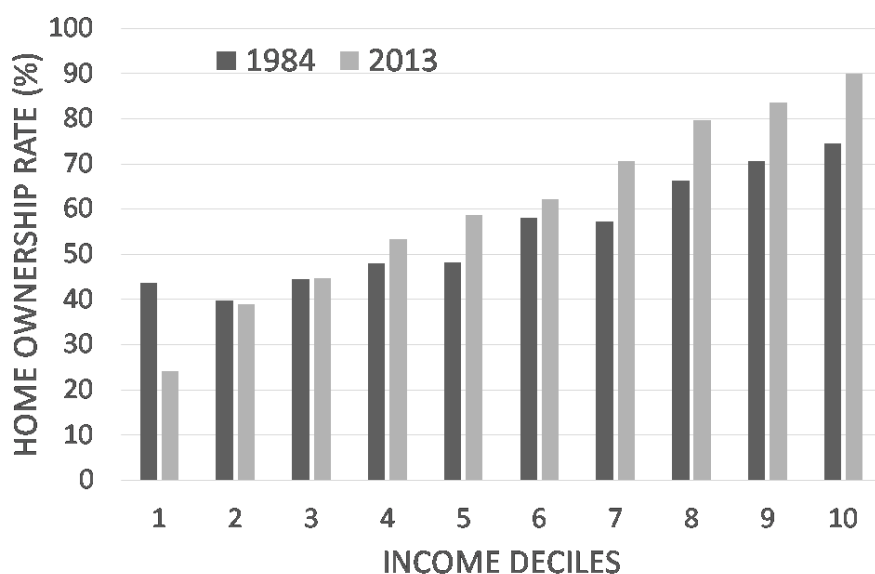
Non-taxation of imputed rent was presented as a way to support homeownership. This political desire is supported by several contributions documenting that higher home-ownership rates are desirable as home-ownership has positive impacts on living standards(see Dietz and Haurin (2003),Rohe et al. (2012),Hilber (2011)). For example, home-ownership decreases crime in neighborhoods (Glaeser and Sacerdote (2000)). In addition, Dietz and Haurin (2003) emphasize that it could also generate more pro-social behaviors.

For these reasons, non-taxation of imputed rents should be assessed through the lens of its capacity to foster home-ownership. However, most academic contributions cast some doubts on its efficacy and are relatively critical towards programs subsidizing home-ownership in general.

⁴We neglect here the other subsidies affecting the tenure choice as social housing, housing allowances or subsidized loans as they are accounted in the public expenditures. We will revert to this issue later

3.2. IMPUTED RENTS EXEMPTION: A CONTROVERSIAL SUBSIDY

The first drawback of subsidizing homeownership through non-taxation of imputed rents is linked with its failure to reach the most vulnerable households who went through a steep decline in their homeownership rates as illustrated in Figure 3.3. In this paper, we will show that in a country as France, where only half of the fiscal households are subject to the income tax, such a fiscal incentive is limited to richer households. This confirms the results of Bourassa and Hendershott (1994) who declare that in spite of being launched to encourage low-income households to become homeowners and create positive externalities within communities, tax exemption policies concerning imputed rents finally benefit high-income households.



Source: INSEE, Logement en France en 2013

Figure 3.3: Homeownership rate by income decile

A second limitation, which naturally stems from the previous point, is the impact of non taxation of imputed rents on income inequalities. Indeed Goode (1960) shows that non-taxation of imputed rents and interest rate exemptions deepen existing inequalities because, it becomes more profitable with higher marginal tax rates. In addition to this, he considers that this situation benefits people that prefer housing to other goods. This intuition is confirmed in Bourassa and Hendershott (1994) who analyze taxes paid over the life cycle in Australia, and show that imputed rents taxation would result in a progressive

or neutral scenario. Similar studies have been conducted in England (Yates (1994)) and Finland (Saarimaa (2011)) showing that imputed rents taxation would lower the Gini coefficient. More recently, Figari et al. (2017) presented an article analyzing three scenarios that reduced labor taxation without increasing inequalities (no compensation for fiscal pressure, compensation by a proportional reduction of taxable income and a fixed annual tax in which imputed rents would be taxed). They consider that in a scenario where imputed rents are exclusively taxed without compensation, the richest households are proportionally more concerned than low-income households. Conversely, a proportional reduction in the tax base would be positive for wealthier households. Finally, a fixed annual tax would have a more direct impact on high-income households without necessarily increasing inequalities. Figari et al. (2017) conclude that imputed rents taxation could be an interesting tool to increase fiscal revenues or to alleviate labor taxation without raising inequalities.

The third argument that casts some doubts on the impact of non-taxation of imputed rents on home-ownership is closely related to the recent results analyzing the efficiency of housing policies. A growing stream of literature has been increasingly pessimistic when analyzing the impact of public subsidies on the housing market. For example Fack (2005) shows that housing allowances tend to be capitalized into rents, while Gobillon and le Blanc (2008) or Labonne and Welter-Nicol C. (2015) show that subsidized loans designed to increase home-ownership rates increase housing and land prices and tend to result in a windfall profit. These results suggest that the low supply elasticity of the housing due to land scarcity dramatically reduces the efficiency of public subsidies and fiscal incentives, which in turn tend to generate price increases. One might fear that similar criticisms could apply to non-taxation of imputed rents but no empirical work has addressed this issue.

The fact that the housing supply remains inelastic in France reinforces the claim that it should be more efficient to tax housing rather than any other type of capital as illustrated in Bonnet et al. (2021). While it should be more efficient to tax the most inelastic production factor, non-taxation of imputed rents has been criticized because it generates a

distortion that pushes to invest in land instead of the productive economies (Artus et al. (2013), Allègre et al. (2012), Allègre et al. (2016)). Several contributions as Landais et al. (2011) promote a reform that would include imputed rent taxation. Artus et al. (2013) propose to reequilibrate capital taxation by providing fewer incentives to invest in housing. More recently, Allègre et al. (2016) support the total elimination of the ISF (French Solidarity Tax on Wealth), which could be compensated by taxing imputed rent. All these arguments and debates preceded the French fiscal capital taxation reform in 2017, which led to a transformation of the ISF into the IFI (*Impôt sur la fortune immobilière*). In order to foster investment in the productive economy, IFI removed financial assets of the fiscal base, creating a new tax solely on real estate assets.

Despite these contributions, one can regret the lack of precise analysis of the quantitative and redistributive impact of such a reform. While the estimates were made thanks to Euromod for several countries in Figari et al. (2017), so far there is no precise idea about the amount of the implicit subsidies received by homeowners in France. In this paper we aim to quantify the fiscal benefit they receive and to identify which households benefit the most from this fiscal device.

3.2.4 Imputed rents taxation in the French fiscal debate

The question of imputed rents taxation in the French fiscal system has been under a heated debate since 2011. First, Landais et al. (2011) proposed to reform the whole fiscal system, their proposed income tax would include imputed rent in the tax base. Later on, Allègre et al. (2012) advocated for evaluating the possibility of deducing the rent of tenants and interest payments of homeowners from the tax base as a potential alternate solution. They argue that it would be more easily accepted and would not imply any imputed rent estimation. However, authors acknowledge that such a reform would remain sensitive since it would imply a raise in income tax levels to guarantee neutrality on public budget. The following year, Artus et al. (2013) analyzed the uneven treatment between the different types of capital income and evoked the possibility to tax imputed rents while Trannoy and Wasmer (2013) proposed to offer the possibility of deducing tenant's rents

from the taxable income while substituting housing allowance with a negative tax. One should remark that if many contributors tackle the possibility of deducing tenant's rent as an alternative, other economists as Goode (1960) emphasize that if such approach can reduce inequality between tenants and homeowners, it is also likely to generate distortions such as encouraging housing consumption at the expense of other goods.

More recently, Allègre et al. (2016) support the total elimination of the ISF (French Solidarity Tax on Wealth), which could be compensated by taxing imputed rents and therefore targeting real estate properties, generalizing taxation on net unrealized gains as well as creating a Mansion tax, without decreasing significantly corporate tax levels. In addition to this, they suggest implementing a progressive taxation of imputed rents to encourage payment of social contributions by owners. Furthermore, this policy could be completed by an interest mortgage deduction from imputed rents to address the inter-generational transmission of wealth inequality, as it could benefit young households' access to wealth at the expense of older households. All these arguments and debates preceded the French fiscal capital taxation reform in 2017, which lead the to a transformation of the ISF into the IFI (*Impôt sur la fortune immobilière*), which took out financial assets of the fiscal base, creating a new tax solely on real estate assets in order to foster investment in the productive economy.

Despite these numerous contributions, one can regret the lack of precise quantification of the redistributive impact of such a reform. While the estimates were made thanks to Euromod for several countries in Figari et al. (2017), so far there is no precise idea about the amount of the implicit subsidies received by homeowners. In this paper we aim to quantify the fiscal benefit they receive and to identify which type of fiscal households benefit the most from this fiscal device.

National accounts can already provide a partial answer allowing us to assess what amount net imputed represent for full right owners and owners with mortgage re-payment. As illustrated in Figure 3.4 and 3.5, in aggregate terms, net imputed rents represent almost exclusively a source of income for full right owners. Indeed, as already mentioned one

should remove the capital depreciation, interest repayment and property tax from the gross rent to compute the fiscal base. When accounting for these, the net imputed rents of full right owners still represent a significant share of the net income (about 4 % in 2014) while the net rent of owners with mortgage repayment is close to 0 and even negative in 2014. This is due to the fact that while interest rates have been declining the length of repayments, the amounts borrowed have been increasing over the first half of the 2000s during the dramatic rise in housing prices.

3.2.5 Should we foster homeownership at any cost? A tale of economic inefficiencies

Furthermore, many authors show some concerns about the economic growth potential and the relative fiscal burden between labor and capital. As far as economic growth is concerned, Andrews and Sánchez (2011) fear that policies aimed to foster access to homeownership based on the development of the mortgage credit market could eventually lead to highly dangerous speculative bubbles. Furthermore, Bourassa and Hendershott (1994) argue that these policies misuse a part of funds issued from the productive economy at the risk of over-investment in housing and at the expense of other economic sectors. On the relative fiscal burden between labor and capital, Figari et al. (2017) analyzed the fiscal and distributional consequences of taxing net imputed rents in six selected European countries (Belgium, Germany, Greece, Italy, the Netherlands and United Kingdom), with different housing market characteristics, housing ownership rates, income tax base and cash disposable income. They concluded that imputed rents appears to be a promising tool for increasing additional revenues with no inequality side effects and a shift of the fiscal burden from labor to housing. Moreover, it can create working incentives when imputed rents taxation is accompanied by reductions in taxpayers' liabilities.

Finally, the pro-social behavior presented as a benefit of high home-ownership rate are connected to a more critical stream of the literature toward the development of homeownership. In his seminal work, Fischel (2002) developed a model in which homeowners

could become overprotective and exert a political pressure on local government likely to rise land use regulation and thus reduce the housing supply elasticity but also impair firm's development (see Blanchflower and Oswald (2013)). This latter point is intimately connected with the Oswald hypothesis (Oswald (1996)) according to which higher home-ownership rate might generate higher unemployment rates because of an environment less favorable to business development and a lower geographical mobility of unemployed owning their home. It is worth noting that if several contributions pointed that homeowners might have longer unemployment duration, the differential between owners and tenants is unlikely to explain the observed aggregate differences in unemployment. The overview of the current state of the literature suggests that if there are benefits of homeownership, it remains unclear what is the optimal home-ownership rate and even if there is one.

To conclude, the current economic literature remains inconclusive on the capacity of non-taxation of imputed rents to foster home-ownership, but also on the opportunity of subsidizing home-ownership.

3.3 Assessing the subsidy provided to homeowners thanks to Taxipp

3.3.1 Taxipp model

Most of the previous academic work simulates and analyses the potential redistributive impact of imputed rents taxation. However, our approach is slightly different as our main goal is not to assess the potential impact of imputed income taxation but firstly aims to assess the transfers between households due to this fiscal exemption and compare it with other type of housing subsidies in France. In a nutshell, we consider imputed rents taxation as a subsidy that should be computed in government spending as housing allowances, and analyse to which extent such subsidy affects differently households following their income level and age.

For this reason, we create a counterfactual situation reproducing a neutral fiscal treat-

3.3. ASSESSING THE SUBSIDY PROVIDED TO HOMEOWNERS THANKS TO TAXIPP

ment of imputed rents using the fiscal simulator provided in Landais et al. (2011). The Taxipp model is a micro-simulation model of mandatory social contributions that unlike the standard micro-simulation approach, places a special emphasis on imputation of high revenues and on calibrating the model according to national accounts. In addition to this, it should be noted that the database could be used at the fiscal household level. This allowed us to assess the amount of tax credit received by each fiscal household and its redistributive impact. The calculation of imputed rent, imputed property tax and imputed property revenues are described below.

3.3.2 Computing the net imputed rent

Based in Landais et al. (2011), we provide an estimate of gross rent thanks to a hedonic regression model. We then use several scenarii described in Table 3.2 in order to compute the net imputed rent. In the first scenario, we use the baseline parameters of Landais et al. (2011) using the National account base 2005. We slightly change their approach estimating mortgage interest payment following the principles of Distributional National Accounts. We use household wealth survey of 2010 we focus on Homeowners with mortgage repayments for their main residence and define groups according to two dimensions: age groups and financial income. Second, for each group we compute the share of the total interests repaid by the group. We then identify the same groups in TAXIPP and use the average amount repaid by the group to infer the amount of interest payment for each household. We finally assign these interest payments between the tax units of each household. We also use the imputed property taxes (IPT) provided by Landais et al. (2011) for each individual that we attribute to each tax unit.

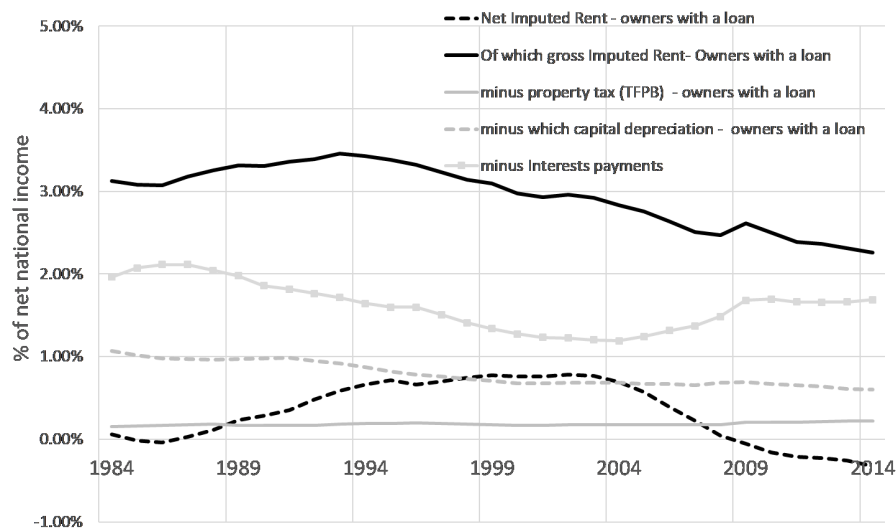
The other scenarii are used for robustness checks. In the scenarii 2 and 3 we account for the change in National accounts occurred when switching from the base 2005 to the base 2010. Indeed, the base 2010 adopted a much higher depreciation rate for housing capital which increased by 10 percentage points between 2000 and 2010. In the third scenario, we substitute the declared property tax and the imputed mortgage interest payment with constant shares of the gross rent. We do so by exploiting national accounts aggregates

3.3. ASSESSING THE SUBSIDY PROVIDED TO HOMEOWNERS THANKS TO TAXIPP

provided in the previous section. All these scenarii yield relatively similar results, the major change in the tax base comes from the hypothesis on capital depreciation, which creates a discrepancy of about 10 billion euros between the two extreme scenarii. Finally, the fourth scenario takes a different perspective and tries to assess what would be the fiscal income under the hypothesis that taxation of imputed rents for homeowner occupiers substitutes Property Tax. We take the same parameters as Scenario 1 but consider that the Property Tax does not exist anymore. This scenario allows to assess whether the substitution of the two taxes for homeowners would translate into a net fiscal gain or loss for the state.

In Figures 3.4 and 3.5 we perform the same exercise with aggregate data in order to compare the fiscal base from the simulator with national accounts. Reassuringly, the aggregate net rents are very close to the sum of the fiscal base in the micro data set. Total net imputed rent remains between 53 and 73 billion euros which represents about 4% of the net national income as in the aggregate data.

3.3. ASSESSING THE SUBSIDY PROVIDED TO HOMEOWNERS THANKS TO TAXIPP

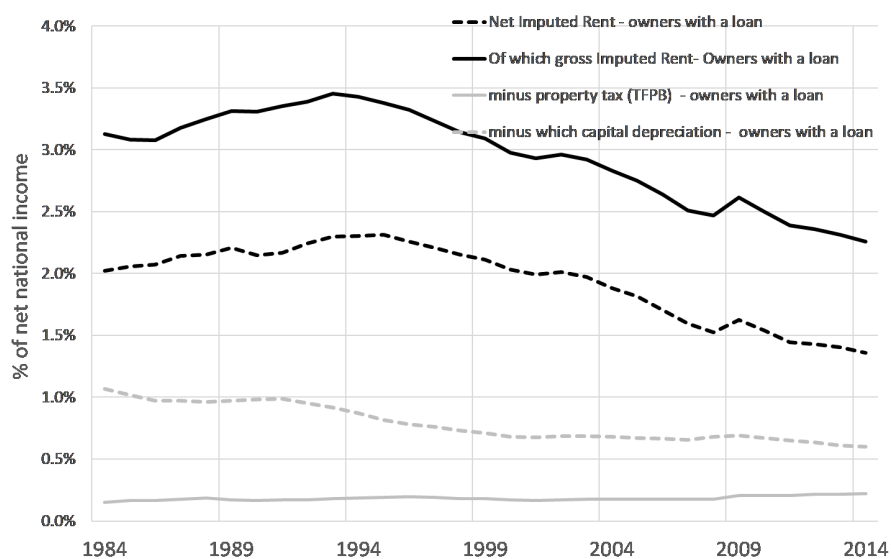


Source: Authors' computations from the French housing account 2014 (Comptes du logement 2014).

Decomposed aggregate taxable rents of homeowners with a mortgage (dash line) into its four main components: the gross rent, the capital depreciation, the interests repayment and the Property tax.

Figure 3.4: Gross, net imputed rents and property tax for owner occupiers with a loan

3.3. ASSESSING THE SUBSIDY PROVIDED TO HOMEOWNERS THANKS TO TAXIPP



Source: Author's computation from the French housing account 2014 (Comptes du logement 2014).

Decomposed taxable rents of homeowners with no loan (dash line) into its three main components: the gross rent, the capital depreciation and the property tax.

Figure 3.5: Gross, net imputed rents and property tax for owner occupiers without a loan

3.3. ASSESSING THE SUBSIDY PROVIDED TO HOMEOWNERS THANKS TO TAXIPP

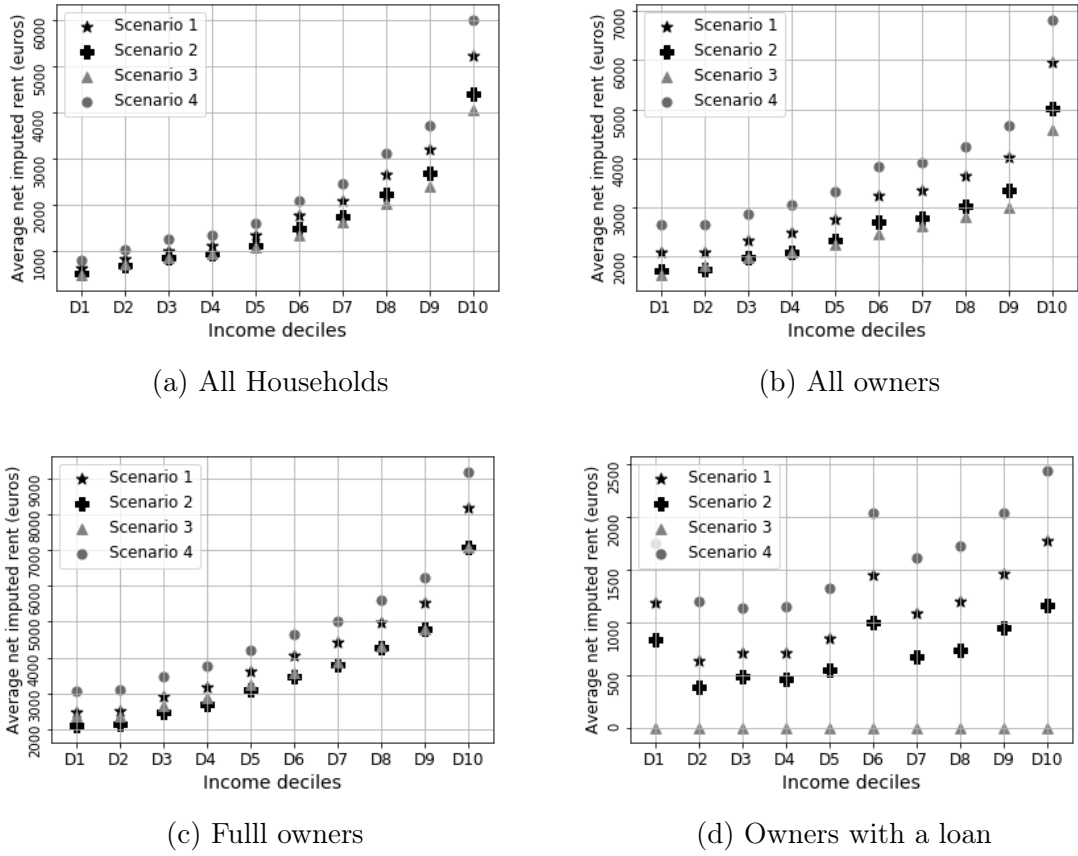
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	(Nat. Accounts Base 2005)	(Nat. Accounts Base 2010)	(Nat. Accounts Base 2010)	(Nat. Accounts Base 2006)
Depreciation rate (% of rent)	18%	28%	28%	18%
Mortgage interest payments	imputed	imputed	70%	imputed
Property Tax (PT)	declared	declared	8%	suppressed
Net/Gross Imputed rent - full owner	82% - IPT	72% - IPT	64%	82%
Net/Gross Imputed rent - owner with loan	12% - IPT	5.4% - IPT	0%	12%
Total Net Imputed Rent (Billions of Euros)	70.6	59.07	55.19	83.31

Table 3.2: Scenarii to calculate the net imputed rent

In Figure 3.6 we represent the distribution of the average net imputed rents per decile of taxable income for all households, owners with a mortgage and full right owners. When looking at households overall, one can observe that the taxable base dramatically increases with income. This is easily explained by two phenomena. The share of homeowners is higher in the upper deciles. Richer households have a higher housing consumption and thus higher imputed rents. Panel c) shows that individuals in the 10th richest decile, who are full right owners, receive the highest net imputed rents. For these households, the average net imputed rents is between 7,000 and 9,000 euros per year. However, it steeply declines as income decreases: the 9th decile only receives between 5,000 and 6,000 euros and the 1st decile only receives between 2,000 and 3,000 euros on average. The difference between owners with mortgage and full right owners is striking when comparing panel c) and d). Accounting for interest rate repayment reduces dramatically the net imputed rent: for the 10th income decile, owners with a loan receive on average about 1800 euros in Scenario 1 (around 2500 when suppressing the property tax in Scenario 4), which stands for around only 25% of the subsidy of full right owners with a similar income level.

3.3. ASSESSING THE SUBSIDY PROVIDED TO HOMEOWNERS THANKS TO TAXIPP

Figure 3.6: Net Taxable Imputed Rent



Moreover, the distribution of imputed rents across age groups reveals a steep inter-generational inequality, as illustrated in panel a) in Figure 3.7. One can note that it is unevenly distributed between generations. The average net imputed rents of young households is extremely low as few of them own their house and among the few owners most of them still have to repay their mortgage. The untaxed imputed rents revenues are thus undeniably larger for old age groups. In fact, they represented in average 194 euros for 18-30 year-olds whereas they accounted for 3,713 euros and 3,316 euros for the 60-75 year-old cohort and above 75 year-olds respectively. These patterns can be easily explained when looking at panel b). Indeed, relatively few households belonging to groups aged between 18-30 and 30-45 are homeowners (respectively 13% and 50%) and among those who own their house, an outstanding majority has a mortgage. In contrast, the homeownership rate is relatively high for older groups (more than 60%) and most of the older households are full right owners.

Figure 3.7: Net Taxable Imputed Rent and Home-ownership rates by age group



Finally, even if the dataset is not precisely geolocated it is also interesting to compare how imputed rents vary across French regions. Our dataset only allows to compare three types of Area mainland France (Area 3), large urban areas with more than 200,000 inhabitants (Area 2) and Paris urban area (Area 1). We report in Figure 3.16 the average imputed rent by area. One can observe that for owners, imputed rents are higher in Paris and in large urban areas than in other regions of the country. However, when considering all households, mainland France receives on average a larger imputed rent than urban areas with more than 200,000 inhabitants because the homeownership rate is higher in rural areas (Figure 3.16 in Appendix).

3.4 Results

3.4.1 Non-taxation of imputed rent is the most important subsidy to homeowners

We first present our estimates of the aggregate fiscal subsidy provided by non-taxation of the imputed rent. As illustrated in Table 3.3, following the parameters of the simulation, the total fiscal subsidy represents between 9 and 11 billion euros. This subsidy represents around 25% of the total subsidies dedicated to housing in the French National accounts of 2010. Indeed as described in Table 3.4, total subsidies represented 40 billion euros in 2010. Non-taxation of imputed rent is thus the second most important housing program

3.4. RESULTS

after housing allowances which represented 17 billion euros. It is worth noting that this subsidy is larger than the Property Tax paid by homeowners which represented about 10 Billions euros in 2010 as illustrated in Table 3.6 in the appendix. As a consequence a substitution of the property tax by imputed rent taxation for homeowners would be totally self-financed.

Non-taxation of imputed rent appears, by far, as the major subsidy to homeowners. It is followed by the deduction of interest rates from loans, made possible between 2007 and 2009 (TEPA fiscal device) and is still having some budgetary consequences years after its repeal. Not accounting for the non-taxation of imputed rent leads to underestimate the public support to home-ownership. We can notice that the inclusion of non-taxation of imputed rent changes dramatically the distribution of subsidies between housing tenure. While the current national accounts show that the vast majority of housing subsidies go to the rental sector, this trend is no longer valid when accounting for non-taxation of imputed rent. Indeed, total subsidies to owners almost double and are very close to subsidies created for tenants (around 23 billion euros for owners compared to 26 billion euros for tenants).

When confronting these results with the findings in Figari et al. (2017), one can note that in case of imputed rents taxation, additional tax receipts would remain relatively modest. This is because, the income tax only represent less than 10% of the public revenues in France (Matias and Guillot (2014)) and is supplemented by the CSG and CRDS⁵ which are not progressive.

	without Imputed rent	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Total tax revenue (Billions of Euros)	53.54	65.60	63.57	62.92	67.75
Estimated subsidy (Billions of Euros)	-	12.06	10.03	9.38	14.21

Table 3.3: Estimation of the Fiscal Subsidy due to non taxation of imputed rents

⁵Contribution Social Generalisée

	Main Residences (MR)						Secondary Residences	Provisionary residences	Total
	Owners	Rental Sector				Total (MR)			
		Physical landlords	Social Landlords	Other Landlords	Total (rental)				
Subsidies to consumers									
Housing allowances	0.948	7.757	5.772	0.760	13.843	14.791	-	1.137	15.928
Other allowances	0.005	0.095	0.131	0.038	0.264	0.268	-	0	0.268
Fiscal Subsidy	1.061	-	-	-	0.354	1.141	-	-	1.414
Total	2.013	-	-	-	14.460	16.474	-	1.137	17.611
Subsidies to Producers									
Operating and investment subsidies	0.134	0.230	1.288	0.497	2.015	2.149	-	0.027	2.176
Subsidized loans	2.818	-	-	-	2.833	5.651	1	0	5.652
Fiscal Subsidies	7.027	-	-	-	4.249	11.276	-	-	11.276
Others	1.252	0.156	1.936	0.419	2.510	3.762	0.099	0.070	3.931
Total	11.231	-	-	-	11.607	22.838	0.100	0.096	23.034
TOTAL									
Total	13.244	-	-	-	26.067	39.311	0.100	1.233	40.645
Accounting for non imputed rent taxation									
Non imputed rent taxation	9-11	0	0	0	0	0	0	0	0
Total with non imputed rent	22.244 -24.244	-	-	-	26.067	48.311-50.311	0.100	1.233	49.645-51.645

Table 3.4: Total housing subsidies in 2010

3.4.2 Estimating the marginal tax rate of imputed rents

As emphasized in Equation 3.5, the magnitude of the subsidy is defined by the marginal income tax rate of households and their net imputed rent. As the income tax schedule is progressive, we estimate in column 1 and 3 of Table 3.5, the following equation:

$$Y_i = \tau_j \times D_{d(i)=j} \times R_i + \epsilon_i \quad (3.7)$$

We interact the income decile dummies ($D_{d(i)=j}$) with the imputed rent (R_i) to recover the marginal tax rate of each income decile j (τ_j). In column 1, Y_i is the implicit subsidy estimated in scenario 1 and defined in equation 3.5. In column 3, Y_i is the variation in taxation resulting from a substitution of the property tax by imputed rent taxation⁶ as defined in scenario 4. Columns 2 and 4 estimate the following equation:

$$Y_i = \tau \times R_i + \epsilon_i \quad (3.8)$$

which allows us to recover τ which is the average marginal tax rate of imputed rent for the whole sample of landlords. The dependent variables are the same as in columns 1 and 3.

Following closely results shown in Table 3.5, we observe that in the first scenario, all income deciles would face a progressive increase in their income tax payment if imputed rent taxation was reestablished in France while keeping the current fiscal system. In fact, the first and second deciles would pay respectively 0.01 and 0.0248 euros per net taxable euro concerning imputed rent leading to a marginal taxation of 1% and 2.48% . On the other hand, middle-classes in the 5th and 6th deciles would pay respectively 0.110 euros and 0.139 euros per net taxable euro, with marginal rates at 11 % and 13.9%. Finally, upper classes in the 9th and 10th deciles, would pay 0.167 euros and 0.346 euros per each net taxable euro, which would imply a 16.7% marginal tax rate for the 9th decile and a marginal rate of 34.6% for the 10% highest incomes in France. In addition to this, it can be observed that when only regressing the first scenario on taxable net imputed rent without controlling for income deciles, we see that overall, for every net taxable euro in imputed rent, there would be a 0.273 euros increase, which represents a 27.3% marginal

⁶ $Y_i = \Delta Taxation = \tau(w + R) \times (R) - \tau(w) \times (w) - \tau_p$

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tax rate.

Concerning the second scenario, which consists of simultaneously reintroducing, imputed rent taxation and eliminating property tax for homeowners, the fiscal burden is transferred from a local regressive tax to a progressive national tax. Looking at results in columns 3 and 4 (Table 5), we can conclude by merely looking at the signs in our coefficients, that the first income deciles would benefit from a decrease in income tax, favoring redistribution. Marginal negative rates for the 40% most modest revenues in France would be comprised between -12.8% (first income decile) and -2.24% (fourth income decile). Moreover, for the middle class (from the 5th and 6th deciles), marginal rates would represent 0.349% and 3.61%, lower than those calculated for the 1st scenario.

Finally, for the highest income deciles, eliminating property tax, would lead to marginal tax rates lower than those described in Columns 1 and 3: 11.3% for the 9th decile and 6.43% for the 10th decile. When regressing solely the dependent variable on net taxable imputed, the overall marginal tax rate is 23%.

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	(1)	(2)	(3)	(4)
	Maintaining the property tax		Suppressing the property tax	
	Δ Taxation	Δ Taxation	Δ Taxation	Δ Taxation
1st Income Decile * R	0.0100*** (0.000882)		-0.128*** (0.00130)	
2nd Income Decile * R	0.0248*** (0.000796)		-0.103*** (0.00117)	
3rd Income Decile * R	0.0672*** (0.000700)		-0.0485*** (0.00103)	
4th Income Decile * R	0.0917*** (0.000670)		-0.0224*** (0.000988)	
5th Income Decile * R	0.110*** (0.000595)		0.00349*** (0.000878)	
6th Income Decile * R	0.139*** (0.000506)		0.0361*** (0.000746)	
7th Income Decile * R	0.160*** (0.000457)		0.0591*** (0.000673)	
8th Income Decile * R	0.168*** (0.000393)		0.0665*** (0.000579)	
9th Income Decile * R	0.167*** (0.000342)		0.0643*** (0.000504)	
10th Income Decile * R	0.346*** (0.000150)		0.230*** (0.000222)	
R		0.273*** (0.000208)		0.160*** (0.000246)
N	489578	489578	489578	489578
R ²	0.920	0.777	0.697	0.463

Standard errors in parentheses

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

The dependent variables in column (1) and (2) correspond to the implicit subsidy received by a household because of non imputed rent taxation computed in scenario 1 with the current fiscal system. The dependent variables in column (3) and (4) indicates the change in taxation after the substitution of the property tax by the imputed rent taxation computed in scenario 4. For columns (1) and (2), interaction terms represent the marginal values per income decile based on R in euros.

Table 3.5: Marginal taxation rate by net taxable imputed rent and income decile

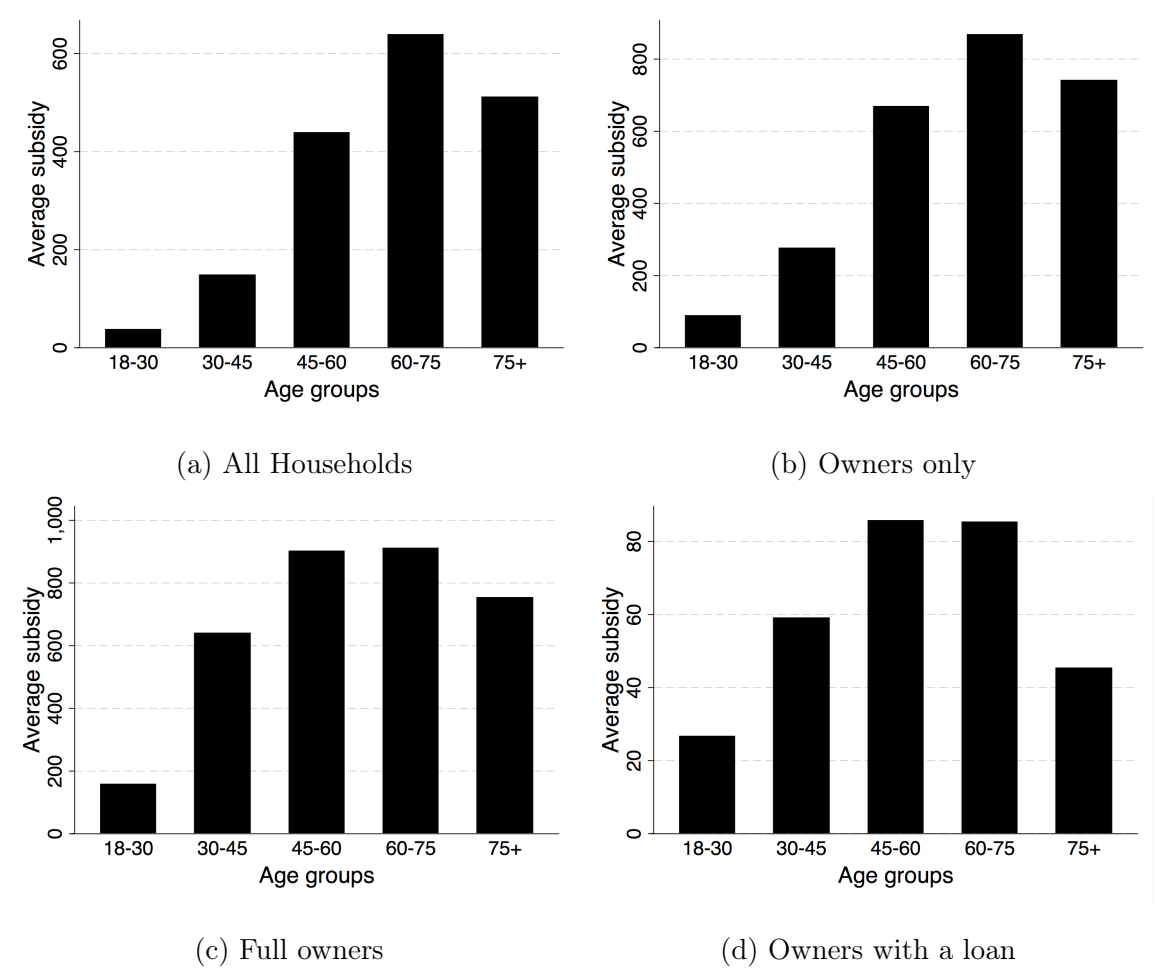
In Table 3.7 in the appendix, we also report the characteristics of our micro sample of fiscal households. It is worth noting that from our estimates about 1 826 081 mostly from the deciles 3,4 and 5 would become taxed if imputed rents were included in the tax base. Nevertheless, on average their income tax would be less than 300 euros.

3.4.3 Non-taxation of imputed rent mainly benefits older households

Figure 3.8 shows the average subsidy by age groups. Overall results underline that older groups (60-75 year-olds and above 75 year-olds) are the main beneficiaries from non-taxation of imputed rent. The subsidy closely follows the patterns of the net imputed rent received by each generation and the homeownership rate by age group. One can observe that younger households, aged between 18 and 30 years old, only receive a residual subsidy below 20 euros per year while those aged between 30 and 45 receive about 100 euros. (Figure 3.8). This can be explained by the fact that these generations are respectively mostly tenants or owners with a mortgage and thus would either have to pay any or very low net imputed rent. The average subsidy then rises dramatically for older households who have a higher homeownership rate and are more likely to be full-right owners. Households between 45 and 60 years or older than 75 receive a yearly subsidy between 400 and 600 euros while those aged between 60 and 75 years old receive the highest subsidy, amounting up to 600 euros.

These trends are confirmed when we divide homeowners into full right homeowners and owners with a mortgage (3.16 in the Appendix). It can be observed that the average increase in $\mathbf{X}$ is substantially higher for older categories, in particular full right owners in the 45-60 and 60-75 age categories. In fact, these age groups save an average of around 850 euros in income tax, whereas the amount would only represent between 40 and 90 euros for mortgage payers from these same age cohorts. Conversely, households under 30 who pay a mortgage, which is the case of the majority of fiscal households of this age group (Figure 3.7, panel b)) save an average of approximately 15 euros per year, whereas it would represent around 180 euros for full right owners (less than 0.5 % of total full right homeowners across age groups).

Figure 3.8: Current Implicit subsidy due to non taxation of imputed rent by age groups



These figures suggest that the inter-generational analysis is a key issue and deserves particular attention when considering the possibility to remove this hidden subsidy.

The fact that non-taxation of imputed rent mainly benefits older households contributes to the literature that explores the difficulties youth face in the housing market. For example, Wasmer and Eyméoud (2016) showed that difficulties youth face in accessing the rental sector decreased dramatically their mobility and their capacity to find a job. The non-taxation of imputed rent presents two major drawbacks after the recent surge in housing prices. First, it benefits old households who already received important capital gains in the 2000s and have a high level of wealth while other housing policies appear to fail granting access to young and poorer households to homeownership. It is thus reinforcing inequalities between generations. Second, given the growing role of inter-vivos donations

3.4. RESULTS

in access to homeownership, inter-generational inequalities also have deep consequences on intra-generational inequalities. In such a context, one can question the relevance of a subsidy that ultimately advantages households who benefited from an inter-vivos donation from their relatives to access homeownership.

Figure 3.9: Variation in Taxation when substituting the property tax with imputed rent taxation by age group

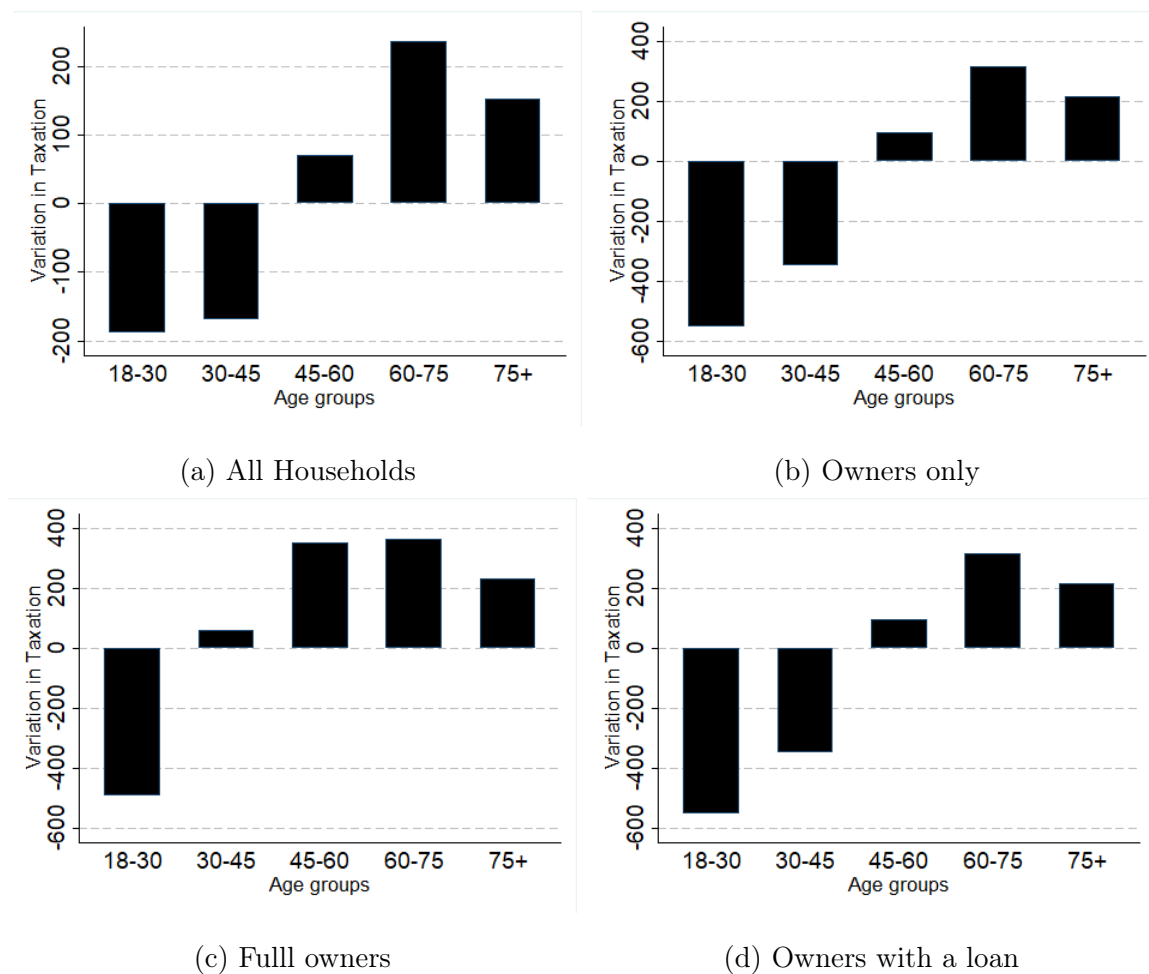


Figure 3.9 illustrates how age groups would be affected by a substitution of the Property Tax with imputed rent taxation for homeowners. As expected, such a subsidy would strongly benefit the youngest and the owners with a loan, given that the youngest have the highest financial liabilities and are on the lowest income brackets. On average young households would benefit from a drop of taxation of around 200 euros while older households would see their taxation level increase by more than 150 euros. The reform would

strongly benefit owners with a loan who would benefit from a drop of 600 euros of their level of taxation. Such a reform would thus constitute a major transfer from the elderly to the youngest households on the short run and could be an interesting response to the increasing wealth inequality resulting from the surge in housing prices. Indeed, when looking at the evolution of the net wealth by age groups as illustrated in Figure 3.11, one can observe that older generations mostly benefit from the appreciation of the housing wealth while younger households' wealth remained almost stable.

This surge in wealth inequalities between generations is also likely to have important consequences on intragenerational disparities through donation and inheritances (Le Bayon et al. (2013)). However, increase in intergenerational and intragenerational inequalities had already started to take place before the unprecedented rise in housing price of the 2000's in France. Courgeau and Meron (1995) state that access to first homeownership in France among the young has decreased since the early 1990's, as suggested by household surveys from the 1970's to late 1990's. Beyond sociological explanations such as longer study periods, delay in marriage and having children, job insecurity since the 1990's has negatively affected first homeownership among the young, specially modest young households increasing intra-generational inequalities.

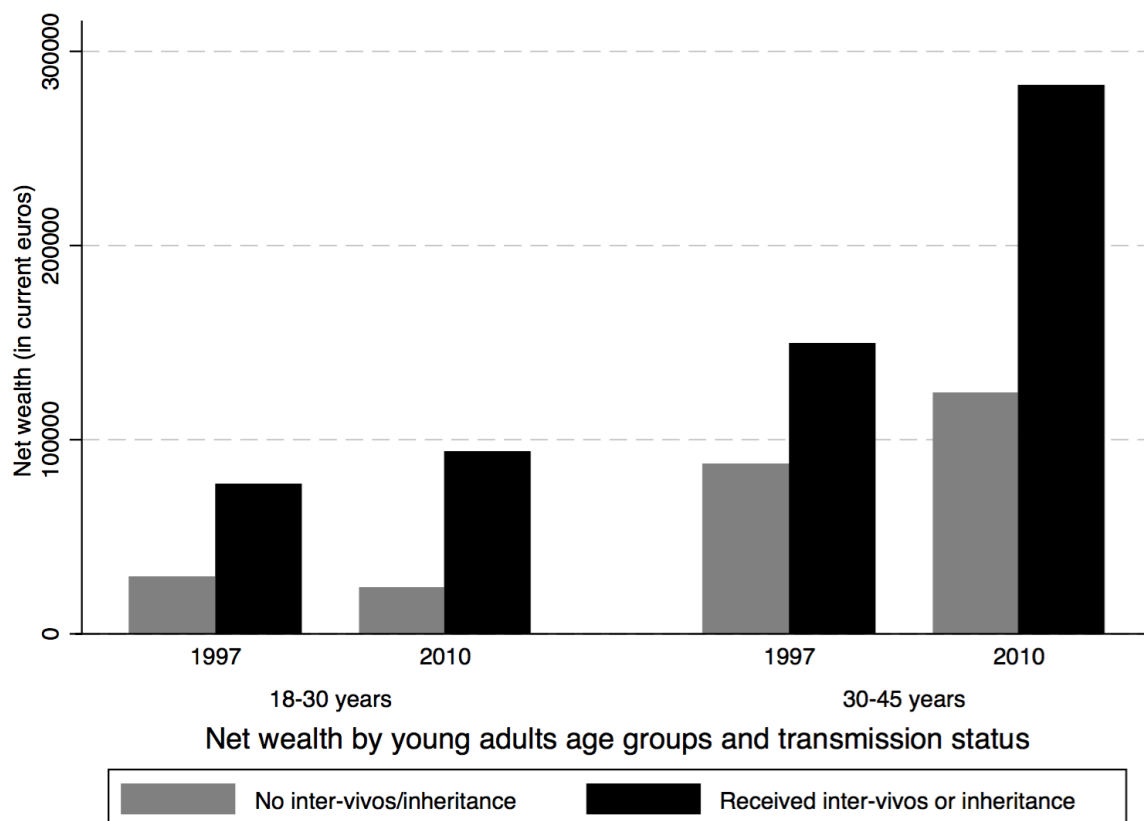


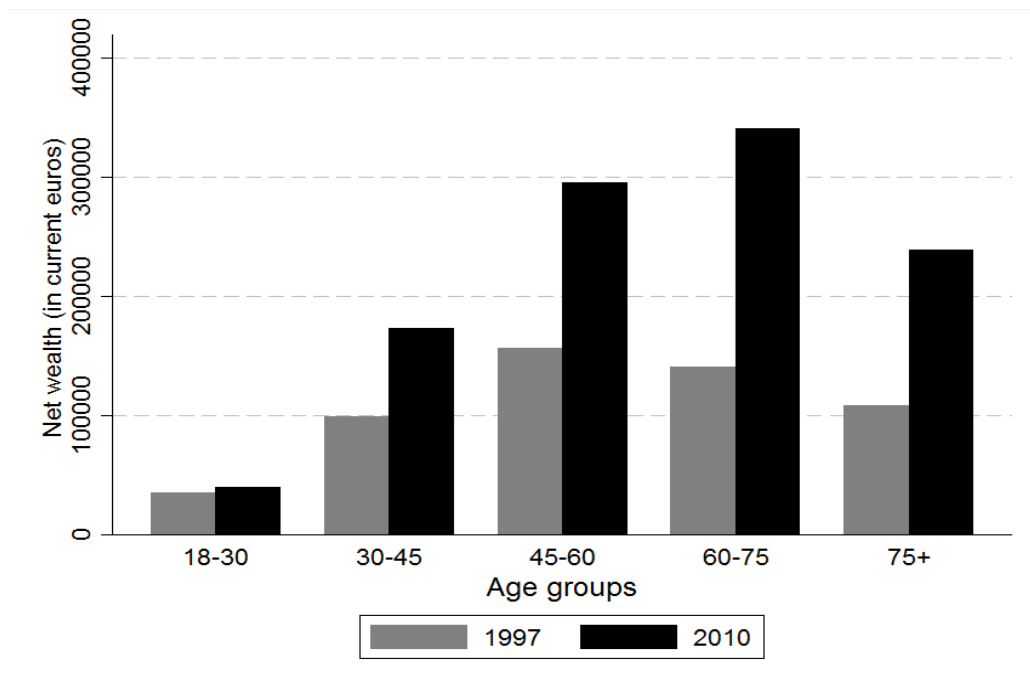
Figure 3.10: Net wealth among young adults according to wealth transmission status

Source: Authors' computations from the French Wealth Survey (Enquête Patrimoine).

In this context, a rise in prices in the 2000's and alleviating fiscal policies since 2006, have exacerbated this trend. For example, Arrondel et al. (2014) show that inter-vivo donations play a key role to allow younger household to buy their main residence and could increase inequalities in the access to homeownership. Moreover, Bonnet et al. (2019) underline that receiving donations leads to a higher chance to access home-ownership, particularly after the increase in housing prices as the relative value of donations with respect to housing prices remained stable. Non-taxation of imputed rents thus results in a subsidy directed to the households who could benefit from these inter-generational transfers reinforcing the income inequalities between heirs and the others households. On this matter, Figure 15 presents data from the French Wealth Survey from 1997 before the

2000's rise in prices and from 2010 that confirms this theory. In fact, net wealth increased for both age groups for individuals having received either an inheritance or donations. However, this increase is particularly high for the 30-45 age group, and between 1997 to 2010. Net wealth of 30-45 year old having received wealth transmission was nearly the double compared to wealth of those not having benefited from donations or inheritances.

Figure 3.11: Evolution of net wealth by age group (1997-2010)



Source: Authors' computations from the French wealth survey (1997 and 2010)

3.4.4 Upper deciles of full right owners are the main beneficiaries

Figure 3.12 represents the distribution of the subsidy by income deciles. One can clearly observe that non taxation of imputed rent mostly high-income households. This is easily explained by two reasons. First, as already mentioned richer households are mostly owners, consume more housing and are less dependent on mortgage funding. Their implicit rent is thus much higher as illustrated in Figures 3.6. Second, it is important to remember that 50% of the French fiscal households are not paying any income tax because their total

income is below the taxation threshold. This casts some doubts on the capacity of such subsidy to increase the homeownership rate, as it benefits mostly richer households who are already mostly owners. Indeed, increasing the home-ownership rate would require programs mostly focused on poorer households who constitute the vast majority of the tenants. However, we acknowledge the case of low-income retirees that have inherited or bought with past revenues high valued property. Providing targeted fiscal measures could avoid affecting the life standard of the latter.

Some remarks arise when looking at these results. As expected, the subsidy mostly concerns full right owners who receive an implicit subsidy of 2,000 euros for the top income decile but only between 500 and 800 euros for the 7th, 8th and 9th richest deciles. Finally, the subsidy received by the lower deciles is below 500 euros and almost null for the two first deciles. As far as owners repaying a mortgage are concerned, the yearly subsidy received for the top income decile is slightly higher than 100 euros. Therefore, most of the benefit is received by full right owners in top income deciles, while owners with mortgage receive almost no subsidy.

3.4. RESULTS

Figure 3.12: Current Implicit subsidy due to non- taxation of imputed rent by income decile

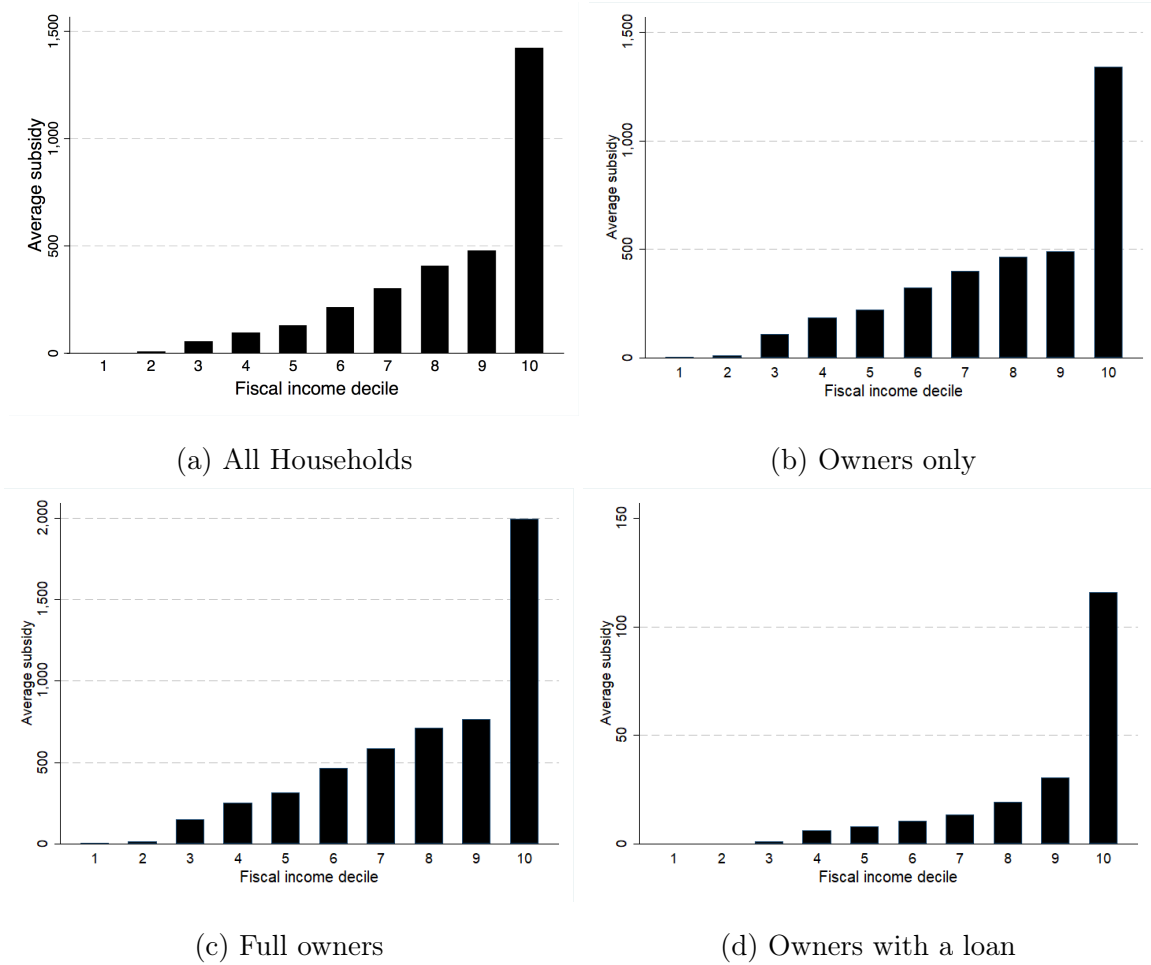
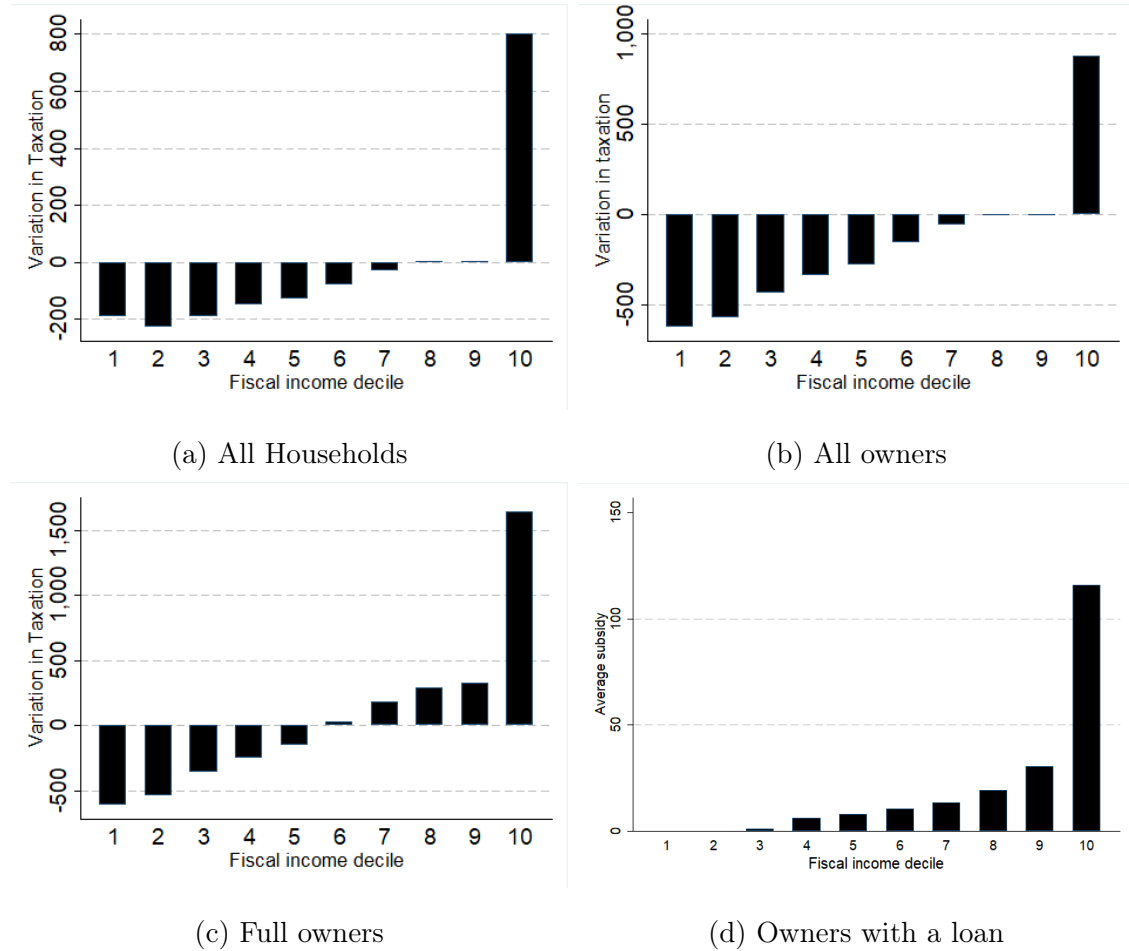


Figure 3.13 illustrates the redistribution between deciles resulting from a substitution of the property tax by the taxation of imputed rent. It is worth noting that such a reform would mostly benefit the five first income deciles, which would see their taxation decrease by 200 euros (500 euros for homeowners of the two first deciles). The reform would be neutral for the deciles 6 to 9 while the 10th decile would see its taxes increase by 800 euros (1000 euros for homeowners). Such a reform would subsidize households where the homeownership rate is the lowest and tax the households with the highest income and homeownership rate.

This fact is of particular interest provided that the lowest income deciles went through a dramatic drop of their homeownership rate. In 1984, 43.6% of the first decile owned their

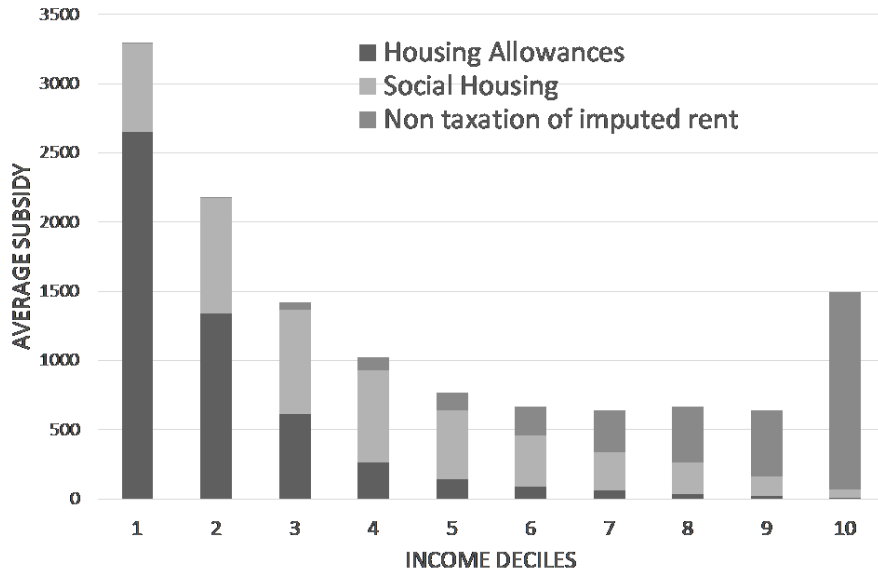
home while only 24.2% did in 2013. On the other hand, the home-ownership rate of the top income decile increased dramatically, from 74.5% in 1984 up to 89.9% in 2013. Abstracting from the general equilibrium effect, one might hope that such a reform could help to improve the access of the poorest households to homeownership and partially mitigate the housing burden of these households. With progressive taxation that accounts for the situation of each household, this substitution could prove more useful than alternate policies supporting home-ownership for low and medium income households. Indeed, additional policies developed in order to decrease the cost of homeownership such as subsidized loans (PTZ) have been proved to be relatively inefficient, having a positive impact on housing prices (Labonne and Welter-Nicol C. (2015)) and resulting to a large extent in a pure windfall effect for potential owners (Gobillon and le Blanc (2008)). One can expect that such a tax scheme would mostly benefit to low- income households by reducing their fiscal burden and reducing the willingness to pay of households belonging to the highest tax income brackets. It remains unclear whether such a reform would reduce housing price as it provides some incentives to finance homeownership with debts. Nevertheless, provided that the reform decreases the benefits of homeownership for the top income decile, one might hope that such a tax scheme could improve the situation of low-income and middle-income households on the housing market.

Figure 3.13: Variation in Taxation when substituting the property tax with imputed rent taxation by income decile



Finally, in Figure 3.14, we represent the redistributive profile of the three main housing policies: Housing allowances, social housing (which benefits was estimated in Trevien (2014)) and non imputed rent taxation. It is worth noting that non imputed rent taxation cancels the redistributive profile of the two previous schemes. If the two first deciles receive the largest yearly transfer (respectively 3,200 and 2,200 euros), the third income decile receives as much at the 10th income decile (around 1,500 euros). Middle class (deciles 4 to 9) receive about 500 euros. While housing subsidies, and in particular housing allowances, are often presented as the main redistributive tool of the French fiscal system, it is worth noting that accounting for non taxation of imputed rents tends to attenuate this view as the top income decile appears to benefit much more from the fiscal devices than deciles 4 to 9.

Figure 3.14: Distributive profile of the three main housing policies



3.4.5 Potential General Equilibrium effects of Imputed Rent Taxation

In this paper we adopted a static framework with no adjustment in agent's behaviour and no general equilibrium effect to estimate the amount of implicit subsidy received by homeowners. This approach is standard in the literature to estimate tax savings (Poterba and Sinai (2008), Poterba and Sinai (2008)) but does not account for the incidence of such a policy. Given the large transaction cost on the real estate market and the low mobility rate of homeowners, one might argue that the estimated tax savings would be relatively close to the actual tax receipts in case of reestablishment of imputed rent taxation in the first years.

In the short run, the substitution of property tax with imputed rent taxation is likely to create some redistribution from the older to the youngest. Few papers tried to estimate the general equilibrium effect of non taxation of imputed rent. One notable exception is Skinner (1996) who builds an Overlapping Generation Model to estimate the efficiency cost of the preferential tax treatment of housing. If the model does not include a tenure choice dimension and has no heterogeneity in income, the efficiency implications of the preferential tax treatment of housing complements our estimates stressing the role of cap-

ital gains. In this framework a preferential tax treatment of housing generates a rise in housing price and thus a windfall capital gain for current homeowners at the expense of future generations who face higher price for the same houses. This description appears to be extremely close to what is described in Figure 3.11. The tax incidence might have magnified the inter generational inequalities that we highlighted. Moreover Skinner (1996) goes beyond the simple redistributive impact of such a tax scheme and shows that such an intergenerational transfer has a large efficiency cost. In a general equilibrium perspective, lower housing price generated by imputed rent taxation should improve efficiency.

From an equity viewpoint, we stressed that imputed rent taxation mostly benefits to the wealthier households. A reestablishment of imputed rent taxation should thus increase the user cost of richer households and decrease the user cost of modest households in case of substitution with the property tax. The net redistributive effect of such a reform accounting for the tax incidence is thus hard to predict as prices and rents might vary on the medium run. If one might expect a drop in real estate price for households in the highest income brackets, prices might also capitalize the subsidy received by low-income households (Hilber and Turner, 2014). The net effect will depend on how segmented housing markets are connected (Piazzesi et al., 2020). Some works as Fack (2005) showed that housing allowances tended to be capitalized into the rent paid by low-income households relative to households not concerned by the policy. This might be particularly true in places where the housing supply is inelastic (Eriksen and Ross, 2015).). This evidence suggests that our estimated redistributive impact of a substitution of property tax by imputed rent taxation might be a lower bound of its true redistributive effect, as prices might vary for different segments of the market. High-income households living in an expansive segment might also experiment capital loss while low-income households living in less expensive neighborhoods might observe a drop in the capitalization rate. This phenomenon could be explained as the result of a possible rise in prices while rents and thus imputed rents might drop.

3.5 Conclusion

In this paper we documented that non-taxation of imputed rent represents a significant amount of fiscal spending mostly directed toward the richest and wealthiest homeowners with no financial liabilities. Imputed rents are as observed in National French Accounts, the major housing subsidy in the country. Moreover, we consider that the recent rise in housing prices of the 2000s that led to a divergence of wealth between older and younger generations should re-open the debate on the opportunity to restore a tax on land through imputed rent taxation.

Throughout our computations thanks to the Taxipp model, while re-including imputed rent taxation in the income tax base as before 1965, we find that the suppression of a subsidy mainly captured by the top income deciles should not affect owners with mortgage and thus should not be detrimental to homeownership access. In addition to this, further simulations allowed us to account for a scenario with a potential substitution of the current property tax by imputed rent taxation. Our results show that this change in taxation would lower current taxation for the four most modest deciles and emerge as a much more viable policy option that would increase taxation at a lesser extent for the remaining deciles.

Finally, concerning a broader discussion on inter-generational inequality, discussing imputed rent taxation could help improve inter- and intra-generational equity. In fact, a new set of policies including imputed rent taxation could to a certain extent stop subsidizing the wealthier households that benefited from unprecedented capital gains in the 2000s. Thus, creating inter-generational inequalities that are perpetuated through the inter-vivos donations or inheritances transmitted to their relatives, reinforcing intra-generational inequalities, as depicted for France by (Bonnet et al., 2019). However, as inter and intra-generational inequalities are rising worldwide, this assessment goes beyond our country case study.

3.6 Appendix

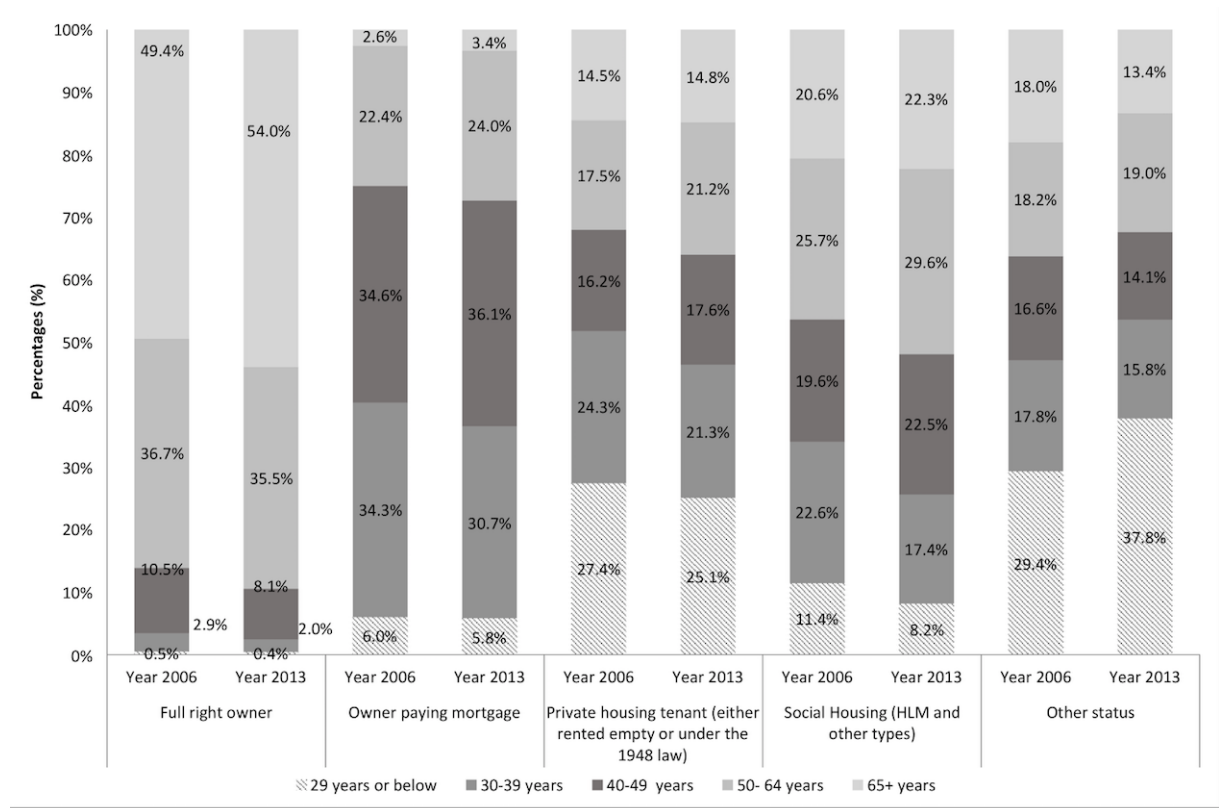


Figure 3.15: Homeownership status by age groups

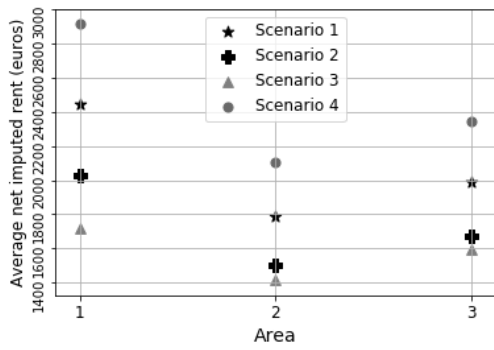
Source: Authors' computations from the French housing survey (Enquête Logement) 2006 and 2013.

Stacked bars above represent the evolution of homeownership status by age groups between 2006 and 2013. The left axis accounts for the percentage of each age group within each homeownership status either in 2006 or 2013.

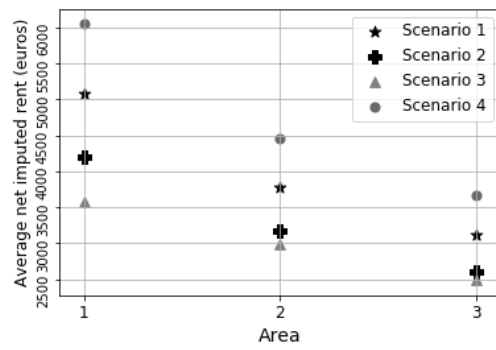
Contributors	Amount of TFPB	percent
Owners with mortgage	3.392	19.8%
Owners outright	6.767	39.49%
Landlords	2.815	16.4%
Social Housing	2.094	12.2%
Others	2.063	12%
All	17.137	100%

Table 3.6: Property Tax income by source

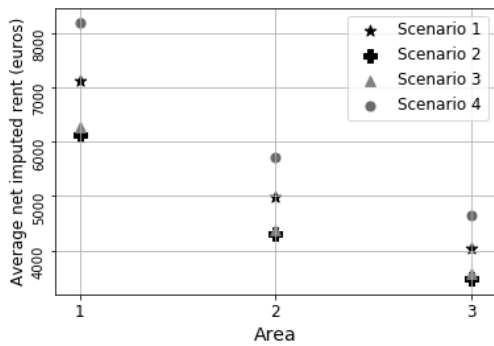
Figure 3.16: Net Taxable Imputed Rent by area



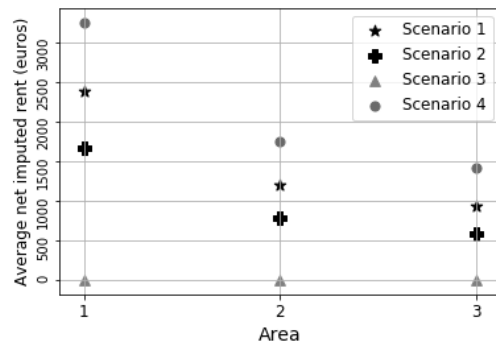
(a) All Households



(b) All owners



(c) Full owners



(d) Owners with a loan

	All	Never taxed	Become taxed	Always taxed
Weigthed Number	35 55 9744	13 023 974	1 826 081	20 709 694
Average imputed rent	2750.89	1374.63	5266.81	3394.55
Average tax without imputed rent	1505.73	0.00	0.00	2585.42
Average tax with imputed rent	1780.99	0.00	291.69	3032.34
Average tax savings	275.26	0.00	291.69	446.92
Demographics				
Married (%)	35.88	22.20	34.25	44.63
Women (%)	45.27	26.37	31.36	58.39
average age	48.27	45.39	61.15	48.94
Age Groups				
18-30 (%)	20.98	27.93	10.01	17.57
30-45 (%)	28.33	30.27	14.20	28.35
45-60 (%)	24.28	19.01	18.22	28.13
60-75 (%)	14.51	10.41	26.90	15.99
> 75 (%)	11.90	12.38	30.67	9.95
Area				
Area 1 (Paris) (%)	13.28	9.27	7.24	16.34
Area 2 (other agglomerations) (%)	32.83	34.30	28.22	32.31
Area 3 (others) (%)	53.89	56.43	64.54	51.34
Gross Income Deciles				
1	10	27.47	0.01	0.00
2	10	26.67	3.32	0.00
3	10	20.48	25.47	2.04
4	10	10.43	25.82	8.33
5	10	6.73	21.44	11.05
6	10	3.90	14.61	13.43
7	10	2.36	4.13	15.32
8	10	1.20	2.56	16.19
9	10	0.43	1.51	16.77
10	10	0.32	1.13	16.87

Table 3.7: Descriptive statistics of beneficiaries' socio-demographic traits

Chapter 4

Pension Reform & indebtedness among the elderly: a struggle for keeping up with consumption levels?

4.1 Introduction

Macron's 2019 government proposal for pension reform has placed retirees' living standards at the center stage of a heated political debate. A comprehensive understanding of this link has been an ongoing topic in economic literature after major OECD economies such as France, Germany or Italy have launched since the early 1990's, a series of pension reforms in a difficult economic environment of high unemployment and low growth to face growing public deficits and increasing dependency ratios. Therefore, whether these changes in retirement schemes have affected living standards of retirees or soon-to-be retirees is of great interest. The individual responses to these shocks are also of capital importance.

During the last two decades, many scholars have underlined a positive correlation between age and financial distress through a decrease in net worth and an increase of poverty risk. This phenomenon was observed for non redistributive pension systems as depicted by Hardy (2009) and Lee (2004) for the United States. Evidence on financial strain among

European retirees with historically redistributive bismarckian pension systems has also been provided by scholars such as Litwin and Sapir (2009) who conclude that one third of soon to be retirees and pension recipients in twelve European countries have difficulties making ends meet. This issue raises questions to which extent pensions reforms have added further pressure to social safety-nets as pension benefits and their conditionality has become more restrictive to make the system financially sound. In this vein, the scope of this paper is to assess to which extent indebtedness levels among the elderly have been affected by the last two pension reforms in France (1993 Balladur Reform and 2003 Fillon Reform).

As studied by economic literature in the last decades, to which extent access to credit among seniors constitute a means to smooth economic shocks is at the heart of the economic debates on the adequacy of old-age financing resources. In this respect, Montgomerie and Johnna (2011) explored the rising indebtedness of young adults and senior citizens as a result of slow growth and rising health expenses during the credit bubble that lead to the 2008-2009 financial crisis in the United States. Moreover, Christelis et al. (2009) examine debt rates among seniors in eleven European and point at high levels of debt in France, Switzerland and Scandinavian countries.

Indebtedness levels among the elderly have been rising in France during the last three decades as shown by Wealth Surveys from 1986 to 2014 (Botey and Direr (2018)). Indebtedness among 60-70 year-olds increased continuously from 22.8 % in 1986 to 39.5 % in 2010, registering a slow drop in 2014 at 37.37 %. This increase in indebtedness levels is also observed among the +70 year olds: 2.49% were indebted in 1986 compared to 11.39% in 2014. These figures suggest that retirees' demand for credit has been stronger in the last years than twenty years ago. When looking at descriptive statistics in Section 5, general debt among the elder (both private and professional) shows that after the 1993 Balladur Reform and the 2003 Fillon Reform this trend continues steadily. Moreover, this increase in debt rates has been also accompanied by a larger offer by banks in terms of financial products for seniors. For example, in 2016 banks such as Banque Populaire designed loans for purposes such as residential refurbishment or even buying a car for grandchildren. In

the same vein, Crédit du Nord has started an innovative program so that clients over 40 have access to a banking counselor that has been strikethrough especially trained to deal with retirement planning and care dependency associated costs. Within this context, insurance premium for the elderly, even if still higher compared to those for younger clients, have adapted its costs for cohorts that have higher life expectancy in good health and, therefore has, different reimbursement profiles compared to previous generations.

The French pension system has undergone a set of major reforms since 1970's, which included two decades of expansion of pension benefits and coverage since the same decade such as decreasing retirement age in 1983 and Maastricht Treaty requirements to contain fiscal deficits in 1992. The 1993 Balladur Reform targeted private workers and independent aligned regimes to the General Regime, including changes in contribution lengths and evolution of pension's growth. This reform was followed by the Fillon Reform in 2003 that extended the previous reform to public servants after a failed attempt during the Juppé government in 1995. Later on, the Woerth Reform in 2010 increased the contribution length to 43 years of contribution.

Since the 1993 Fillon and the 2003 Balladur Reforms have been the most substantial reforms in the last three decades, this paper aims to provide some innovative evidence through a difference-in-difference approach (DID) to assess the link of indebtedness and pension reform within a Pay-as you Go redistributive pension system. Following Blake and Garrouste (2019), concerning the evaluation of the 1993 Balladur Reform, we take public sector and liberal regimes as control groups. We then apply this same strategy of evaluating the 2003 Fillon Reform, taking the private sector as the control group. Our results underline the educational divide in the effects of pension reforms, following Blake and Garrouste (2019) and suggest that the least educated bear the burden of these reforms. Moreover, it must be noted that a significance is also found among those not having had financial difficulties in recent years in spite of still being creditworthy. However, some significance among the highly educated for mortgage and refurbishment loans, including for those having financial difficulties is found in the 2003 Fillon Reform.

The article is organized as follows: Section 4.2 provides a review of the existing literature of indebtedness levels and economic frailty among the elderly in recent decades. Moreover, Section 4.3 attempts to clearly explain the policy design of these reforms and how the 1993 Balladur Reform and the 2003 Fillon Reform affected gradually affected cohorts born between 1934 and 1943 and cohorts born between 1944 and 1954 . Section 4.4 goes through the description of the 2004 and 2014 French Wealth Survey and explains Blake and Garrouste (2019) identification strategy. Section 4.5 presents results from our impact evaluation framework using a DID (for both the 1993 Balladur Reform and the 2003 Fillon Reform. In order to verify our results, Section 4.10 will go through placebo tests to provide robustness checks. Finally, Section 4.7 discusses results from the previous section in order to set differences and similarities when comparing the 2004 and 2014 Wealth Surveys.

4.2 Literature review

Literature review on economic frailty among the elderly in OECD countries underlines trends in recent decades. This phenomenon has affected baby boomers in spite of common beliefs of being considered the most privileged cohorts of the last century. When looking at international experiences of pension reform in the last twenty years, nor there seems to be no consensus about effects on retirees' financial strain, nor it has been a very explored topic.

4.2.1 Life cycle theory at glance: growing financial frailty at both ends of adulthood

According to the life cycle theory, the household demand for credit decreases with age as depicted by Modigliani and Miller (1963). Income debt-ratio among young adults (usually fresh new homeowners) is expected to be high compared to older groups who have accumulated wealth during their working life and have usually paid off mortgage. However,

these trends have evolved in recent years and have led to greater indebtedness within both ends of adulthood: young adults who enter the labor market and senior citizens that are either still reimbursing loans or acquiring new ones at the verge of or during retirement. A rigid and insecure job market and the unprecedented rise in prices in the real estate market for the youngest group of adults, as well as a degradation of living standards account respectively among the oldest households account to a large extent for these changes.

Population ageing has increasingly encouraged economic literature to devote attention to the issue of financial resources, consumption smoothness and economic frailty among the elderly. In this respect, economic frailty and financial strain among senior citizens are issues that have gradually gained importance as pension systems sustainability seem compromised through two different channels: 1) early baby boomers reached the verge of retirement during the early 2000's and 2) life expectancy has steadily increased in developed economies in the last century. Whether indebtedness rates among retirees have come as a response to these economic shocks is at the heart of the debates on the adequacy of old-age financing resources.

4.2.2 Indebtedness rates and financial frailty among the elderly on the rise since the 1990's

Litwin and Sapir (2009), use the 2004 SHARE survey to assess perceived financial distress among 50-year-olds and older in twelve European countries while looking at pension and private wealth of this age group. Results show that 38% of older households in Europe, and specifically 34% of older French households declare having difficulties making ends meet, a trend that diminishes within respondents 80 years and older. Moreover, they find that low financial wealth for all cohorts and pessimistic financial expectations are good predictors of financial frailty. Similarly, Bierman (2014) uses data from the *Aging, Stress and Health (ASH)* study from three longitudinal waves between 2000 and 2004 and shows that age is positively related to financial strain when age and cohort effects are dissociated while using growth curve modeling. Findings show that while age-related increases

in financial difficulties are stronger among women and individuals with lower education levels, they are weaker when individuals were born substantially before or at the end of the Great Depression of 1929 . This is in line with Lee et al. (2007) who declares that the pre-baby boom generation has been the most fortunate senior generation in recent history.

In this vein, Christelis et al. (2009) specifically examine debt rates in eleven European countries among respondents aged 50 years old and over using data from the 2004 SHARE Survey. As a result, they find that the fraction of households with non-mortgage debt is quite large in France and significant in Scandinavian countries and Switzerland where mortgage debt is also especially high. Moreover, more than 20% of French respondents who reported economic difficulties have at least one type of debt, a figure that is only surpassed by Scandinavian countries and Switzerland. Overall, their analysis suggests that, in countries where financial markets are less developed, debt is less likely to be used as an instrument to smooth economic shocks and maintain consumption levels during old age.

These European trends echoed a similar increase in indebtedness rates in the United States among early-boomers on the verge of retirement. Copeland (2006) analyzes the evolution of the financial situation of individuals 55 years and older using the Federal Reserve's Survey of Consumer Finances (SCF) between 1992 and 2004, targeting individuals both at the verge of retirement and retirees. Results show that senior debt levels rose sharply among the oldest households and especially among the most economically vulnerable putting at risk their most important asset: their home. Likewise, Anguelov and Tamborini (2009) point out how near-retirees in 2004 (the early baby-boomers) had more consumer and housing debt than their counterparts in 1995. These findings match Wolff (2002)'s results on observed lower levels of wealth among early baby-boomers compared to previous cohorts at the verge of retirement.

Moreover, Lee et al. (2007) analyze the determinants of indebtedness using the 2000 Health and Retirement Study (HRS). They conclude that older individuals in larger households, aged 65-74 and married had a higher probability of holding debt. Moreover, when the individual had already consumer or mortgage debt, the probability of also holding the

other kind increased. In the same vein, Lusardi and Mitchell (2014) examine individuals aged 56-61 using three waves of the HRS (Health and retirement study) 1992, 2002 and 2008 and National Financial Capability Study (NFCS) in order to analyze cross-cohort changes over time. Findings conclude that early baby-boomers have higher amounts of debt in particular because they have bought more expensive homes with smaller down payments. This could be explained by a less risk-averse attitude of baby-boomers toward engaging in costly loans and financial operations. Individuals at higher risk of financial vulnerability are those who have more numerous families and are exposed to financial shocks which underline the need for further financial literacy among these latter.

4.2.3 Baby-boomers massive retirement waves have reinforced this sustained trend of indebtedness

More recent studies have underlined the severity of this phenomenon in Europe. Anioła-Mikołajczak (2017) shows for Poland that the risk of over-indebtedness increased in particular among elder citizens. In addition to this, Majamaa et al. (2019) tackle this issue using 2013 data for Finland and conclude that despite it being young adults who are the most hit by over-indebtedness, middle-aged debtors aged 55 years and older seemed to increasingly incur in indebtedness problems. Moreover, seniors 65 years and older represented a non-negligible fraction in consumption debt arising from telecommunications services, credit card indebtedness, lending companies and larger consumer loans. Widowhood, retirement and divorce prove to be for both categories an income shock that makes older households more vulnerable to over-indebtedness.

In the same line, Lusardi et al. (2020) show, using the 2018 National Financial Capability Study, that a sizable fraction of older Americans still carry debt today, especially in the form of student loans (either for themselves, a partner or descendants) and unpaid medical bills. Moreover, socio-demographic determinants such as having children, being a woman or being “nonwhite” also play a major role in debt rates. Lack of financial literacy is underlined also as a key determinant regarding debt vulnerability. Additionally, while

comparing the hardship in old age of near-retirees in the mid- 1990's to that of the same age group in mid-2010's in the United States using a two decades longitudinal survey from the Health and Retirement Study. Thanks to findings concerning the evolution of the financial situation of the first cohort during their 70's and 80's, they predicted the potential outcomes for the late middle-aged adults in the mid-2010's and asserted that higher economic vulnerability was expected among these latter, especially among men.

4.2.4 Pension Reforms seem to have mixed effects concerning retirees' financial strain

Pension reforms' effect on late-adulthood poverty and financial strain has been a widely discussed issue in particular in European countries with redistributive Pay-as-you go systems as is the case of the French Pension System. In this vein, Hershey et al. (2010) examine income worries and saving practices using the 2005 European Social Survey within 19 European countries. Individual-level socio-demographic characteristics set aside, a country-level effect can be observed in terms of income worries toward the future among soon-to-be and early retirees, especially in countries with high income inequality or strong projections on population ageing. Conversely, this effect is not verified when focusing on saving rates or pension age reforms.

Moreover, Alessie et al. (2013), using the second wave of SHARELIFE 2006-2007, estimate whether and to what extent elder European households substitute pension wealth by private savings. Their findings suggest that marginally for each euro, a 47-61 cent decline is observed in private wealth, in particular in Mediterranean and Easter European countries. However, this result is not found to be true for the low-educated who do not show this displacement.

4.2.5 The link between credit and pension reform has not been explored in previous assessments of the Balladur and the Fillon Reform

Scholars have studied in the last decades the effects of pension reforms in Europe. These reforms have been launched as both the result of ageing population and a response to deficit requirements and premises enacted by the Maastricht Treaty (1992). Assessments of French pension reforms that have taken place since 1993 have focused mainly on the analysis of financial losses undergone by cohorts affected by both 1993 Balladur Reform and 2003 Fillon Reform. For instance, Bridenne and Brossard (2008) estimate pension replacement levels in a hypothetical counterfactual scenario where the Balladur Reform had not taken place. They find that the reform through replacement rates alone triggered pensions by 9% and had an accumulative indexation effect on inflation of 8% between 1993 and 2003. In the same vein, Debrand and Privât (2006), based on a micro-simulation approach conclude that the 1993 Balladur Reform reached its goal of lowering pension levels, especially for the lowest pensions, but modified only marginally the number of retirees as the pension age slightly changed.

In addition to this, other authors have analyzed the socio-demographic inequalities produced by these reforms. Bonnet et al. (2006) examine consequences on gender inequalities driven by the 1993 Balladur Reform and 2003 Fillon Reform using micro-simulation tools and data from the private sector. Results show that, given replacement rates are estimated using the best 25 years of contributions (it previously concerned the best 10 years), gender gaps have widen since women suffer already from disadvantages linked to career gaps arising from raising kids. Finally, Blake and Garrouste (2019), evaluate the impact of the 1993 Balladur Reform on health using the French Health Barometer (*Baromètre Santé*) concluding that the impact on perceived health is negatively significant among the low educated.

However, in spite of these insightful findings no assessment has yet been made on the

indebtedness rates of retirees following both the 1993 Balladur Reform and the 2003 Fillon Reforms. An impact evaluation of these pension reforms on debt levels among retirees would allow a better understanding of the consequences of pension reforms on old-age financing within a Pay-as you Go such as the French Pension System. Simultaneous increase of debt levels and the launch of two major reforms affecting first the private sector and aligned regimes at first through the 1993 Balladur Reform and later on public servants through the 2003 Fillon Reform motivate our analysis.

4.3 The design of the French Pension System Policy Reform

4.3.1 The French Pension System before the Balladur and Fillon Reforms

After the creation of the system in 1945, numerous reforms were launched to make the system more generous. For instance, the 1971 Boulin Reform increased replacement rate levels and the 1983 Reform during the Mitterrand government which lowered retirement age from 65 years old to 60 years old.

Equation 1 presents the three variables on which depends the pension level P of the soon-to be retiree. PC corresponds to the *pro rata* coefficient and $W_{ref}(1)$ to the wage reference level.

$$P = \tau * PC * W_{ref}(1)$$

with minimum pension $\leq P \leq$ maximum pension limit

Until 1993, at 60 years old, with 37,5 years of contribution, full replacement rate was at 50 %. Moreover, for those individuals that did not have enough quarters, this rate was reduced by 10 % (minus 5 points by year) by missing contribution years or if more advantageous for the worker, by missing years to reach 65 years old.

Therefore, if the contributor worked until 65 years old, he would get full replacement rate even if the number of required trimesters is not complete.

These rules are summarized in the following formula:

$$\tau = 0.50 * [1 - \delta * \max\{0, \min[(65 - \text{retirement age}), \frac{N_1, 2 - D}{4}]\}]$$

δ represents the discount fixed at 10 % in 1971. N represents the minimum contribution length for full pension and D stands for the career length of the individual (the actual number of contributions) in each regime. Before 1993, N_1 and N_2 were both set at 150 quarters. τ is the minimum pension value which was set at 25 % replacement rate.

4.3.2 The 1993 Balladur Reform: private sector and associated regimes

The Balladur Reform only targeted private sector employees and associated independent regimes of farmers, craftsmen and traders. Table 4.1 describes the different dimensions of this reform. The reform had three different channels:

1. **Longer contribution needed:** 160 quarters contribution required for full replacement rates: starting with THE cohort born in 1934, every cohort born until 1943 had to contribute an additional quarter with respect to the previous generation. However, it must be underlined that for aligned regimes with the General Regime (MSA, ORGANIC, CANCAVA), this measure was adopted more progressively: one quarter every two generations, reaching 160 quarters in 2013.
2. **Reduced benefits:** lower replacement rates instead of taking the best 10 years of contributions the reform calculated pension replacement on the best 25 years of contributions.

3. **System indexation:** This measure has an immediate effect on the pension level of retirees as past salaries earned are not indexed on salaries growth but on inflation, which directly affects the level of the pension when past salaries are brought to present value. Moreover, long and medium term slower pension growth since living standards were affected through lower pension benefits since they are no longer pegged to salaries.

Equation 1 could now be expressed as follows:

$$P = \tau * \min\{1, \frac{D}{N_2}\} * W_{ref}(3)$$

And Equation (2) for the private sector now looks like:

$$\tau = 0.50 * [1 - \delta * \max\{0, \min[(65 - \text{retirement age}), \frac{N_1 - D}{4}]\} \quad (4)$$

At this point, N_1 (Contribution required for full pension for General Regime (Private sector and aligned regimes (MSA,ORGANIC,CANCAVA)) changes every year for generations born between 1934 and 1943 in the private sector, each generation having to contribute an additional quarter with a target of 160 quarters in 2003. For the remaining regimes (independent workers with more volatile revenues) as stated before, this measure was applied more gradually through an additional quarter every two generations starting with generation born in 1934.

4.3.3 The 2003 Fillon Reform: public sector and liberal professions

The 2003 Fillon Reform during the Raffarin government, which could be seen as the extension of the 1993 Balladur Reform, as it finally applied these measures to public servants after failed attempts by the Juppé Government in 1995. Some minor reforms were also addressed to the private sector.

1. **Longer contribution needed:** 160 trimesters contribution needed for full replacement rates: starting with cohort born in 1944, every cohort until cohort born in 1948 had to contribute two additional quarters with respect to the previous generation. The target by 2008 was to homogenize contribution length between private and public sectors. Cohort born in 1944 will contribute two extra quarter, cohort born in 1945 will work four extra quarters, cohort born in 1946 six extra quarters, cohort born in 1947 eight extra quarters until cohort born in 1948 will remain 10 extra quarters in the workforce.

Moreover from 2009, when the cohort born in 1949 turns 60, each new cohort both from the private and public sector also attaining retirement age, will need to contribute an additional quarter until reaching 164 quarters in 2012 (41 years of contribution).

2. **System indexation:** This measure has an immediate effect on the pension level of the retiree as past salaries earned are not indexed on salaries growth but on inflation, which directly affects the level of the pension when past salaries are brought to present value. Moreover, long and medium term slower pension growth since living standards were affected through a slower growth in terms of pension benefits since they are were no longer pegged to salaries.
3. **Further incentives for working longer in both regimes** Individuals at the verge of retirement from both regimes are offered a bonus in order to encourage them to stay in the workforce. After having completed the mandatory number of contribution quarters, a 3% increase in replacement rate will be given per additional year worked.

And Equation (2) for both the private and public sector now looks like:

$$\tau = 0.50 * [1 - \delta * \max\{0, \min[(65 - \text{retirement age}), \frac{N_{1,2}-D}{4}]\} + \\ s * \max\{0, \min[\text{Age} - 60), \frac{D-N_{1,2}}{4}, \text{PensionYear} - 2004\} \quad (5)$$

δ which is the discount when the individual has not reached the required number of contributions) is not fixed at 5% as for the private sector.

Targeted Regimes	Retirement Age	Full contribution length	Pension Formula	Indexation
General regime & aligned regimes: Private Sector, Traders(ORGANIC), Agricultural employees (MSA), Craftsmen (CANCAVA).	60 years old (unchanged) for full pensions if 160 quarters completed	Target: 160 trimesters in 2003 Transition: 1934-1943 cohorts One extra quarter progressively per cohort compared to the previous cohort*	Best 25 years of contribution (Best 10 years before)	On inflation (previously indexed on salaries)

Table 4.1: Measures comprised within the Balladur Reform. (1993).

Targeted Regimes	Retirement Age	Full contribution length	Pension Formula	Indexation
Public Sector including employees from the Health System	60 years old (unchanged) for full pensions if 160 quarters completed	Target: 160 quarters in 2008 Transition: 1944-1948 cohorts Two extra quarters progressively per cohort compared to the previous cohort	No changes in last 6 months of salary calculation	On inflation (previously indexed on salaries)

Table 4.2: Measures comprised within the Fillon Reform (2003)

**For aligned regimes (ORGANIC,MSA, CANCAVA) it increased by one trimester every two cohorts.*

4.4 Empirical Strategy and Data

4.4.1 Identification strategy

As implemented by Blake and Garrouste (2019) for health outcomes depicting the effects of the 1993 Balladur Pension Reform, the empirical strategy in this analysis to assess indebtedness rates is a Difference-in-Differences approach using a logit model. We examine the shift in the probability of being indebted as an effect of the 1993 Balladur Reform by comparing the difference between the private sector and its aligned regimes, compared to the public sector and liberal regimes not affected by the change in legislation. This approach is a difference-in-differences method based on birth cohorts instead of time spans since the reform impact depends on the year of birth. A causal effect is identified of the pension reform under the following assumption: without the reform, differences between generations treated and untreated individuals would have been the same in the public and private sectors.

Since the paper's aim is to assess the consequences of the 1993 Balladur Reform and the subsequent Fillon Reform of 2003 on indebtedness, two waves are used: the 2004 Survey and the 2014-2015 survey for the cross-sectional analysis at the household level. In this sense, concerning the 1993 Balladur Reform (effective in 1994) individuals in the treatment group (concerning private sector and independent regimes) ¹ were affected by the 1993 reform 1-10 years before the 2004 Survey. The first cohorts affected by the reform were those born in 1934 as they were entitled to retire at 60 years old in 1994, up until the 1943 cohort who reached legal age of retirement in 2003. However, we conduct our analysis until cohort born in 1941 as one third of the 1942 did not claim their pension benefits Gabin Langevin (2019).

Likewise, when assessing the effects of the 2003 Fillon Reform (effective in 2004) using the 2014 Wealth Survey, cohorts born between 1944 and 1954 are evaluated. At this time, the

¹Independent regimes involved: 1) MSA (Mutualité sociale agricole) for agricultural employees 2) CANCAVA for craftsmen 3)ORGANIC for Industrials/Traders.

control group is composed of private sector employees. However, with the “point system” regime created for liberal professions in the 2003 Fillon Reform, as well the creation in 2006 of a new regime for independent workers from MSA, CANCAVA and Organic, called the RSI (Régime Social des Indépendants), they are withdrawn from the second analysis using the 2014 Survey.

Thus, seniors in a given sector have not experienced other shocks that could affect household indebtedness rates. On this respect, as pointed out by Blake and Garrouste (2019), the 2005 French Labor Force Survey (*Enquête Emploi 2005*) shows that only very few people moved from the private to the public sector before retirement. This is also confirmed while looking at the *Enquête Emploi 2014*. As security in employment is different within the private and the public sector, the vulnerability of lending profiles differ between both sectors, theoretically easing access to credit among public employees even at the verge of retirement. However, statistics show that before the 1993 Balladur Reform, demand for credit was very similar between these two sectors as shown in 4.3. Moreover, as outlined by Blake and Garrouste (2019), among the differences that could be discussed between these two sectors, pre-retirement policies are only applied to the private sector. However, as the authors note, pre-retirement rules were particularly modified before the 1990’s but not for generations retiring after 1998.

Concerning the treatment groups, the Balladur Reform did not apply equally to all generations born between 1934 and 1943. In fact, individuals in the treatment groups are affected differently by this contribution length policy, which is not the case for the inflation indexation dimension of the reform that affected all retirees in the same manner. For instance, the 1934 cohort from the private sector and associated independent regimes had to work 151 quarters (one quarter more than the 1933 cohort), the 1935 cohort had to contribute a total of 152 quarters (two additional quarters), the 1936 cohort had to complete 153 quarters (three additional quarters) and so on. The 1943 cohort had to contribute 160 quarters (ten more quarters compared to the cohort born in 1933). Moreover, with the 2003 Fillon, the first cohort born in 1944 was forced to work two extra quarters, the cohort born in 1945 had to contribute four extra quarters, the 1946 cohort

six extra quarters, the 1947 cohort eight additional quarters and the 1948 10 additional quarters. From 2008, all workers from both sectors could only retire with full pension benefits if they had completed 160 quarters.

Difference-in Differences for 1993 Balladur and 2003 Fillon Reform

We estimate

$$Y_i = \beta_0 + \beta_1 T(\text{Balladur/Fillon})_i + \beta_2 P_i + \beta_3 T(\text{Balladur/Fillon})_i * P_i + \beta_4 X_i + \mu_i \quad (4.1)$$

where Y_i is the indebtedness dummy for an individual ($T(\text{Balladur/Fillon})_i$ is a dummy variable taking the value of 1 if individual is treated (i.e., born between 1934 and 1941 for Balladur Reform and born between 1944 and 1954 for the Fillon Reform) and value 0 if in the control group (i.e., born between 1929 and 1933 for the Balladur Reform and born between 1939 and 1943 for the Fillon Reform). When assessing the Balladur Reform, P is a dummy variable taking value 1 if individual $_i$ was in the private sector or the associated independent regimes (MSA, CANCAVA, ORGANIC) to the General Regime and value 0 if individual was in the Public Sector or the Liberal Professions Regime (CNAVPL). On the other hand, when tackling the Fillon Reform, P is a dummy variable taking the value 1 if an individual was in the Public Sector and value 0 if an individual was in the Private Sector. For both reforms, X is a set of controls (including gender, marital status, household size, number of children, homeownership status, socio-professional category, an unexpected expense, financial difficulties, regional area, pension recipient, age).

We conduct placebo tests i) on older individuals who are not impacted by the reform, as well as ii) on younger individuals who are impacted by the reform in the same way (Section 4.10).

However, as we are specifically measuring the link between pension reform and indebtedness, the extension of the indexation of pensions to the public sector in 2004 is the main change we are evaluating. Nonetheless, one must note that the use of a difference-in-difference approach in non-linear models has been a source of debate among economists in the last decades. On one hand, Norton et al. (2004) underline that interaction terms using logit models are often misleading when focusing on the log odds coefficients as one would do with OLS regressions. However, Puhani (2012), argues that this point is not the main issue, as the cross difference is not equal to the treatment effect, which is the parameter of interest.²

4.4.2 The French Wealth Survey (2004, 2014)

The database used throughout this paper is the French Wealth Survey (Enquête Patrimoine) conducted every 4-6 years starting in 1986 by the French Statistics Institute INSEE (Institut National de Statistiques et des Etudes Economiques). It not only contains information on the respondent's wealth, indebtedness by type of debt, but also on their self-perceived financial situation and socio-demographic characteristics.

Main Variables of interest

Table 4.3 and Table 4.4 display means of main variables within our analysis for pre-trend cohorts for both treatment and control groups when assessing the Balladur and Fillon Reforms. Socio-demographic characteristics such as gender, skilled worker (regardless of diploma), homeownership, financial difficulties, highly educated and if living in an urban area.

²In fact, the sign of the treatment effect is equal to the sign of the coefficient of the interaction term of the time and treatment group indicators with a strictly monotonic transformation. However, in the case of logit models the treatment effect is described simply as the incremental effect of the coefficient of the interaction term. On this matter, the Stata command *Margins* addresses this issue and allows to calculate average marginal effect of pairwise comparisons between treatment and control groups.

Debt is measured throughout all waves of the French Wealth Survey through binary variables that state whether the individual has contracted debt or not. The main results of this paper are constructed using private debt (*Dette privée*)³ as our main variable as less than 1% of respondents of cohorts under study in both rounds have past professional debt and a percentage even smaller accumulates both debts. For this reason, the main focus of analysis will be private debt as senior employment among retirees in France is very low which explains why professional debt is low among seniors. Table 4.3 shows a lower level of indebtedness among private employees respect to private employees for the last cohorts not affected by the 1993 Balladur Reform. Conversely, debt levels seemed similar between private and public sector cohorts before the 2003 Fillon Reform. The overall share of respondents having financial difficulties increased between the 2004 and the 2014 waves of the French Wealth Survey.

³Private debt for a household is described within the French Wealth Survey as "Household having acquired debt for private matters"

Sector	Public Employee	Private and aligned regimes
Group	Control (Col 1)	Treatment (Col 2)
Private Debt	0.159	0.136
Sex	0.693	0.714
Skilled Worker	0.594	0.398
Homeowner	0.807	0.788
Financial difficulties	0.131	0.189
Highly educated	0.510	0.204
Urban area	0.578	0.453
Observations	192	518

Table 4.3:

Descriptive statistics for Balladur Reform-Pre-trend group (cohorts 1929-1933). This table reports descriptive statistics for retirees belonging to cohorts born between 1929 and 1933 belonging to the pre-trend group and not affected by the Balladur Reform. Column (1) reports the mean of the different variables for retirees in the control group (Public Employees retirees). Column (2) reports the mean of the different variables for retirees in the treatment group (Private Sector and aligned regimes retirees). *Source:*

French Wealth Survey 2004.

Sector	Private Sector	Public sector
Group	Control (Col 1)	Treatment (Col 2)
Private debt	0.214	0.229
Sex	0.677	0.523
Skilled worker	0.585	0.640
Homeowner	0.815	0.876
Financial difficulties	0.269	0.235
Highly educated	0.381	0.562
Urban area	0.529	0.510
Observations	378	153

Table 4.4:

Descriptive Fillon Reform- Pre-trend group (cohorts 1939-1943). This table reports descriptive statistics for cohorts individuals born between 1929 and 1933 belonging to the pre-trend and not affected by the Balladur Reform. Column (1) reports the mean of the different variables for retirees in the control group (Private Sector Retirees). Column (2) reports the mean of the different variables for retirees in the treatment group (Public Sector retirees). *Source: French Wealth Survey 2014.*

4.5 Results

4.5.1 Results when assessing the 1993 Ballardur Reform

Results for private debt by education level and financial difficulties

Results from our Difference in Differences evaluation of 1993 Ballardur Reform are shown in Table 4.5 taking private debt as our dependent variable. After analyzing effects for the whole sample, we create the following subsamples:

(1) Whole sample and subsequently divided in those having or having had and those not having had financial difficulties in the last five years (2) Only respondents with low education levels for the whole sample and also divided among those having or having had and those not having had financial difficulties in the last five years (3) Only respondents with high education levels for the whole sample and when divided among those having or having had and those not having had financial difficulties in the last five years.

In spite of rather important standard errors due to a limited sample, we find significant results to get a better understanding of indebtedness after each reform. A significant effect is observed when taking the entire cohort with an average differences in differences of 10.0 percentage points at the 5 % level when the individual is a private employee or independent worker of the associated regimes, therefore suggesting an indebtedness effect arising from the Ballardur Reform. Similarly, when focusing exclusively on the low-educated and those not having financial difficulties at least once in the last five years, probabilities stand respectively at 10.8 and 10.3 percentage points at the 10% significance level. However, when focusing on those having structural financial difficulties during the last years, we find a very significant probability of 29.6 percentage points (this category excludes those that only had difficulties in the past or have had only recent difficulties taken into account within the 5 years category). Moreover, we do not find an effect either when restricting the sample to the highly educated.

As for significance within control variables when running marginal effects as depicted in Table 4.9, households having a collateral and qualifications are more likely to contract debt: being a *Homeowner*, being a *Skilled Worker* ⁴, as well as having an unexpected event are highly significant factors behind indebtedness profiles. At a regional level, significance is found for retirees living in the West Region.

4.5.2 Results for mortgage and refurbishment loans

As observed in Table 4.5, when analyzing indebtedness dynamics within the 2004 Survey, the analysis focuses exclusively on Mortgage on the Primary Residence and Mortgage and Refurbishment loans ⁵, as there were not enough observations to tackle consumption credits. As there was a sample size limitation, we run only one regression using *Mortgage on Primary Residence* as the dependent variable. In this respect, when taking exclusively mortgage on the primary residence as a dependent variable, we observe a significant probability of 29.4 percentage points at a 95% Confidence Interval. This underlines that there was a greater increase among retirees of the private sector to continue paying their mortgage on primary residence after retirement after the 1993 Balladur Reform.

When taking Mortgage and Refurbishment as a dependent variable as seen in Table 4.5, the interaction term shows a probability of 9.2 percentage points at the 5% level for the whole cohort. As for private debt, we observe significant probabilities at the 90% when restricting the sample to the low-educated and those not having financial difficulties: 10.0 and 8.9 percentage points respectively. As for the highly educated and those having financial difficulties, no significance was found.

As for marginal effects, when taking *All Mortgages and Refurbishment*, we find similar results to private debt: being a *Homeowner*, being a *Skilled Worker* (regardless of the diploma) are positively significant at the 1% level for the whole sample, for those not having financial and the low educated (Table 4.10).

⁴This variable is divided from categories of the French Wealth Survey in 1 "Skilled" vs 0 "Unskilled" (regardless of the diploma)

⁵This refers to loans concerning mortgage loans for any type of residence and expenses linked to major repairs in a house. In the French Wealth Survey this is known under "Gros travaux immobiliers"

4.5.3 Results for the 2003 Fillon Reform

Results from our Difference in Differences evaluation of the 2003 Fillon Reform are shown in Table 4.6. After analyzing the effects for the whole sample, we create the following subsamples as done for the Balladur Reform. Standard errors are also non negligible due to the limited size of the sample.

Results for private debt by education and financial difficulties

Overall results are similar compared to the Balladur Reform: interaction terms are significant at the 10% level (Table 4.6) for the whole sample and when focusing on the low-educated and those not having had financial difficulties at some point in five years. A probability of 10.4 percentage points is observed for the entire cohort, a probability of 10.1 percentage points when reducing the entire sample to those without financial difficulties at least once in five years and a probability of 11.6 percentage points when reducing the sample to the low-educated. However, a 17.1 percentage points probability is also found for those both not having financial difficulties at least once in the last 5 years and being low educated. Rather similar to what was observed before for the 1993 Balladur Reform, for the 2003 Fillon Reform we do not find a general effect when restricting the sample to the highly educated.

As for the Balladur Reform, when running marginal effects (Table 4.11 in the Appendix), controls underline that traditional households with a collateral are the ones having contracted debt. Being a *Homeowner* and *Skilled Worker* are either positively significant at the 1% level or 5% level for all regressions described above. In the same vein, *Couple with more than one child* is positively significant at the 5% level for the entire cohort, being *Married* or *Divorced* are also positively significant at the 5% level. Moreover, when taking the whole sample as well as when restricting it to the low-educated, we can see that five regions are significant at the 5% level with a probability of around 20% of being indebted: *Parisian Basin*, *East*, *West*, *South-West*, *Mediterranean*.

Results by type of loans: mortgage, refurbishment and car loan

Moreover, when using as a dependent variable those having contracted a loan for either or both *Mortgage and Refurbishment* as seen in Table 4.6, a similar pattern with higher significance is observed compared to private debt. The whole sample displays an interaction term with a positive probability of 18.4 percentage points at the 95% Confidence Interval. When focusing on those not having or not having had financial difficulties, the effect increases to a probability of 22.7 percentage points and when restricting to both low-educated and those not having or having had financial difficulties at least once in the last five years account for a probability of 36.9 percentage points at a 5% level. Additionally, a significance at the 5% is also found when restricting the sample to the highly educated, with a 20.2 percentage points probability.

When taking a look at marginal effects in Table 4.14, the same pattern as for private debt is observed. However, additional significance is also observed for being a *Homeowner* and a *Skilled Worker* among the highly educated and for having a *Secondary Residence* compared to private debt .

Only refurbishment

When taking Refurbishment Loans (without Mortgage) when looking at Table 4.6, when controlling for the whole sample a probability of 6.2 percentage points is observed and a probability of 18.6 percentage points when also controlling for *Refurbishment Expense*. Moreover, the interaction term takes a value of 8.9 percentage points when reducing the sample to those not having had financial difficulties at least once in 5 years, a figure that rises to 32.9 percentage points when controlling for *Refurbishment Expense*. Restricting the sample to those with higher diplomas displays an interaction term of 13.00 percentage points at the 5 % level (18.9 percentage points if controlling for *Refurbishment Expense*) and 19.8 percentage points when for those highly educated also having had financial difficulties at least once in 5 years. Marginal effects (Table 4.15) show similar results to mortgage and refurbishment loans underlining once more a traditional and financially sound households: being *Married or remarried*, having *At least one child* and a *Sec-*

ondary residence, are highly significant at the the 5% level. Additionally, we observe that respondents concerned do not live in Paris or in a small city: urban units of 20 000-49 999 inhabitants and living in Paris show a negative significance at the 5 % level.

Car Loan & motorbike consumer debt

Loans concerning light motor vehicles are the only consumption debt we were able to asses within this study. While regressing the interaction term and the controls on *Car Loan* (loan exclusively for a four-wheeled vehicle), the interaction term is positively significant at the 90% level and a probability of 7.5 percentage points suggests that public employees contracted further loans for this purpose as seen in Table 4.6. Marginal effects (Table 4.15) show a similar pattern to private debt and mortgage and refurbishment loans: being *Married or remarried*, a *Homeowner* and being a *Skilled Worker* are highly significant.

4.6 Event Study for Balladur and Fillon Reform

As in any DID (Difference in Differences) experiment, our main assumption is that the Balladur Reforms and the Fillon Reforms explain the changes on indebtedness among pension recipients affected by these latter and that trends of both the control and treatment gorups would have continued the same in the absence of the reform. Figure 4.1 and Figure 4.2 depict respectively event studies for the 1993 Balladur Reform and the 2003 Fillon Reform. Coefficients correspond to the coefficients of the interaction term ($\beta_3 Ti * Pi$) in equations 5.1 and 5.2. These equations are repeated for each cohort from 1934 to 1941 for the Balladur Reform while taking the 1933 exclusively as the baseline year. In the same manner, these equations are repeated for each cohort from 1944 to 1954 for the Fillon Reform while taking 1943 as the baseline year.

For both reforms, we observe that after the Balladur and Fillon reforms, difference-differences coefficients display an increase respect to pre-trend levels. Concerning the Balladur Reform, when taking 1933 as the base level we observe that after the reform a general increasing trend takes place and a sustained higher debt levels are achieved after

1937, which represents the 4th generation having embraced the reform. Moreover, the Fillon Reform which takes 1943 as base level, also displays values where the difference between the treatment and control group are overall higher than pre-trend values before the reform.

	Whole Sample					Low-Educated					Highly Educated		
	dx/dy	SE	CI		N	dx/dy	SE	CI		N	dx/dy	SE	CI
Private Debt	0.100**	0.047	0.009	0.192	1756	0.108*	0.058	0.012	0.204	1206	0.036	0.093	-0.147 0
Without Financial difficulties at least once in 5yrs	0.103*	0.062	0.002	0.205	1405	0.106	0.066	-0.027	0.232	928	0.057	0.099	-0.137 0
Financial difficulties at least once in 5 yrs	0.094	0.120	-0.141	0.329	349	0.124	0.145	-0.160	0.407	253	-	-	- -
Structural financial difficulties at least once in 5 yrs	0.296**	0.145	0.011	0.580	158	0.211	0.183	-0.149	0.570	103	-	-	-
Primary Residence Mortgage	0.294**	0.150	0.001	0.588	186	-	-	-	-	-	-	-	-
All Mortgages & Refurbishment Loans	0.092**	0.045	0.019	0.166	1756	0.100*	0.058	0.005	0.195	1206	0.036	0.089	-0.139 0
Without Financial difficulties at least once in 5 yrs	0.089*	0.050	0.006	0.172	1405	0.094	0.066	-0.036	0.224	928	0.050	0.091	-0.130 0
Financial difficulties at least once in 5 yrs	0.127	0.121	-0.110	0.363	349	0.119	0.148	-0.171	0.409	253	-	-	- -

Table 4.5: Interaction terms within Difference-in-Differences Analysis (Wealth Survey 2004) for the 1993 Ballardur for cohorts born 1929-1941. For all models above, we control for socio-demographic variables Table 4.9 & Table 4.10 (Appendix). ** 5% significance level/ * 10% significance level

	Whole Sample					Low-educated					Highly-educated		
	dx/dy	SE	CI		N	dx/dy	SE	CI	N		dx/dy	SE	
Private Debt	0.104*	0.057	0.011 0.197		1970	0.119*	0.071	0.002 0.237	1.079		0.050	0.103	-0.11
Without Financial difficulties at least once in 5 yrs	0.101*	0.060	0.002 0.201		1358	0.171*	0.079	0.042 0.301	652		0.118	0.097	-0.14
Financial difficulties at least once in 5 yrs	0.027	0.117	-0.166 0.220		607	-0.035	0.140	-0.266 0.196	607		-	-	
Structural financial difficulties	0.057	0.148	-0.234 0.347		243	-0.078	0.197	-0.465 0.309	153		-	-	-
All mortgage & refurbishment loans	0.184**	0.072	0.042 0.326		758	0.116	0.096	-0.073 0.304	408		0.202*	0.116	0.01
Without Financial difficulties at least once in 5 yrs	0.227**	0.082	0.067 0.387		443	0.361**	0.148	0.070 0.652	928		-0.084	0.241	-0.55
Financial difficulties at least once in 5yrs	0.069	0.097	-0.120 0.259		588	-0.082	0.238	-0.548 0.385	191		-	-	
Only Refurbishment loans	0.062**	0.027	0.008 0.116		1927	0.116	0.096	-0.073 0.304	208		0.130**	0.054	0.02
Without Financial difficulties at least once in 5 yrs	0.089**	0.033	0.024 0.155		1342	0.066	0.039	-0.010 0.143	665		0.104	0.052	0.00
Financial difficulties at least once in 5 yrs	0.016	0.065	-0.112 0.143		576	-0.073	0.140	-0.347 0.201	223		0.198*	0.105	0.02
Car loan	0.075*	0.044	0.003 0.148		1903	-	-	- -	-		-	-	

Table 4.6: Interaction terms within Difference-Differences Analysis (Wealth Survey 2014) for the 2003 Fillon Reform for cohort born 1943-1954. For a above, we control for socio-demographic variables Table 4.11 to Table 4.15 (Appendix). ** 5% significance level/ * 10% significance level

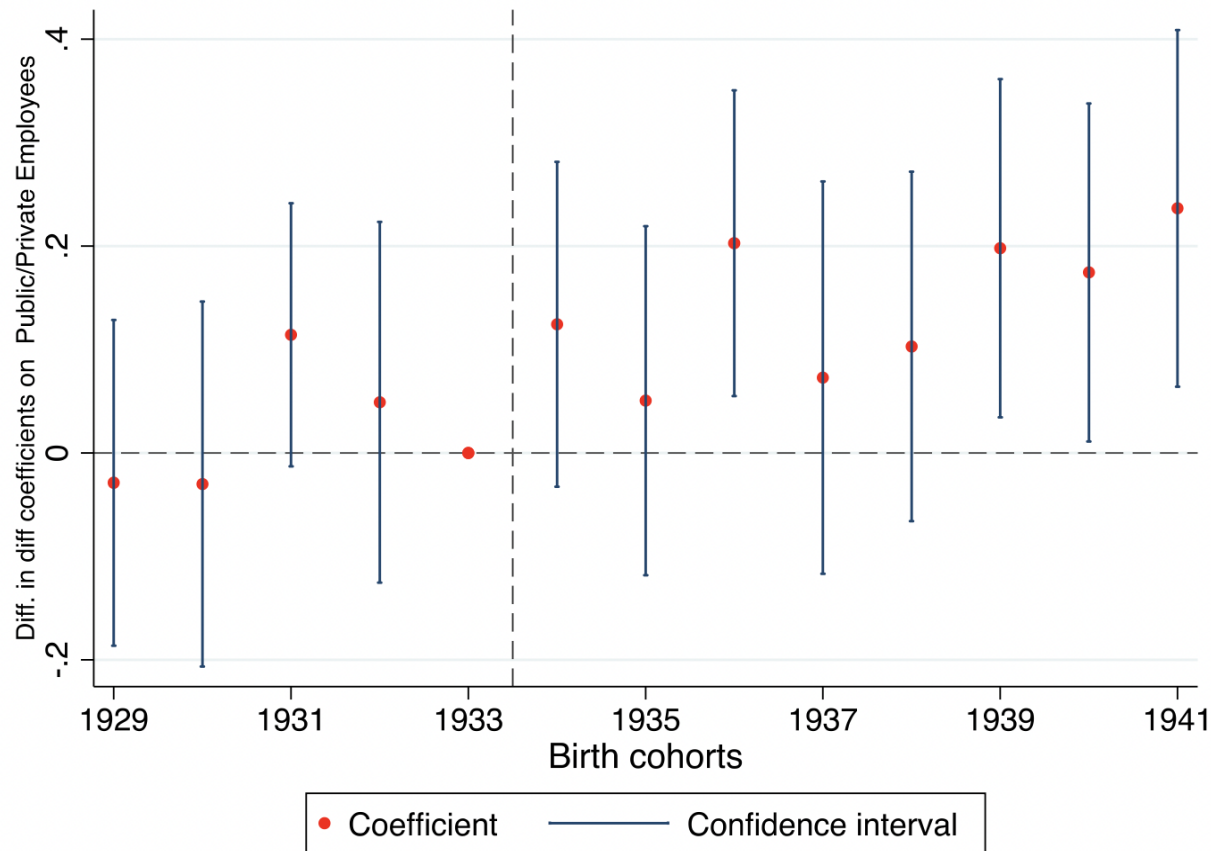


Figure 4.1: Event study for the Balladur Reform-1993. The figure displays the estimated difference of the probability of having debt probability between Private Sector, Aligned Regimes retirees and Public Sector retirees obtained from regressing an indebtedness dummy on a full set of interactions between the Private Sector/Aligned Regimes dummy and cohort dummies while controlling for socio-demographic characteristics such as age, gender, homeownership, urban unit or marital status. Baseline year is set for the cohort born in 1933, the last generation not affected by the Balladur Reform. *Source:* Enquête Patrimoine 2004.



Figure 4.2: Event study for the Fillon Reform-2003. The figure displays the estimated difference of the probability of having debt between Public Sector and Private Sector retirees obtained from regressing an indebtedness dummy on a full set of interactions between the Public Sector dummy while cohort dummies and controlling for socio-demographic characteristics such as age, gender, homeownership, urban unit or marital status. Baseline year is set for the cohort born in 1943, the last generation not affected by the Fillon Reform. *Source:* Enquête Patrimoine 2014.

4.7 Discussion of results of the Balladur and Fillon Reforms

The aim of this paper was to provide some evidence on the link between Pension Reform and indebtedness in order to have a deeper view on old-age financial frailty in countries having implemented major pension reforms. The French case offers a good opportunity to test this hypothesis through a Differences-in-Differences (DID) approach in a two decade time span where two different reforms took place first affecting exclusively one group of workers and then the other. Concerning the first reform, in the 1993 Balladur Reform, the affected sector was the private sector and the aligned regimes of farmers, traders, craftsmen (MSA, CANCAVA, ORGANIC) and not the other sectors (public sector and liberal professions) allowing us to have a pertinent control group where the economic and financial environment in France was identical for both groups in the first reform. Likewise, the Fillon reform in 2003 which affected exclusively the public sector (a special regime for independent workers was created in 2006), also allowed in the same manner to identify pertinent treatment and control groups for our analysis despite of some common additional measures taken for both regime from 2009 concerning contribution length.

Results from section 4.5 suggest that overall pension reforms and indebtedness are two phenomena that are linked. Both the 1993 Balladur Reform and the 2003 Fillon Reform show that the group affected by each reform shows higher levels of private indebtedness during the seven or ten years following the reforms compared to the non-concerned sector. Table 4.5 and Table 4.6 display the significance of interaction terms within our DID analysis and gives

4.7. DISCUSSION OF RESULTS OF THE BALLADUR AND FILLON REFORMS

us an overall picture of how both reforms have had an effect on private indebtedness rates among retirees. These results show that after both reforms, when taking the treatment group as a whole and when focusing on those not having had financial difficulties at least once in 5 years, we observe for both the Balladur and Fillon Reforms an increase of around 10 percentage points. However, we must note that for private and aligned regime workers affected by the Balladur Reform, there is a strong significance when restricting the sample solely to those having structural debt problems. Likewise, while focusing on mortgage and refurbishment loans, interaction terms after both reforms (Table 4.5 and Table 4.6) are significant when assessing the whole sample and when not having had at least once financial difficulties during the 5 last years.

When creating sub-samples of private debt by levels of education, results shed light on the socioeconomic profiles of retirees who rely more on debt after each reform. Following Blake and Garrouste (2019), the least educated as a whole seem to be significant for our Differences- in Differences impact evaluation of both reforms as seen in Table 4.5 and Table 4.6. Moreover, for both reforms when taking a look to *Mortgage and Refurbishment loans* positive significance is also found among the low-educated and those not having been least once in the last 5 years at financial strain. Additionally, for exclusively *Refurbishment loans*, positive significance is observed among the highly educated public servants and to a lesser extent with financial difficulties affected by the Fillon Reform. This last result could be interpreted as a sign of a conjunctural liquidity need for a specific urgent project within the household. However, overall, education as a proxy to lower socio-economic status seems to play a crucial role in contracting debt for private workers

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concerned by both reforms in spite of a general trend profile of creditworthy customers.

Table 4.9 through Table 4.15 in the Appendix display marginal effects offering us further information on socio-demographic and recent financial characteristics when analyzing overall *Private Debt* and *Mortgage and Refurbishment loans* within the 2004 and 2014 French Wealth Surveys. A traditional household setup seems to be more prone to debt incurment for both reforms : having children (*Type of household* for 2004 and *Having at least one child* for 2014). Being a *Homeowner* and therefore owning a collateral is significant either for private debt as a whole or when focusing in mortgage or refurbishment loans for both reforms. In the same line, regardless of the diploma belonging to a *Skilled socio-professional*) category is highly positively significant for all types of debt when analyzing both rounds of the survey (Table 4.9 and Table 4.11), suggesting that debt is more accessible to those having had a more stable professional path. Not surprisingly, private debt is negatively correlated to *Age* for both reforms. Finally, having an *Unexpected Expense* seems to play a significant role under the Balladur Reform for overall private debt and real state loans, under the idea that debt might be to a great extent linked to conjunctural economic frailty.

The 2014 Wealth Survey provided a larger database which allowed us to get a grasp of further socio-demographic characteristics. Being *Married-Remarried* and *Divorced* increases the possibility of having overall private debt either underlining the couple as the main economic unit of behind indebtedness or divorce as a source of financial frailty. Moreover, living in a rather small or medium urban unit of 50 000 - 99 999 inhabitants, as well as having a

4.7. DISCUSSION OF RESULTS OF THE BALLADUR AND FILLON REFORMS

Secondary Residence increases the probability of indebtedness for the entire sample and sub-samples for all types of debt implying loans are linked to debtors with sound financial profiles. Moreover, when looking at regional dynamics, living in a rather small or medium urban unit of 50 000 - 99 999 inhabitants decreases the probability of contracting debt. Additionally, a closer look may be taken concerning regional patterns for the 2014 Survey: the Parisian Basin, the West region, the South-West region, the East region and the Mediterranean increased the probability of debt incurrment by around 20%, the West Region displaying the highest probability at 22.2%. The Paris Region and the Centre-East regions are the areas least concerned by overall private debt. However, a probability of around 30.0 % is observed for contracting debt for those living in the *Parisian Region*, the *Parisian Basin*, the *Mediterranean* and the *South West* when analyzing *Mortgage and Refurbishment loans*. These regions are those where potentially pension recipients have the higher purchasing power or the southern sunbelt regions usually sought for retirement.

Given our main results: low-educated workers with no recent financial difficulties, we could link our results to recent studies on retirees in France. As pointed out by INSEE (2020) (National French Statistics Institute)⁶ using more recent data from pre-retirees in 2010 and retirees 2016, as much as retirement actually improves economic conditions of the first income decile of workers (the opposite effect is observed for the tenth income decile), the overall trend is for 6 out of 10 retirees, to suffer a decline of living standards of 6,9 % for women and 9.1% for men. This could explain our results

⁶*Insee, Première, "Des évolutions de vie contrastées au moment du départ à la retraite", N.1792, 2020)*

4.8. CONCLUSION

underlining greater indebtedness arising from both reforms as those with lower income (low-educated) but who however have a good lender profile are both in need for liquidity and creditworthy. In this context, as both reforms lowered pension levels through a less advantageous benefit calculations and inflation indexation instead of salaries indexation, demand for debt in an ageing population increased. However, significance for structural debt among private sector retirees workers also points out an important trait among private workers underlined in this report: private workers struggle the most during the last working years in terms of unemployment and financial stability. At the eve of retirement, this leads to either lower replacement rates or full pension due to missing contribution quarters and financial frailty.

4.8 Conclusion

This paper provided empirical and innovative evidence of a yet underexplored dimension of economic frailty among the elder: indebtedness rates. More specifically, it analyses the effects of pension reforms on indebtedness levels among retirees. Moreover, the set of French pension reforms provided an ideal framework for impact evaluation as the set of reforms first affected private workers and aligned regimes (traders, farmers and craftsmen) which allowed to consider public servants and liberal independent workers as a reliable control group following Blake and Garrouste (2019) to assess the 1993 Balladur Reform. Additionally, we extend this identification strategy to the 2003 Fillon Reform taking the public sector as the treatment group since both the indexation of pensions on inflation (previously on salaries) and a less generous pension formula taking the best 25 years of contributions (pre-

4.8. CONCLUSION

viously 10 years) had not applied to this sector with the Balladur Reform. However, as a disclaimer we must note that in terms of contribution length an extension to 160 quarters starting progressively by 2009 for both sectors was part of the 2003 Fillon Reform. In both evaluations, as both treatment and control groups live in the same country under the same economic conditions and credit policies, internal validation between groups is guaranteed. Results show that after both reforms, indebtedness levels increased among retirees in France having been affected within 10 years following the reform.

Results (Section 2.4) underline that both reforms increased debt levels among the low-educated and those not having financial difficulties at least once during the last five years for overall private debt. Moreover, a strong significance is found among private workers and aligned regimes having had structural debt during the last years. An educational divide also found by Blake and Garrouste (2019). A similar pattern was found for mortgage and refurbishment loans for the Balladur Reform. Additionally, some significance was found among retirees highly educated retirees from the public sector for mortgage and refurbishment loans. This result was particularly important for those having contracted refurbishment loans and having had financial difficulties at least once in the last 5 years after the Fillon Reform. Finally, socio-demographic and economic control variables point out that traditional households have a higher probability of contracting debt: having children, being a homeowner and belonging to a skilled professional category. Moreover, being divorced, having a secondary residence living in an urban unit of 50 000- 99 999 inhabitants and in the Paris Basin, West and South-West, East and Mediterranean regions are also significant determinants for retirees affected by the 2003 Fillon Reform.

Overall, these results underline higher debt levels among retirees after pension reforms affecting both either the private or public sector. However, the common profiles of these retirees of both reforms are low educated and not having financial difficulties. Significance among retirees having had structural financial difficulties within the last years also adds a further dimension that recalls frequent statistics stating that private workers suffer more from unemployment than public employees during the last years before retirement. These features suggest that, as much as the level of education is a good proxy of modest income in the socioeconomic scale, financial profiles among those contracting debt underline different stories behind the need for liquidity after a decline in pension benefits. On one hand, after both reforms retirees who were creditworthy, increased their demand for credit for leisure projects such as refurbishment loans or cars. On the other hand, our results also underline that those having structural financial difficulties among private workers were strongly concerned by indebtedness after the 1993 Balladur Reform.

4.9 Appendix

4.9.1 Debt measure

Binary Variable for having or not having debt.

Debt is divided into three categories according to the Household Head in the Household File: 1) Private debt (*Dette privée*) 2) Professional debt (*Dette professionnelle*) 3) Either Private or Professional debt (*Dette générale*). When taking a look to Figure 4.4, we observe, with the exception of 2004, that in-

debtedness among all age groups seem to have decreased, underlining that the overall trend of indebtedness seems on the rise.

Types of Debt

For both the 2004 and the 2014 Survey, private debt is divided in the following categories of binary variables (plainly having or not having the type of loan): 1) Primary residence mortgage 2) Mortgage and refurbishment loans 3) Refurbishment loans only 4) Loans for a motor vehicle 5) Consumer credit 6) Loans for Capital Goods. ⁷

4.9.2 Education and financial difficulties

When restricting equations to target socio-economic profile among debt holders, two major variables are used: 1) *Having or having had financial difficulties in the last 5 years* 2) *Education level (low-educated vs highly educated)* (measured by the highest diploma held by respondents). These variables are both essential in providing a proxy for socioeconomic status since income sources are not fully reported within the survey and an indicator of a more conjunctural dimension of the financial situation of the main respondent within the household.

⁷For the analysis concerning 2004, given that in the last three categories less than 9% of respondents within our target cohorts in the experiment answered positively, our analysis concerning specific types of debt will exclusively focus on the first three categories. On the other hand, for the evaluation concerning the 2014 Survey, a bigger sample made it possible to also include loans for private transports such as vehicles and motorbikes.

4.9. APPENDIX

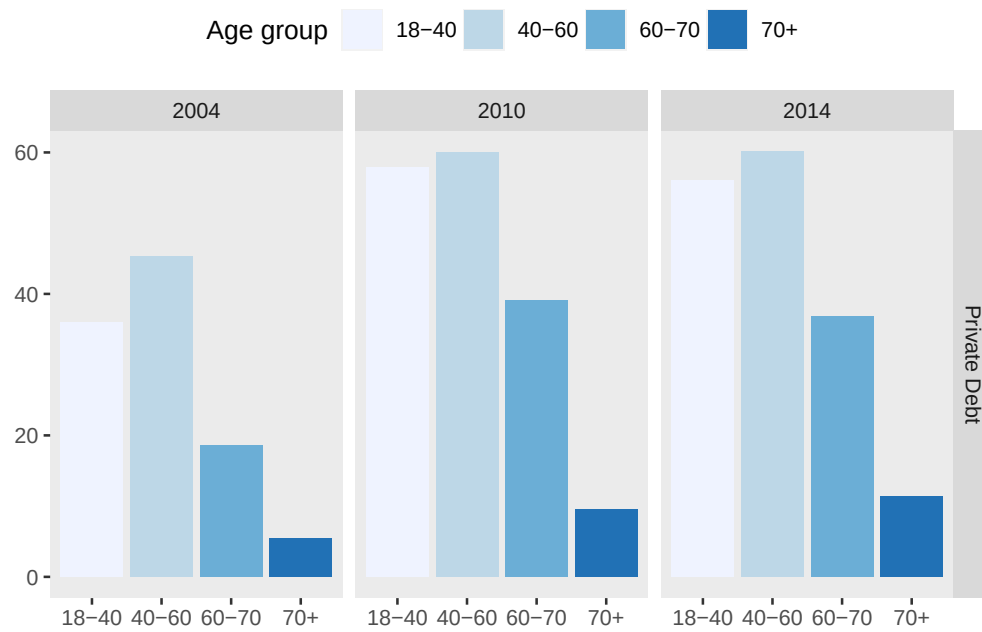


Figure 4.3: Indebtedness rates (%) within age groups (French Wealth Survey 1986, 1992, 1998, 2004, 2010, 2014)

Financial difficulties

For surveys comprised between 1998 and 2014, this a variable assesses either past, present or persistent financial difficulties.(Figure 4.4). Thanks to this variable, we create a new binary variable named *Recent financial difficulties in the last five years*. We create a binary variable which takes the value of 1 for those who are having or have recently had financial difficulties in the last 5 years and take the value of 0 for those who declare never having had any financial distress.⁸

Education level

An education level variable was created in order to divide the sample between low-educated individuals and highly educated individuals in order to divide cohorts into balanced groups. Unlike Blake and Garrouste (2019) who use throughout their evaluation an education divide on whether respondents had a complete high school diplomas, we set them apart in a different manner. Therefore, within our database, in order to reach balanced groups for comparison.⁹, we will split the sample between low-educated and highly

⁸ "Have you had encountered difficulties to make ends meet?" (Avez-vous des difficultés pour faire face à vos échéances ?)

Possible Answers :

1) *No, it has never happened to me* (Non, et cela n'est jamais arrivé). 2) *No, but it has happened recently (during the last five years)* (Non,mais cela est arrivé récemment (dans les 5 dernières années) 3) *Yes, it has happened to me* (Oui, cela m'est arrivé) 4) *Oui, depuis plusieurs années* (Yes, during the last years) 5) *Yes, less than one year ago* (Oui, depuis moins d'un an).

⁹Only 40%respondents above 60 years old and retired had completed at least a professional full high school diploma *Baccalauréat Technique* and only 35% had at least a full

4.9. APPENDIX

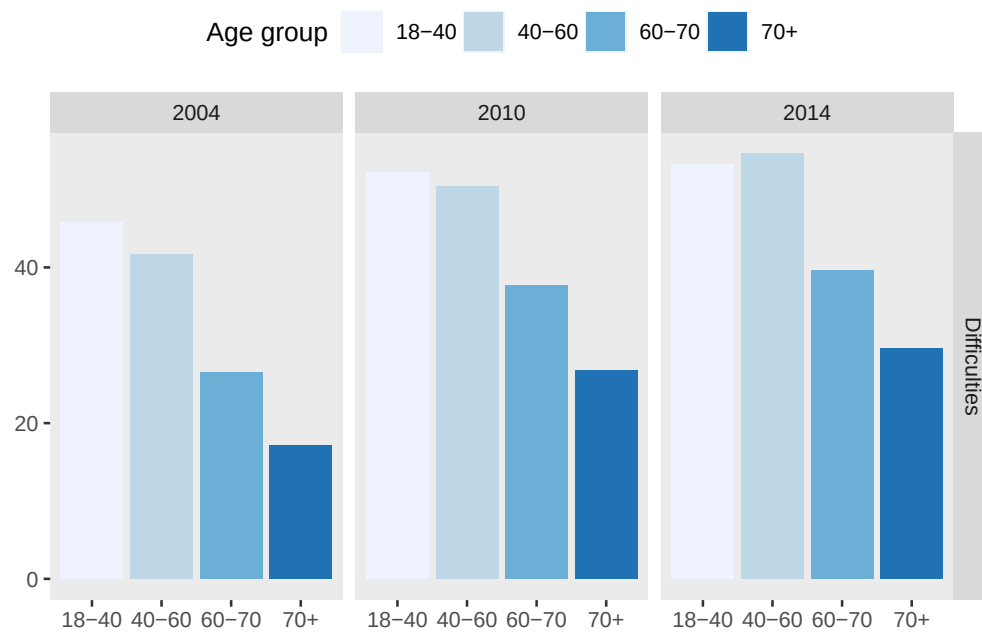


Figure 4.4: Financial difficulties (%) within age groups (French Wealth Survey 1998, 2004, 2010, 2014)

educated using intermediate high school /professional diplomas. These diplomas known as *CAP*(*Certificat d'Aptitudes Professionnelles* and *BEP*(*Brevet d'Etudes Professionnelles* allow individuals to join rather easily the workforce right after completing the program.

4.10 Robustness checks

As robustness checks, we run several placebo tests throughout our sample for verifying both results arising from the evaluations performed using the 2004 and the 2014 French Wealth Survey. Table 4.7 and Table 4.8 report results from placebo tests performed in order to assess the robustness of results described above. For this purpose, hypothetical reforms were created in order to observe if the significant results found earlier were significant and reliable or part of an extended trend before the 1993 Balladur Reform and the 2003 Fillon Reform. For each hypothetical pension reform, we run regressions changing year by year the year when these hypothetical reforms took place affecting the five previous cohorts and either the eight for the Balladur Reform or the ten cohorts following the Fillon Reform. Concerning the design of control groups, the public sector and liberal regimes remain the control group for the Balladur Reform and the private sector for the Fillon Reform.

4.10.1 Placebo Tests for 1993 Balladur Reform

As seen in Table 4.7, robustness checks through placebo test when evaluating the indebtedness effects of the 1993 Balladur Reform comprise generations born between Table 4.5 1924 and 1933 since respondents born in 1923 and academic high school diploma *Baccalauréat Général*.

4.10. ROBUSTNESS CHECKS

older were not numerous enough to provide enough observations for performing the the Differences-in- Differences analysis. For all regressions shown in Table 4.7, all controls are the same used in Table 4.5. When assessing results from hypothetical reforms taking place between 1924 and 1929, the double interaction displays a non significant positive coefficient, except for hypothetical reforms taking place in 1928 and 1929. The lack of significance in these regressions suggests that the effect on indebtedness of low-educated cohorts. Table 4.5 of the 1993 Balladur Reform is robust and not arising from a previous trend.

4.10.2 Placebo Tests for 2003 Fillon Reform

In the same vein, we perform placebo tests for assessing our results arising from our DID analysis using the 2014 Wealth Survey to evaluate the relevance of our results when analyzing the effect on debt rates among the elderly of the 2003 Fillon Reform (Table 4.7). The same controls used in Table 4.6 are included to run regression within our hypothetical reforms. In this case, regressions include generations born between 1933 and 1943 to match the same time span taken for the 1993 Balladur Reform. For the Fillon Reform, we focus on cohorts born between 1933 and 1943. Cohorts born between 1936 and 1940 exhibit a negative non significant coefficient. Moreover, cohorts born between 1941 and 1943 show either positive or negative low coefficients that are not significant either. Therefore, as for the Balladur Reform, these results suggest that after the 2003 Fillon Reform a positive effect on indebtedness rates among the low-educated without financial difficulties(Table 4.6) do not arise from a previous trend.

4.10. ROBUSTNESS CHECKS

Year of birth of Hypothetical Reform	dy/dx	Std.Err.	[95%Conf.	Interval]	Sample Size
1923	-	- -	-	-	
1924	0.061	0.084	-0.104	0.225	1286
1925	0.066	0.079	-0.088	0.220	1378
1926	0.028	0.059	-0.087	0.143	1487
1927	0.006	0.054	-0.099	0.111	1546
1928	-0.049	0.031	-0.110	0.012	1588
1929	-0.042	0.030	-0.102	0.017	1640
1930	0.049	0.043	-0.035	0.134	1674
1931	0.028	0.043	-0.057	0.112	1702
1932	0.021	0.042	-0.061.	0.103	1728
1933	0.037	0.045	-0.052	0.125	1749

Table 4.7: Placebo tests when using the 2004 French Wealth Survey (INSEE). Our dependent variable is private debt as in Equation 5.1 Each row simulates a hypothetical pension reform for the cohort born in each given year in order to confirm the robustness of our results concerning the 1993 Balladur Reform affecting the private sector. Control groups correspond to the five precedent generations to the hypothetical reform and the treatment to the first eight generations affected by the reform as done in our analysis for the Balladur Reform.

4.10. ROBUSTNESS CHECKS

Year of birth of Hypothetical Reform	dy/dx	Std.Err.	[95%Conf. Interval]	Sample Size
1933	-0.012	0.068	-0.144 0.121	1290
1934	-0.023	0.065	-0.150 0.104	1371
1935	0.020	0.066	-0.108 0.149	1452
1936	0.008	0.062	-0.113 0.130	1546
1937	0.042	0.059	-0.073 0.157	1653
1938	0.071	0.055	-0.036 0.178	1729
1939	0.036	0.060	-0.081 0.153	1798
1940	0.038	0.062	-0.084 0.160	1879
1941	0.006	0.062	-0.116 0.128	1937
1942	0.006	0.062	-0.116 0.128	1961
1943	0.017	0.074	-0.128 0.163	1966

Table 4.8: Placebo tests when using the 2014 French Wealth Survey (INSEE).

Our dependent variable is private debt as in Equation 5.2. Each row simulates a hypothetical pension reform in each given year in order to confirm the robustness of our results concerning the 2003 Fillon Reform affecting the public sector. Control groups correspond to the five precedent generations to the hypothetical reform and the treatment to the 10 first generations affected by the reform as done in the analysis for the Fillon Reform.

Sector	Private	Private	Private
Education		Low Educated	
Debt			Yes
Variables	$\frac{dx}{dy} - S.E.$	$\frac{dx}{dy} - S.E.$	$\frac{dx}{dy} - S.E.$
Treated	-0.031 – 0.039	-0.044 – 0.042	-0.045 – 0.036
Private Employee	-0.025 – 0.023	0.023 – 0.023	-0.008 – 0.020
Sex	-0.006 – 0.040	-0.002 – 0.038	-0.018 – 0.035
Marital status			
Married or remarried	0.026 – 0.054	0.009 – 0.058	0.017 – 0.054
Widow		0.062 – 0.059	0.040 – 0.044
Divorced	0.038 – 0.052	0.042 – 0.059	0.038 – 0.045
Skilled worker	0.059 ^{**} – 0.021	0.025 – 0.023	
Type of household			0.050 – 0.055
Couple without child	0.037 – 0.052	0.052 – 0.060	0.045 – 0.066
Couple with child	0.023 – 0.063	0.077 – 0.079	0.187 – 0.194
Couple avec enfants	0.273 – 0.239		0.049 – 0.064
Single headed household	0.000 – 0.074	0.002 – 0.053	0.035 – 0.052
Other	0.093 – 0.076	0.036 – 0.055	0.058 ^{**} – 0.020
Urban area	-0.036 – 0.022	-0.030 – 0.024	-0.010 – 0.020
Homeowner	0.129 ^{***} – 0.018	0.131 ^{***} – 0.016	0.145 ^{***} – 0.015
Working partner	0.062 – 0.044	0.042 – 0.043	0.068 [*] – 0.041
Unexpected expense	0.069 ^{**} – 0.030	0.073 ^{**} – 0.030	0.071 ^{**} – 0.026
Region			
Parisian basin	0.055 [*] – 0.032	0.035 – 0.038	0.035 – 0.031
North	-0.002 – 0.033	0.013 – 0.047	0.001 – 0.037
East	0.039 – 0.039	-0.007 – 0.040	0.005 – 0.035
West	0.099 ^{**} – 0.036	0.076 [*] – 0.041	0.061 [*] – 0.034
South-West	0.046 – 0.036	0.023 – 0.040	0.027 – 0.034
Centre-East	0.004 – 0.034	-0.026 – 0.038	-0.022 – 0.032
Mediterranean	0.035 – 0.036	0.033 – 0.042	0.010 – 0.032
Age	-0.011 ^{**} – 0.005	-0.012 ^{**} – 0.005	-0.012 ^{**} – 0.004
Pension recipient	-0.077 – 0.085	0.005 – 0.070	-0.036 – 0.059

Table 4.9: Private sector and aligned regimes. Private Debt-Balladur Reform (2004 Wealth Survey)

^{*} $p < 0.10$.

^{**} $p < 0.05$.

^{***} $p < 0.01$.

Mortgage and Refurbishment	Yes	Yes	Yes
Education	Low Educated		
Financial Difficultes	No		
Variables	$\frac{dx}{dy} - S.E.$	$\frac{dx}{dy} - S.E.$	$\frac{dx}{dy} - S.E.$
Treated	-0.036 – 0.033	-0.048 – 0.038	-0.036 – 0.037
Private Employee	-0.011 – 0.019	0.022 – 0.024	-0.018 – 0.021
Sex	-0.015 – 0.032	-0.000 – 0.037	-0.009 – 0.037
Marital status			
Married or remarried	-0.003 – 0.058	-0.009 – 0.064	0.009 – 0.061
Widow	0.037 – 0.041	0.057 – 0.053	0.042 – 0.048
Divorced	0.035 – 0.043	0.041 – 0.056	0.038 – 0.053
Skilled worker	0.056 ^{**} – 0.018	0.028 – 0.021	0.060 ^{**} – 0.021
Type of household		0.043 – 0.024	
Couple without child	0.054 – 0.057		0.045 – 0.055
Couple with children	0.054 – 0.067	0.061 – 0.062	0.032 – 0.068
Couple avec enfants	0.180 – 0.123	0.091 – 0.072	0.210 – 0.132
Single headed household	0.044 – 0.056	0.003 – 0.065	0.000 – 0.084
Other	0.010 – 0.056	0.012 – 0.062	0.062 – 0.065
Urban area	-0.008 – 0.020	-0.030 – 0.025	-0.036 – 0.023
Homeowner	0.295 ^{***} – 0.057	0.243 ^{***} – 0.057	0.232 ^{***} – 0.065
Working partner	0.050 – 0.031	0.035 – 0.035	0.040 – 0.035
Unexpected expense	0.054 ^{**} – 0.020	0.056 ^{**} – 0.023	0.053 ^{**} – 0.024
Region			
Parisian basin	0.038 – 0.030	0.043 – 0.041	0.058 – 0.035
North	0.006 – 0.039	0.021 – 0.051	-0.003 – 0.044
East	0.019 – 0.037	0.004 – 0.048	0.054 – 0.041
West	0.055 – 0.031	0.068 – 0.041	0.087 – 0.035
South-West	0.029 – 0.032	0.036 – 0.044	0.059 – 0.038
Centre-East	-0.044 – 0.038	-0.026 – 0.051	-0.004 – 0.042
Mediterranean	0.010 – 0.034	0.035 – 0.045	0.039 – 0.040
Age	-0.010 – 0.004	-0.011 ^{**} – 0.005	-0.012 ^{**} – 0.005
Pension recipient	-0.026 – 0.049	0.018 – 0.070	-0.065 – 0.059

Table 4.10: Private sector and aligned regimes.Mortgage & Refubrishment loans-Balladur Reform (2004 Wealth Survey)

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

	Private Debt	Private Debt
Financial difficulties	Whole	No
Variables	$\frac{dx}{dy} - S.E$	$\frac{dx}{dy} - S.E$
Treated (born ≤ 1944)	0.048 – 0.045	0.068 – 0.053
Public Sector	0.004 – 0.026	-0.008 – 0.029
Sex (Male)	-0.000 – 0.029	-0.003* – 0.034
Urban unit		
<i>Less than 5 000 inhab</i>	0.051 – 0.052	0.096 – 0.055
<i>5 000 – 9 999 inhab</i>	-0.031 – 0.051	-0.022 – 0.06
<i>10 000 – 19 999 inhab</i>	-0.005 – 0.052	0.057 – 0.065
<i>20 000– 49 999 inhab</i>	-0.04 – 0.048	0.002 – 0.054
<i>50 000– 99 999 inhab</i>	-0.136** 0.052	-0.026 – 0.059
<i>100 000 – 199 999 inhab</i>	-0.041 – 0.05	0.016 – 0.059
<i>200 000–1 999 999 inhab</i>	-0.027 – 0.036	0.032 – 0.041
<i>Paris</i>	-0.079 – 0.091	-0.097 – 0.116
Marital Status		
<i>Married-Remarried</i>	0.093** 0.044	0.094* – 0.05
<i>Widow</i>	0.033 – 0.053	0.047 – 0.06
<i>Divorced</i>	0.122** 0.049	0.097 – 0.059
Homeowner	0.102*** 0.031	0.117** 0.042
At least one child	0.101** 0.044	0.102* – 0.055
Skilled Socio-Professional Category	0.121*** 0.026	0.120*** 0.029
Region		
<i>Parisian Region</i>	0.108 – 0.094	0.153 – 0.159
<i>Parisian Basin</i>	0.239** 0.102	0.188 – 0.126
<i>North</i>	0.181* – 0.107	0.104 – 0.134
<i>East</i>	0.214** 0.104	0.187 – 0.127
<i>West</i>	0.259*** 0.101	0.198 – 0.124
<i>South-West</i>	0.253** 0.103	0.194 – 0.126
<i>Center-East</i>	0.102 – 0.067	0.122 – 0.127
<i>Mediterranean</i>	0.225** 0.103	0.178 – 0.127
Working Partner	0.004 – 0.042	0.05 – 0.052
Secondary Residence	0.073** 0.029	0.068** 0.031
Wealth Variation		
<i>Decrease</i>	0.036 – 0.038	- - -
<i>Stable</i>	-0.006 – 0.037	- - -
Home savings scheme	-0.031 – 0.025	-0.016 – 0.03
Age	-0.008** 0.005	-0.010** 0.005
Observations	1918	684

Table 4.11: 2014. Public Sector-Private Debt by Financial Difficulties.

* $p < 0.10$ [**] $p < 0.05$, [***] $p < 0.01$.

	Private Debt	Private Debt
Education	Low	Low
Financial difficulties	Whole	No
Variables	$\frac{dx}{dy} - SE$	$\frac{dx}{dy} - SE$
Treated (born ≤ 1944)	0.015 – 0.053	0.05 – 0.066
Public Sector	0.002 – 0.033	0.008 – 0.037
Sex(Male)	0.01 – 0.039	0.007 – 0.047
Urban unit		
<i>Less than 5 000 inhab</i>	0.008 – 0.055	0.031 – 0.064
<i>5 000 -9 999 inhab</i>	-0.054 – 0.064	-0.103 – 0.082
<i>10 000 – 19 999 inhab</i>	0.015 – 0.055	0.088 – 0.072
<i>20 000– 49 999 inhab</i>	-0.024 – 0.053	0.033 – 0.061
<i>50 000– 99 999 inhab</i>	-0.147** – 0.063	-0.016 – 0.069
<i>100 000 – 199 999 inhab</i>	-0.091 – 0.063	-0.09 – 0.084
<i>200 000-1 999 999 inhab</i>	-0.002 – 0.044	0.064 – 0.051
<i>Paris</i>	-0.051 – 0.121	-0.081 – 0.163
Marital Status		
<i>Married-Remarried</i>	0.140** – 0.061	0.112 – 0.071
<i>Widow</i>	0.112 – 0.071	0.091 – 0.084
<i>Divorced</i>	0.167** – 0.068	0.111 – 0.085
<i>Homeowner</i>	0.105** – 0.037	0.120** – 0.05
At least one child	0.065 – 0.055	0.056 – 0.072
Skilled socio-professional category	0.125*** – 0.031	0.115*** – 0.036
Region		
<i>Parisian Region</i>	0.175 – 0.164	0.08 – 0.19
<i>Parisian Basin</i>	0.275 – 0.134	0.125 – 0.137
<i>North</i>	0.207 – 0.142	0.025 – 0.156
<i>East</i>	0.253* – 0.137	0.118 – 0.141
<i>West</i>	0.289** – 0.134	0.129 – 0.137
<i>South-West</i>	0.255* – 0.138	0.092 – 0.143
<i>Central-East</i>	0.184 – 0.137	0.097 – 0.14
<i>Mediterranean</i>	0.262* – 0.138	0.103 – 0.145
Secondary Residence	0.05 – 0.04	0.058 – 0.045
Wealth Variation		
<i>Decrease</i>	0.035 – 0.022	0.013 – 0.056
<i>Stable</i>	0.033 – 0.501	-0.005 – 0.055
Home savings scheme	-0.064* – 0.033	-0.039 – 0.039
Age	-0.008 – 0.005	-0.011* – 0.006
Observations	1094	684

Table 4.12: 2014. Public Sector- Private Debt. Low education.

* $p < 0.10$ **] $p < 0.05$, [***] $p < 0.01$.

	Mortgage & Refurb	Mortgage & Refurb
Financial difficulties	Whole	No
Variables	$\frac{dx}{dy} - SE$	$\frac{dx}{dy} - SE$
Treated (born ≤ 1944)	-0.006 – 0.048	0.072 – 0.07
Public Sector	0.048 – 0.031	0.045 – 0.039
Sex (Male)	-0.007 – 0.034	-0.025 – 0.049
Urban unit		
<i>Less than 5 000 inhab</i>	0.042 – 0.05	0.033 – 0.058
<i>5 000 -9 999 inhab</i>	-0.002** – 0.049	0.056 – 0.064
<i>10 000 - 19 999 inhab</i>	-0.075 – 0.06	-0.037 – 0.093
<i>20 000- 49 999 inhab</i>	-0.027 – 0.047	-0.062 – 0.067
<i>50 000- 99 999 inhab</i>	-0.116** – 0.063	-0.11 – 0.083
<i>100 000 - 199 999 inhab</i>	-0.059 – 0.063	-0.002 – 0.075
<i>200 000 - 1 999 999 inhab</i>	-0.013 – 0.041	-0.004 – 0.051
<i>Paris</i>	-0.162* – 0.096	-0.260** – 0.119
Marital Status		
<i>Married-Remarried</i>	0.162** – 0.069	0.151* – 0.088
<i>Widow</i>	0.137* – 0.077	0.113 – 0.099
<i>Divorced</i>	0.222** – 0.072	0.229** – 0.097
Homeowner	0.844*** – 0.208	0.713*** – 0.134
At least one child	0.346** – 0.117	0.148** – 0.065
Skilled worker	0.067** – 0.029	0.088** – 0.04
Region		
<i>Parisian Region</i>	0.316** – 0.156	0.476** – 0.17
<i>Parisian Basin</i>	0.289** – 0.139	0.403** – 0.143
<i>North</i>	0.123 – 0.15	- - -
<i>East</i>	0.266* – 0.142	0.471*** – 0.145
<i>West</i>	0.252* – 0.14	0.399** – 0.14
<i>South- West</i>	0.295** – 0.141	0.430** – 0.146
<i>Central-East</i>	0.187 – 0.143	0.329** – 0.142
<i>Mediterranean</i>	0.302** – 0.14	0.380** – 0.148
Working Partner		
Secondary Residence	0.072** – 0.034	0.067* – 0.04
Major real state expense (12 months)	-0.014 – 0.087	0.013 – 0.097
Home savings scheme	0.031 – 0.027	0.029 – 0.034
Age reference	-0.007 – 0.005	-0.007 – 0.006
Observations	755	443

Table 4.13: 2014. Public Sector. Mortgage & Refurbishment by Financial Difficulties

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

	Mortgage & Refurb	Mortgage & Refurb
Financial difficulties	No	Whole
Education	Low	High
Variables	$\frac{dx}{dy} - S.E.$	$\frac{dx}{dy} - SE$
Treated (born ≤ 1944)	-0.036 – 0.098	0.251** 0.108
Public Sector	0.058 – 0.071	0.103 – 0.063
Sex (Male)	-0.107 – 0.092	0.047 – 0.073
Urban unit		
<i>Less than 5 000 inhab</i>	0.011 – 0.152	0.229** 0.114
<i>5 000 - 9 999 inhab</i>	-0.033 – 0.109	0.186 – 0.114
<i>10 000 - 19 999 inhab</i>	0.155 – 0.169	-0.124 – 0.166
<i>20 000 - 49 999 inhab</i>	-0.094 – 0.103	-0.05 – 0.127
<i>50 000 - 99 999 inhab</i>	-0.147 – 0.094	-0.07 – 0.143
<i>100 000 - 199 999 inhab</i>	-0.068 – 0.105	0.165 – 0.118
<i>200 000 - 1 999 999 inhab</i>	-0.025 – 0.094	0.016 – 0.079
<i>Paris</i>	-0.186** 0.081	-0.577** 0.269
Marital Status		
<i>Married-Remarried</i>	- - -	0.107 – 0.127
<i>Widow</i>	- - -	-0.004 – 0.156
<i>Divorced</i>	- - -	0.096 – 0.141
<i>Homeowner</i>	- - -	0.844*** 0.208
At least one child	0.001 – 0.176	0.346** 0.117
Skilled socio-professional category	0.119* – 0.067	-0.089 – 0.098
Region		
<i>Parisian Region</i>	- - -	0.834** 0.391
<i>Parisian Basin</i>	- - -	0.365 – 0.326
<i>North</i>	- - -	0.221 – 0.335
<i>East</i>	- - -	0.449 – 0.326
<i>West</i>	- - -	0.316 – 0.325
<i>South-West</i>	- - -	0.522 – 0.322
<i>Central-East</i>	- - -	0.296 – 0.321
<i>Mediterranean</i>	- - -	0.262 – 0.322
Secondary Residence	0.142 – 0.085	0.075 – 0.06
Major real state expense (12 months)	0.047 – 0.182	-0.043 – 0.146
Home savings scheme	0.008 – 0.066	0.079 – 0.057
Age reference	-0.014 – 0.01	-0.001 – 0.01
Observations	177	300

Table 4.14: 2014.Public Sector- Mortgage & Refurbishment loans. Low and High Education

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

	Only Refurbishment loan	Car loan
Education	High	Whole
Variables	$\frac{dx}{dy} - SE$	$\frac{dx}{dy} - SE$
Treated (born $\leq$ 1944)	0.171 [*] - 0.098	0.014 - 0.035
Public Sector	0.039 - 0.060	0.027 - 0.019
Sex (Male)	-0.115 [*] - 0.063	0.026 - 0.025
Urban unit		
<i>Less than 5 000 inhab</i>	-0.130 - 0.105	0.005 - 0.034
<i>5 000 - 9 999 inhab</i>	-0.046 - 0.120	0.008 - 0.035
<i>10 000 - 19 999 inhab</i>	-0.121 - 0.103	0.029 - 0.035
<i>20 000 - 49 999 inhab</i>	-0.365 ^{**} - 0.130	-0.009 - 0.035
<i>50 000 - 99 999 inhab</i>	-0.031 - 0.098	-0.067 - 0.041
<i>100 000 - 199 999 inhab</i>	0.123 - 0.103	-0.011 - 0.04
<i>200 000 - 1 999 999 inhab</i>	-0.082 - 0.055	-0.012 - 0.026
Paris	-0.561 ^{**} - 0.171	0.185 - 0.113
Marital status		
<i>Married-Remarried</i>	0.275 ^{**} - 0.101	0.072 ^{**} - 0.036
<i>Widow</i>	0.050 - 0.159	0.041 - 0.042
<i>Divorced</i>	0.150 - 0.124	0.038 - 0.042
Homeowner	- - -	0.061 ^{**} - 0.027
At least one child	0.234 ^{**} - 0.088	0.044 - 0.032
Skilled socio-professional category	0.097 - 0.090	0.064 ^{***} - 0.019
Region		
<i>Parisian Region</i>	0.345 - 0.284	-0.154 - 0.13
<i>Parisian Basin</i>	0.230 - 0.236	0.061 - 0.078
<i>North</i>	0.047 - 0.251	0.054 - 0.081
<i>East</i>	0.296 - 0.234	0.093 - 0.078
<i>West</i>	0.136 - 0.237	0.036 - 0.076
<i>South-West</i>	0.283 - 0.230	0.072 - 0.078
<i>Central-East</i>	0.188 - 0.233	0.05 - 0.078
<i>Mediterranean</i>	0.101 - 0.227	0.078 - 0.078
Working partner	-0.094 - 0.081	0.007 - 0.029
Secondary Residence	-0.103 ^{**} - 0.050	
Major real state expense (12 months)	-0.190 - 0.129	
Age	0.003 - 0.010	-0.007 ^{**} - 0.004
Wealth Variation		
Decrease		0.053 [*] - 0.029
Increase		0.020 - 0.030
Observations	285	1899

Table 4.15: 2014. Public Sector-Only refurbishment (high education)
and Car loan

^{*} $p < 0.10$ [^{**}] $p < 0.05$, [^{***}] $p < 0.01$.

Chapter 5

Conclusion

Economic inequality is attracting increasing interest amongst academics. This thesis studied inter and intragenerational inequalities in France from a historical and fiscal perspective, with a specific focus on gender and on the evolution of living standards within generations. Studying this phenomenon from these different perspectives allowed us to have a greater understanding of the demographic transition and population ageing, two of the major demographic processes witnessed by advanced and a number of emerging economies during the past two hundred years. During the late 19th century in Europe the demographic transition through a drop in fertility challenged the traditional role of women within the family unit. It led to a social revolution enabling women to join massively the labor force and empowering them economically and socially. By contrast, population ageing became a widely discussed topic later on, in the 1990's, when the baby-boomers approached retirement. This phenomenon is of critical importance in countries in Western and Central Europe, as well as Scandinavia, where the welfare state and redistributive social systems are under increasing pressure. Against this backdrop, this thesis provided three analyses to understand some of the

underlying drivers and policy options to address the link between economic inequality and demographic change. First, through a retrospective theoretical model that underlines the evolution of women’s labor force participation, and their contribution to growth, it estimates the effect of demography on economic growth. Second, through a policy experiment that proposes to replace the current French property tax (taxe foncière), a regressive property tax by a more progressive tax such as imputed rent, it provides evidence for policymakers working on the complex task of fighting inequalities. Finally, it sheds light on the consequences of past pension reforms in France on the indebtedness of retirees.

The first chapter “Working Women in France: a Tale of Two Centuries Closing the Gaps” of this thesis analyses French demographic transition in the late 18th century, which started relatively early compared to richer and more populated neighboring countries. This analysis unveils the evolution of major demographic trends since the 19th century and their effect on paid and unpaid labor. This is of capital importance as the trade-off between remunerated and unpaid activities is at the heart of economic and social inequalities between men and women. It is critical to integrate unpaid work in our analysis to take into account the bargaining power within couples and the opportunity cost for women of either working in the market or having more children without outsourcing any domestic tasks. As stated throughout this manuscript, this early demographic transition was both the result of a drop in fertility and a rise in life expectancy. Families were more likely to privilege quality over quantity of children Diebolt et al. (2021), while health conditions improved throughout the 19th century. We observe that the sustained drop in fertility had an immediate effect on women’s labor force participation as

early as the 1880's. It led to a massive female presence within the market economy that we call the "First Female Revolution", a trend which was reinforced by the need of women to fuel the economy during WWI and WWII. By the end of these worldwide conflicts, women were responsible for around 45 % of market growth production and over 50% of augmented production (adding home production), compared to 35% and around 47% respectively before 1880. Despite a decrease in female labor force participation during the Thirty Glorious, the 1970's saw a "Second Female Revolution" with a growing number of educated women joining the market economy, a trend that is still prevalent nowadays. We used a realistic demography and an innovative OLG model to recreate the French economy from the early 19th century and observed a convergence between both genders of the amount of time devoted to paid and unpaid labor during the last two hundred years, even if women still spend more time to unpaid activities than men. The estimation of the evolution of unpaid work allowed us to shed light on the trade-off faced by couples, but especially by women between greater fertility and labor force participation. In addition to this, from an intergenerational point of view, inequalities by cohorts and gender also underline the redistributive role of the welfare state between sexes and goes against the myth of baby-boomers as over-privileged cohorts of the 20th century. This finding opens further avenues for research on this common belief that deserves to be further analyzed.

On the other hand, within the second and third chapter of this thesis assessed policies linked to population ageing, either from a retrospective analysis or a simulation of future policy options. Throughout the second chapter "Not taxing imputed rent: a gift to Scrooge?", we deployed fiscal simulation in order to uncover the inter and intragenerational inequalities arising from the

steep rise in real estate prices in France, current fiscal policies, and the ongoing process of population ageing. In France, imputed rent taxation was abolished during the Thirty Glorious (1965), to satisfy a growing social demand for better access to homeownership. It represents today one of the highest housing subsidies in the country. Our results show that not taxing imputed rent favors the richest and oldest households in particular the 9th and 10th deciles. The effect becomes more apparent when distinguishing between full right owners (usually older households) from owners with a mortgage (younger households) to whom we withdraw interest payments from the taxable base. These results deserve special attention in a context where an ageing population, as well as the younger generations (especially millennials), are struggling to access homeownership. In addition to this, throughout this chapter we advocate for the substitution of the current main residence tax, which we consider a local regressive tax that does not include overall revenues by a more progressive national property tax through imputed rent taxation. Simulations underline that this policy change would ensure a redistributive tax scheme, as it will lead to a tax increase for households in the 1st to the 7th decile of income distribution and would only imply a tax increase for households in the 10th decile. Overall, this chapter provides unprecedented evidence for policymakers to promote greater inter and intra-generational equity through fiscal policy.

Finally, in the third chapter “Pension Reform & indebtedness among the elderly: a struggle for keeping up with consumption levels?”, we explored the effect of recent pension reforms in France on the levels of private debt amongst retirees using a DID (Differences-in-Differences) model using the 2004 and 2014 rounds of the French Wealth Survey. Following Blake and

Garrouste (2019), we used public employees as a control group to assess the effects of the Balladur Reform, as they were not affected by the latter. Indeed, the 1993 Balladur Reform only concerned private sector employees and aligned regimes of farmers, traders, and craftsmen through a progressive increase in the minimum duration of contributions to retire, an indexation of pensions on inflation (previously on salaries) and the calculation of pension benefits taking the best 25 years of earnings (previously the best ten years). It was only ten years later, in 2003, that the Fillon's Reform extended these measures to public servants, who were not concerned by the previous reform. We extended this identification strategy to assess the effects of Fillon's Reform, using public employees as treatment group and private employee time as control group. Results showed overall greater indebtedness among retirees after having been affected by these reforms either for the private sector with the 1993 Balladur Reform or the public sector with the 2003 Fillon Reform. Moreover, we observe heterogeneous effects by level of education and income. In terms of financial frailty, for both rounds of the French Wealth Survey, we find that the less- educated and those not having financial difficulties acquired more debt than similar individuals that were not affected by the reforms. Additionally, we find strong significance exclusively for retirees affected by the 1993 Balladur Reform who had had structural financial issues during the years previous to the 2004 Survey.

When controlling by socio-demographic characteristics within our model tackling pension reforms, we provided further details on the profiles of these indebted retirees. Overall, retirees who were married or remarried, homeowners, and those who had a least one child, had greater probabilities of having acquired debt. Individuals performing a skilled socio-professional job, or hav-

ing a secondary home were also more prone to be indebted, which underlines the creditworthy financial status of those having acquired debt. In addition to this, some regional patterns are observed when assessing the 2003 Fillon Reform: living in the Parisian Basin, the West region, the South-West region, the East region, and the Mediterranean proved to increase the probability of having acquired debt by around 20%. This is not surprising as France's southern regions are usually chosen by seniors as retirement residential spots. Conversely, the Parisian region and the Centre-East regions were the least concerned by this phenomenon.

This thesis studied demographic change from historical and contemporary perspectives, drawing on two of the main mechanisms that drive population ageing: fertility and life expectancy. The innovative OLG model we propose can be used in further research on the retrospective analysis of demographic transition using data from other countries for comparison in particular of the historical trade-off faced by couples and specially women between devoting more time to either domestic or market production. Moreover, exploring the paradoxically delicate but not often studied question of imputed rent taxation adds further fiscal perspectives for tackling inter-generational and intra-generational inequalities in a context of unprecedented longevity, rise of real estate prices and precarity among the young who enter the labor market. In a national context of withdrawal of one of the local property taxes "Taxe d'habitation", this chapter provides further thoughts on fiscal tools to ensure fiscal resources while addressing these inequalities. Our third and last chapter provides retrospective analysis on the effects of pension reforms on indebtedness rates underlines the need for further comprehensive studies on the consequences of such reforms on retirees. This is a timely analysis in a

context of recurrent reforms of redistributive pension systems in the name of financial sustainability, as has been the case for France over the last two years.

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