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Aurélia TISON

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Rapporteurs :
Florence Jusot, Professeur en sciences économiques à l'université Paris-Dauphine, France
Steffen Torp, Professeur en psychologie à l'université de Buskerud et Vestfold, Norvège

Examinateurs :
James K. Hammitt, Professeur en sciences économiques à l'Université d'Harvard, USA
Xavier Joutard, Professeur en sciences économiques à l'Université d'Aix-Marseille, France

Directeurs de thèse :
Alain Paraponaris, Professeur en sciences économiques à l'Université d'Aix-Marseille, France
Bruno Ventelou, DR CNRS au Greqam UMR 7316, Aix-Marseille Université, France

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Résumé

Les travailleurs indépendants, contrairement aux travailleurs salariés, sont autonomes dans leur activité et n'ont pas de liens de subordination hiérarchique. Ils exercent à leur compte une activité économique en supportant tous les risques et en récupérant les bénéfices. Une de leurs principales caractéristiques, les distinguant des travailleurs salariés, est leur très faible aversion au risque.

Dans cette thèse, nous nous sommes demandé quel serait l'impact des maladies sur leurs trajectoires professionnelles mais aussi sur leur goût du risque. Afin de souligner leur différence, nous les comparons aux travailleurs salariés. Nous utilisons plusieurs bases de données. Pour analyser la prise de congés maladie et les trajectoires professionnelles des indépendants et des salariés suite à un cancer, nous utilisons l'enquête nationale française sur le Cancer appelée « Vican 2 ». Cette enquête a été menée par une équipe Sesstim et a été financée par l'Institut National du Cancer (INCA). Nous matchons les survivants d'un cancer à la population française grâce à l'Enquête Emploi de l'Insee, en différenciant les indépendants des salariés. Les modèles économétriques utilisés sont des modèles de Cox, des modèles de Markov et des estimations logistiques en deux étapes.
Pour analyser les impacts des maladies sur l'aversion au risque des individus, nous utilisons dans un premier temps l'enquête nationale française sur le cancer et dans un deuxième temps, une enquête américaine appelée « Health and Retirement Study ». Cette enquête de panel comprend des mesures sur l'aversion au risque et permet d'isoler plusieurs chocs de santé. Un modèle théorique est aussi proposé.

Nous retrouvons des résultats déjà connus concernant l'impact de maladies sur les trajectoires professionnelles. Mais nous renforçons ces résultats en montrant en quoi les maladies ont aussi un impact sur l'aversion au risque des indépendants et des salariés. Dans l'enquête nationale sur le cancer, les indépendants changent leur attitude face aux risques dans le contexte de leurs choix professionnels dans une moins forte proportion que les salariés. Dans l'enquête américaine, les maladies ont un impact sur l'aversion au risque des individus en général. Cet impact dépend de la nature de la maladie. Par exemple, le diabète et les maladies psychologiques pousseraient les gens à devenir plus averses vis-à-vis des risques liés aux choix professionnels. Par contre, dans le cas de gens atteints du cancer, il a été constaté qu'ils deviennent moins averses au risque, toute chose égale par ailleurs.

Les contributions de cette thèse sont multiples.
Tout d'abord, elle souligne la nécessité de faire des études qualitatives et quantitatives seulement sur les indépendants. Cette population fait face à des difficultés différentes de celles

des salariés suite à une maladie, notamment le maintien de leur activité. Il faut mettre en avant ces difficultés et lier leurs discours aux observations quantitatives.

Les résultats soulignent aussi que l'aversion au risque n'est pas une caractéristique innée et stable des individus. Il y a dans ce travail des preuves empiriques, et des fondements théoriques, que les chocs de santé peuvent amener les individus à reconsidérer leur goût du risque, souvent à la baisse (maladies chroniques stables), parfois à la hausse (survie au cancer).

Les maladies ont donc des impacts directs sur les trajectoires professionnelles des individus mais aussi des impacts indirects via la modification de variable psychologique telle l'aversion au risque.

Abstract

Self-employed workers, contrary to salaried employees, are autonomous and do not have any hierarchical links. They work for themselves and bear all the risks of their activity. One of their main characteritics is their very low risk averion, that distinguishes them from salaried staff.

In this PhD, we asked ourselves what would be the impact of diseases on their professional trajectories but also on their taste for risks. In order to underline their difference, we compare them to salaried staff. Several databases are used. To analyze the resort to sick leave, we used the French National Survey on Cancer called « Vican 2 ». This survey was led by a Sesstim unit and was funded by the French National Institute on Cancer (INCa). We matched cancer survivors with the French population from the labor force survey, by differentiating them to salaried staff. Econometric models used are Cox models, Markov models and logistic estimations in two steps. To analyse the impact of diseases on the financial risk aversion of individuals, we used, in a first step, the French National Cancer Survey and, in a second step, an American survey called « Health and Retirement Study ». This panel survey includes measures on risk aversion and allowed us to isolate different health shocks. A theoretical model is also proposed.

Well-known results about the impact of diseases on professionnal trajectories are found. We strengthened these results by showing how diseases impact the risk aversion of self-employed and salaried workers. In the national survey on Cancer, self-employed workers change their attitude towards their professional choices, in a lesser proportion than salaried staff. In the American survey, diseases have, in general, an impact on people's risk aversion. This impact depends on the nature of the disease. For instance, diabetes and psychological diseases would push people to become more risk averse in the field of their careers. However, in the case of people diagnosed with cancer, it has been noticed that they become less risk averse after their disease, all other things kept equal.

Contributions of this thesis are multiple. First of all, it underlines the necessity to do qualitative and quantitative studies only on self-employed workers. This population faces different difficulties from salaried staff, in particular the challenge of maintaining their activity.
Results also underline that risk aversion is not a innate and stable characteritic. In this work, there are empirical proof and theoretical foundations that health shocks can lead people to reconsider their tastes for risks, by an increase of risk aversion (chronic diseases), sometimes a decrease (survival to cancer).
Diseases have direct impacts on people's profesionnal trajectories but also an indirect impact via the modification of some psychological variables such as risk aversion.

Introduction générale

A. Santé et conséquences professionnelles d'un choc de santé

Grâce aux progrès médicaux, les populations vivent plus longtemps et ont plus de chances de survivre aux maladies. Dans le même temps, la perspective de l'allongement de la durée de vie a contribué à étirer les carrières professionnelles, en repoussant l'âge du départ à la retraite. Assez logiquement, de plus en plus de travailleurs doivent composer avec la maladie (Ferlay et al, 2012) (Hoffman et al, 2005). Or, l'impact des maladies sur les trajectoires professionnelles n'est pas neutre. Il est généralement décrit par trois grandes séries de conséquences qui, dans la littérature, se démarquent.

Tout d'abord, les gens ayant subi un choc de santé prennent, pour la plupart, plus d'arrêts maladies. Dans la littérature internationale, l'étude américaine de Finkelstein et al. montrent que ceux qui ont un cancer alors qu'ils sont en emploi passent en moyenne 22,3 jours de plus en congé-maladie qu'une population employée sans cancer (Finkelstein et al, 2009). Ce résultat est nuancé par la considération de certaines variables sociodémographiques. Par exemple, les femmes prennent des arrêts maladie plus longs et plus fréquemment que les hommes (Barnay et al, 2015) (Chaupain et al, 2007) (Ben Halima et al, 2013) (Livanos et al, 2010). En France, Chaupain-Guillot et al. montrent que les individus souffrant d'une maladie chronique aiguë ou d'un handicap ont une plus grande probabilité de se mettre en arrêt maladie que les autres (Chaupain-Guillot et al, 2007). Tandis que Ben Halima et al. soulignent que les individus souffrant d'une maladie chronique aiguë prennent des arrêts maladies plus longs (Ben Halima et al, 2013).

Ensuite, il est établi que les chocs de santé comme le cancer incitent à des départs à la retraite anticipés en comparaison aux populations sans choc de santé. Dans cette thèse, nous utilisons le terme de choc de santé pour qualifier l'apparition et éventuellement la persistance d'une « maladie ». Nous pensons que la découverte d'une maladie par une personne souffrante constitue un réel choc émotionnel pour elle ainsi que pour sa famille, pouvant avoir des conséquences sur leurs vies (Reich et al, 2001) (Spelten et al, 2003) (Delveaux, 2006). Nous ne nous intéressons pas à l'étiologie des maladies dans cette thèse. Notre intérêt porte bien plus sur les effets de la maladie que sur le statut social. Aussi, l'occurrence de la maladie, le choc de santé, seront considérés dans ce qui suit comme une variable exogène aux modèles qui seront envisagés, à la manière, dans un autre registre, des « politiques publiques » dans les modèles macroéconomiques.

En Finlande, le risque relatif de départ à la retraite anticipé, à sexe et âge donnés, est de 2.2 pour les survivants d'un cancer du système nerveux. Il représente ainsi un risque élevé de départ à la retraite anticipé. Le risque relatif est de 2 pour les leucémies, de 1.2 pour les cancers de la langue, de 1.2 pour le cancer du sein et de 1.1 pour la prostate (Taskila-Abrandt et al, 2005).

Par ailleurs, les personnes subissant de plein fouet la maladie ont plus de chance de se retrouver au chômage. Une étude de de Boer et al. estime que le risque de passer au chômage est plus élevé pour les survivants d'un cancer que pour une population saine « non malade » (de Boer et al, 2009). En France, Jusot et al. montrent qu'un mauvais état de santé accroît fortement le risque de devenir inactif ou chômeur (Jusot et al, 2010).

Enfin, ceux qui sont dans une situation de non emploi (chômage ou inactivité) au moment du diagnostic de la maladie ont beaucoup moins de chance de retrouver un emploi deux ans après contrairement à ceux qui n'ont pas subi de choc de santé (Joutard et al, 2012) (Menhert, 2013) (Paraponaris et al, 2004) (Eichenbaum-Volie, 2008).

B. La question spécifique des indépendants

L'impact des maladies sur les trajectoires professionnelles peut être certes résumé par des grands traits communs. Toutefois, des différences de comportements face à la maladie apparaissent entre travailleurs indépendants et salariés. Et ces différences ont été, jusqu'à présent, très peu mises en lumière.

En France, les travailleurs indépendants sont définis de la manière suivante par l'INSEE (Institut National de la Statistique et des Etudes Economiques): *« les travailleurs indépendants sont des personnes qui exercent à leur compte une activité économique, en supportant les risques de cette activité et en s'appropriant les profits éventuels qu'elle peut générer. Ils sont autonomes dans l'organisation de leur travail, et ne se trouvent pas, à la différence d'un personnel salarié, dans une situation de subordination juridique à l'égard de la personne avec laquelle ils contractent. Ils relèvent par ailleurs d'un régime spécifique de protection sociale, distinct du régime général, et leur intervention ne s'inscrit pas dans le cadre des règles fixées par le Code du travail. »*
Dans notre pays, les travailleurs indépendants non agricoles relèvent du Régime Social des Indépendants (RSI) et les travailleurs indépendants agricoles relève de la Mutualité Sociale Agricole (MSA).

Cette population hétérogène croît. Ces dix dernières années, le RSI a vu son nombre de cotisants augmenter de 45 %. Chaque année, il enregistre une augmentation de 3,8 % en moyenne (Rapport RSI, données 2009 et 2011). Bien que le nombre d'agriculteurs diminue, la population des indépendants est en progression (+11, 3%) du fait de l'apparition et de la croissance rapide des auto-entrepreneurs. Ce nouveau statut, apparu en 2009, a allégé les conditions administratives pour devenir entrepreneur ainsi que les charges sociales dans une certaine limite de revenu par année. Le mouvement de délocalisation des entreprises et la dématérialisation caractéristique du fonctionnement des firmes dans bon nombre de secteurs d'activité conduisent bon nombre d'actifs à l'entrepreneuriat. Le savoir et l'innovation reposant, de nos jours, tout autant sur de l'immatériel que sur du matériel, de nombreuses start-ups se développent.

Historiquement, les travailleurs indépendants refusèrent d'intégrer le régime universel d'assurance maladie auprès des travailleurs salariés, proclamant un moindre recours au remboursement des soins (Sauze, 2011). Or de nos jours, à structure d'âge et sexe équivalente, ils se caractérisent par un taux global d'affection en ALD30 confondu supérieur de 9 points à celui des travailleurs salariés. Il n'y pas de différences significatives dans l'incidence des cancers, à la différence des affections cardio-vasculaires, du diabète et de la maladie d'Alzheimer (Sauze et al, 2011). L'admission en ALD 30 est commune aux indépendants et aux salariés (décret du 4 octobre 2004), et la seule différence réside peut-être dans le rôle de la médecine préventive (et d'un médecin du travail) sur le lieu de travail.
Sous l'angle de la protection sociale, cette population reste hétérogène : 5,7 % des affiliés au régime des indépendants sont bénéficiaires de la CMU-C (couverture maladie universelle complémentaire). Une augmentation de 10 % de demande d'aide à la complémentaire santé a été enregistrée, entre 2008 et 2009, parmi les affiliés du RSI.

Comme indiqué précédemment, des différences de comportements suite à une maladie apparaissent entre indépendants et salariés mais faute de données collectées suffisantes, elles sont très peu mises en lumière. Seulement quelques études étrangères mettent en avant ces difficultés. Par exemple, Carlsen et al. (2008) montrent que les travailleurs manuels ont un risque accru de se retrouver au chômage après un cancer par rapport aux autres travailleurs au Danemark (Carlsen et al, 2008). L'étude finlandaise de Taskila et al. (2004) souligne que les survivants d'un cancer travaillant dans l'agriculture, les mines, les forêts, la pêche, les transports et la communication, ont moins de chance d'être en emploi après le diagnostic que les autres, mettant en avant les efforts physiques requis par ces activités. De plus, un rapport irlandais met avant les difficultés financières des travailleurs indépendants suite à un cancer à l'aide d'entretiens (Sharp et al, 2010).

En France, l'étude nationale française sur le cancer réalisée en 2004 par la DREES (Direction de la recherche, des études, de l'évaluation et des statistiques), en partenariat avec les trois principaux régimes d'assurance maladie et l'Institut national de la santé et de la recherche médicale (INSERM), constitue la première grande enquête statistique représentative sur les conditions de vie des malades du cancer deux ans après le diagnostic en France (Le Coroller Soriano et al, 2008). Dans cette enquête, les indépendants se distinguent souvent des salariés. En effet, seulement 45,4 % des agriculteurs actifs atteints d'un cancer fin 2002 s'y révélaient toujours un emploi en 2004, contre 67,7% des employés, 53,7% des ouvriers, 73% des artisans, commerçants, chefs d'entreprises et 74,2% des professions intermédiaires (Paraponaris et al, 2008). De plus, 21% des artisans, commerçants et chefs d'entreprise déclaraient une perte de revenus nette à cause de leur maladie contre seulement 12,8% des cadres. Ce pourcentage était proche de celui des ouvriers (20,7%) (Malavolti et al, 2008). Enfin un indépendant avait une meilleure probabilité que les travailleurs salariés de reprendre un emploi après un cancer. Toutefois, ce résultat est à nuancer. A partir des mêmes données, Sophie Eichenbaum-Voline et al. (2008) ont montré que le retour à l'emploi est plus difficile pour les travailleurs manuels,

notamment les agriculteurs, indépendamment de la gravité relative des cancers qui les touchent. Cependant, ces analyses reposent sur des échantillons comprenant un faible nombre d'indépendants, ce qui n'a pas permis de comparaisons avec la population générale. Dans la mesure où ils semblent faire face à des difficultés différentes de celles des salariés suite à une maladie comme le *« cancer »*, il paraît primordial de réaliser des analyses sur cette population en les comparant à la population générale.

Suite à l'enquête nationale sur le cancer de 2004, une autre enquête « VICAN 2 » a été réalisée en 2012 par l'Institut national du cancer (INCa) et l'Inserm. Cette enquête a interrogé 4349 personnes atteintes d'un cancer deux ans après le diagnostic. Une attention particulière a été portée aux indépendants interviewés.
Dans cette enquête, nous montrons que 75% des indépendants ressentent une peur accrue d'avoir à l'avenir un problème d'accès à un crédit immobilier ou professionnel à cause de leur cancer. Cette crainte est extrêmement importante chez les chefs d'entreprises et les professions libérales (taux respectivement de 91% et 97%) (Paraponaris et al, 2014). Si cette peur s'avère concrète, alors la survie de leur activité est sérieusement en jeu. D'ailleurs, une étude récente de Ha-Vinh et al. (2005) montre que les indépendants font face à un risque accru de cessation d'activité cinq ans après le diagnostic de leur cancer (Ha-Vinh et al, 2015).
De plus, les artisans, commerçants et chefs d'entreprises se plaignent davantage de subir des pertes de revenu suite à leur cancer (Paraponaris et al, 2014). Il est donc nécessaire de mettre en avant les difficultés qu'ils rencontrent afin de dessiner des politiques de santé publique adaptées à leur situation. Pour cela, il est aussi primordial de les comparer à la population générale, n'ayant pas vécu pareil choc de santé, afin de déterminer ce qui est causé ou pas par la maladie, en l'occurrence par un *« cancer »*. Cette double comparaison entre salariés et indépendants ayant eu un cancer et entre survivants d'un cancer et population générale est un des objectifs principaux de cette thèse.

Il y a ainsi fort à penser que, suite à un diagnostic de cancer, la population des indépendants fait face à des situations différentes que celles des salariés, impliquant des prises de décision différentes. Cette particularité s'inscrit dans un cadre plus large de différences relatives à la prise de décision, au sein duquel les indépendants se démarquent des salariés. En effet, une des caractéristiques principales décrivant le goût pour l'entrepreneuriat des travailleurs indépendants est la faible aversion vis-à-vis du risque financier dont ils font preuve et qui est très peu commune en population générale (Cramer et al, 2002) (Colombier et al, 2008). Cette caractéristique explique pourquoi ils acceptent de faire face à de nombreux risques au quotidien. Martine d'Amours, dans son rapport de recherche (2009), définit, au nombre de cinq, les risques encourus par les indépendants. Il y a le « risque de sous-emploi », qui est défini comme la possibilité de manquer de contrats ou de clients, donc de revenus. Le risque accident/maladie/invalidité est défini comme la possibilité d'une perte de revenus liée à l'impossibilité physique ou mentale de fournir la charge de travail habituelle. Le risque parentalité est la possibilité d'une perte de revenus liée à la grossesse et aux premiers mois de vie d'un enfant. Quant au risque « avancée en âge », il est défini comme la diminution de la

capacité de travail ou de revenus issus de l'activité de travail, à mesure qu'on avance en âge. Et pour finir, le risque de « désuétude des connaissances » est défini comme la possibilité de voir son employabilité diminuer si ses connaissances ne sont pas mises à jour. Au quotidien, les indépendants font donc dores et déjà face à de nombreux risques.

A la suite de l'établissement du diagnostic d'une maladie, les indépendants se retrouvent confrontés à deux types d'incertitudes : une incertitude économique liée à la survie de leur entreprise que ne connaissent pas les salariés et une incertitude sanitaire nouvelle liée à leur propre survie menacée par la maladie. Martine d'Amours appelle ce risque « le risque accident/maladie/invalidité ». Voyant se concrétiser ce risque, les indépendants doivent certainement encore plus se soucier du maintien de leur activité.

Nous pouvons donc nous demander dans quelle mesure les travailleurs indépendants ne souhaiteraient pas retrouver une activité salariée après un choc de santé tel le cancer. Est-ce que la maladie contribuerait à modifier leur comportement vis-à-vis du risque et donc leur volonté à affronter régulièrement des situations incertaines ? Modifierait-elle ainsi leur comportement d'investisseurs ?

C. Le concept d'aversion au risque

Avant de décrire le concept d'aversion au risque, il est souhaitable de rappeler ce que sont les préférences pour les économistes : les relations de préférence correspondent à des relations binaires asymétriques et transitives. Si vous préférez X à Y alors il n'est pas possible de dire que vous préférez Y à X, la relation est donc asymétrique. Par ailleurs, si vous préférez A à B et B à C alors vous préférez A à C. On définit ainsi la transitivité.

Les choix A, B et C peuvent être des « loteries », c'est-à-dire des paniers composés de différents paiements risqués (A est composé de 100 euros avec une probabilité de 90% -0 sinon- ; B est composé de 60 euros avec une probabilité de 50% - 120 euros avec une probabilité de 50% sinon).
Selon les économistes, l'aversion au risque se réfère aux préférences qu'éprouve une personne face à ces risques. Une personne averse au risque ne sera pas indifférente entre deux options, par exemple A et B, proposant la même espérance de gain mais présentant deux niveaux de risques différents.

Dans la théorie de l'utilité, l'aversion au risque est d'ailleurs le rapport négatif entre la dérivée seconde et la dérivée première de la courbe d'utilité, qui relie la consommation d'un individu à son niveau de satisfaction. La plupart des économistes estiment que ce paramètre est exogène, inné et immuable. Les préférences des individus seraient alors représentées par des fonctions d'utilité, pour lesquelles l'aversion au risque ne varie pas au cours du temps et en fonction du salaire (dites CARA : constant absolute risk aversion). Cette hypothèse peut être discutée. Est-

ce que ce paramètre est réellement inné et exogène ? L'aversion au risque d'une personne ne varierait-elle pas en fonction de l'état de santé de cette personne ? Si la santé a un impact sur les investissements financiers, doit-on exclure que cet impact résulte d'une modification de l'aversion au risque des individus ?

L'impact d'un choc de santé sur les investissements financiers a déjà longuement été étudié (Hariharan et al, 2000) (Rosen et al, 2004) mais le biais par lequel la maladie contribue à modifier la prise de décision d'investissements n'est pas connu. Est-ce via l'aversion au risque ou d'autres variables psychologiques ? De fait, l'impact d'une maladie sur l'aversion au risque financier est beaucoup moins étudié dans la littérature.

Dans le cadre de la théorie économique, très peu de modèles étudient le lien entre santé et aversion au risque. Hammitt et al. (2009) montrent dans un modèle théorique, basé sur une fonction d'utilité additive, que la santé et la longévité n'influencent pas l'aversion vis-à-vis du risque financier. Ce résultat est lié au fait que, par hypothèse (d'additivité), la santé n'a pas de rôle sur l'utilité marginale du revenu. Nous y reviendrons dans la deuxième partie de cette thèse. Si la santé avait un impact sur l'aversion au risque, plusieurs hypothèses pourraient être alors envisagées. Nous pouvons imaginer qu'un choc de santé puisse modifier l'utilité marginale du revenu, à savoir la satisfaction retirée par la consommation de chaque unité supplémentaire d'un bien. Etant donné que l'aversion au risque est le rapport négatif de la dérivée seconde de l'utilité sur l'utilité marginale du revenu, une modification de l'utilité marginale entraînerait alors une modification de l'aversion au risque. Par ailleurs, une réduction de la longévité, suite à un choc de santé, pourrait diminuer les futurs revenus et donc les futurs besoins de financer des biens de consommation. Ceci impacterait l'utilité du revenu et modifierait ainsi l'aversion au risque d'un individu.
De plus, un choc de santé pourrait tout simplement réduire les futurs revenus et en conséquence impacter l'aversion au risque via le canal de l'utilité marginale du revenu. Et pour finir, les dépenses médicales suivant le diagnostic d'une maladie pourraient faire baisser le budget dédié à la consommation et à l'épargne et ainsi modifier l'aversion au risque.

A l'heure actuelle, aucune de ces hypothèses n'est privilégiée et le biais selon lequel la santé affecterait l'aversion au risque reste à documenter. Au préalable, il faut être certain que la santé influence le comportement des individus vis-à-vis du risque. Sur ce point, il existe quelques études empiriques et expérimentales.

Les études expérimentales sont basées sur des petits échantillons allant de 30 individus à 93 individus. Elles s'appuient sur des méthodes du type Iowa Gambling Task ou Probability Task qui consistent en des jeux de loterie. Les gens souffrant d'Alzheimer auraient ainsi des comportements vis-à-vis du risque altérés par rapport à une population plus saine. Ils feraient des choix plus risqués et moins avantageux que les groupes de contrôle (Sinz et al, 2008) (Delazer et al, 2007) (Ha et al, 2012). Il en irait de même pour les individus souffrant de la

maladie de Parkinson (Delazer et al, 2008). En revanche, les individus souffrant de dépression seraient plus averses au risque que les individus en bonne santé (Smoski et al, 2008).
Par ailleurs, des preuves biologiques montrent que les émotions déclenchées par des événements de santé particuliers sont susceptibles de modifier superficiellement ou profondément les traits de caractère pourtant supposés immuables dans les modèles économiques, notamment ceux liés à l'aversion au risque (Ha et al, 2012) (Carney et al, 2010).

Quant aux études empiriques, elles s'appuient sur des plus grandes bases de données et sur des questions représentant une fois de plus des loteries hypothétiques. Dans leur article, Hammitt et al. (2009) trouvent que plus les individus sont en bonne santé, plus ils sont tolérants vis-à-vis du risque financier, mais cette étude est statique. Dans une perspective dynamique, Sahm trouve qu'une agrégation de chocs de santé a un effet significatif sur l'aversion au risque seulement quand le panel de données étudié *« Health and Retirement Study »* est « balancé » (les différences systématiques entre malade et non-malade sont contrôlées). Ces chocs de santé conduiraient les individus à devenir plus averses vis-à-vis du risque financier. Selon Melnychuck et al. (2012), subir une dépression diminuerait la disposition des individus à investir dans les actifs risqués, vraisemblablement par le canal de l'aversion au risque.

La compréhension des mécanismes pouvant influencer de possibles variations de l'aversion au risque importe tout particulièrement lorsque l'intérêt se porte sur la trajectoire de croissance des économies. Sur le plan macroéconomique, certaines fonctions intègrent l'aversion au risque comme déterminant. Dans la Théorie générale de l'emploi, de l'intérêt et de la monnaie, Keynes fait dépendre l'investissement d'un recrutement suffisant d'individus de *« tempérament sanguin »* et *« d'esprit constructif »* qui s'embarqueraient dans les affaires pour occuper leur existence sans chercher réellement à s'appuyer sur un calcul précis de profit escompté (Keynes, 1936). « *Si la nature humaine n'avait pas le goût pour le risque* », écrit-il, « *les seuls investissements suscités par un calcul froidement établi ne prendraient sans doute pas grande extension* ». Ce goût du risque serait en conséquence nécessaire à la croissance économique d'un pays. D'ailleurs, selon Keynes, « *les revenus sont créés par les entrepreneurs qui produisent en partie à des fins d'investissement et en partie pour la consommation* ». L'entrepreneur a aussi une place centrale dans l'œuvre de Schumpeter. Il est celui qui transforme le cycle économique en le faisant évoluer, celui qui prend des risques, celui qui crée de la valeur, celui qui en détruit ainsi que celui qui innove (Schumpeter, 1942).

Enfin, l'aversion au risque peut aussi être liée à l'instauration d'inégalités dans la mesure où une plus grande tolérance au risque financier ouvre la porte des métiers d'entrepreneurs et indépendants. Dans un article de 1996, Shaw explique que la croissance des rémunérations est positivement corrélée avec la tolérance au risque financier (Shaw, 1996). De fait, les plus éduqués sont les plus enclins à prendre des risques. C'est pourquoi l'auteur suggère que ces comportements vis-à-vis du risque, différents selon le niveau d'éducation reçu, expliqueraient une partie du retour sur investissement de leurs études. Une autre étude, menée en Ethiopie, précise que les agriculteurs présentant une trop grande aversion au risque ou une aversion aux

pertes font des choix d'investissement moins rentables. Cette trop grande aversion constituerait ainsi une trappe de pauvreté (Yessuf, 2009).

Ainsi, l'étude de l'impact des maladies sur l'aversion au risque doit permettre à terme d'anticiper l'effet que les événements de santé sont susceptible d'avoir directement, ou indirectement sur la croissance économique des pays.

D. Question de recherche et présentation du plan

Etant donné le vieillissement des populations dans les pays occidentaux, ainsi que l'importance revêtue par l'aversion au risque des individus, il apparaît intéressant de voir dans quelle mesure ce goût du risque peut se retrouver influencé par les maladies. Si la maladie a un effet néfaste sur le goût du risque des individus, alors elle s'avérerait être un frein à l'essor économique.

L'hypothèse sous-tendue par cette thèse est que les maladies ont non seulement un impact « mécanique » sur la vie professionnelle des gens mais aussi sur des variables psychologiques telles l'aversion au risque, pouvant ainsi amener encore une fois les individus à modifier leurs trajectoires professionnelles. Savoir si les maladies modifient les comportements professionnels des individus directement et indirectement et comprendre par quels biais ces modifications ont lieu sont ainsi au cœur de notre recherche.

La prise de risque étant une variable clé des indépendants qui eux-mêmes jouent un rôle majeur dans les cycles économiques, nous avons décidé de dédier une attention particulière à cette population. Comment réagissent-ils face à la maladie ? Est-ce que le comportement des indépendants vis-à-vis des arrêts maladies et trajectoires professionnelles sont différents de ceux des salariés suite à un cancer ? Modifient-ils substantiellement leurs comportements vis-à-vis du risque, suite à une maladie ? Est-ce que ce changement les inciterait à modifier leur activité, voire à abandonner l'exercice en tant qu'indépendant ? Autant de questions auxquelles les essais suivants tenteront de répondre.

Cette thèse comprend deux parties. Dans la première partie, la situation professionnelle des indépendants et des salariés suite à un cancer est analysée à l'aide de l'enquête nationale française sur le cancer et de l'enquête emploi. Cette première partie comprend deux chapitres.
Le premier chapitre consiste à étudier le recours à l'arrêt maladie de ces deux populations. Le temps mis pour y recourir après le diagnostic de cancer puis le temps passé en arrêts maladies sont ainsi analysés grâce à des modèles de Cox. Les trajectoires professionnelles sont étudiées dans un second chapitre grâce à des modèles de Markov. Les trajectoires des survivants d'un cancer (emploi, inactivité, retraite) sont comparées à celles de la population générale. Une autre comparaison a lieu entre indépendants et salariés ayant eu un cancer.
Ces deux chapitres reposent sur deux articles destinés à des revues de santé publique et d'économie.

L'introduction de la partie 2 met en avant les changements de comportements déclarés vis-à-vis des risques dans le domaine de la carrière et de la santé suite à un cancer. Cette partie repose sur les données de l'enquête nationale française sur le cancer de 2014. Encore une fois, une comparaison entre indépendants et salariés est effectuée. Etant donné la nature fragile de ces mesures d' « aversion au risque », nous avons cherché une enquête comportant un autre type de mesure. Une bonne candidate est l'enquête américaine sur la santé et la retraite *«The Health and Retirement Study »*, qui comprend des mesures de type Barsky et al 1997). Cette méthode consiste à poser des questions aux individus sur leur volonté de changer de travail. Ils ont le choix entre garder le même type de travail avec le même salaire ou opter pour un autre travail pour lequel ils ont 50% de chances de doubler leur revenu ou 50% de chance de le diminuer par 10%, 15% ou 20%. Des réponses oui/non sont attendues et une procédure en deux étapes permet de classer les interviewés en plusieurs catégories d'aversion au risque. Cette méthode n'oblige pas à utiliser une forme de fonction d'utilité pour classer les individus bien que Kimball, Sahm et Shapiro utilisent une fonction dite *« CARA »* (pour laquelle l'aversion au risque est constante) dans un de leur article afin de transformer la mesure ordinale en mesure cardinale (Kimball et al, 2008).

La deuxième partie de cette thèse a été en conséquence réalisée à partir de cette enquête. Elle repose sur deux articles. L'impact d'un choc de santé sur l'aversion au risque en population générale y est étudié. L'effet de différentes maladies est mis en lumière: cancer, diabète, arthrose, maladies pulmonaires, maladies psychologiques, maladies cardiaques, attaques et hypertension.

Dans un premier chapitre, la littérature sur les liens entre la santé et l'aversion au risque ainsi qu'un modèle théorique visant à analyser l'impact d'un choc de santé sur l'aversion au risque, sont présentés. Dans le second chapitre, plusieurs modèles économétriques ont été utilisés afin d'analyser l'effet des maladies sur la variation des comportements vis-à-vis du risque financier. Certains modèles analysent aussi l'effet des maladies sur la variation d'actifs sûrs détenus dans le portfolio des individus. Cette variation d'actifs sûrs peut également représenter la volonté des agents à prendre des risques ou pas et fournit ainsi une seconde variable comportementale intéressante à analyser.

Dans la conclusion de cette thèse, plusieurs « *messages* » et *« idées »* sont présentés aux acteurs et pouvoirs publics. Les « *messages »* destinés aux pouvoirs publics reposent en partie sur les recherches scientifiques menées tout au long de cette thèse. Les *« idées »* font suite au travail de recherche accompli, en s'en émancipant par certains aspects, pour contribuer au débat public sur la situation des travailleurs indépendants en France après un cancer et, plus largement, après une maladie.

General Introduction

A. Health and professional consequences of a health shock

Thanks to medical progress, populations live longer and have more chances to survive diseases. At the same time, extension of the life expectancy contributed to stretch professional career, by delaying the retirement age. Quite logically, more and more workers must deal with a disease (Ferlay et al, 2012) (Hoffman et al, 2005). Yet, the impact of diseases on professional trajectories is not neutral. Generally, three main kinds of consequences are put forward in the literature.

First of all, people enduring health shocks take, for most of them, sick leaves. In the international literature, the American study of Finkelstein et al. shows that people who are employed and who are sick with cancer take 22,3 days more of sick leave compared to an employed population without cancer (Finkelstein et al, 2009). This result is qualified if we take into consideration some certain sociodemographic. For instance, women take longer and more frequent sick leave than men (Barnay et al, 2015) (Chaupain et al, 2007) (Ben Halima et al, 2013) (Livanos et al, 2010). The French study of Chaupain-Guillot et al. shows that individuals suffering from a chronic disease or from a handicap have a higher probability of taking sick leaves than others (Chaupain-Guillot et al, 2007). Another French study of Ben Halima and al. underlines that individuals suffering from an acute disease take longer sick leaves than others (Barnay et al, 2015) (Ben Halima et al, 2013).

Then, it has been established that health shocks, such as cancer, encourage early retirement, compared to the population without health shocks. The term health shock is used in this thesis to describe the occurrence of a disease and eventually its maintenance. We think that being diagnosed a disease constitutes a real emotional shock for the patient and for his/her family, that leads to consequences in his/her life (Reich et al, 2001) (Spelten et al, 2003) (Delveaux, 2006). We are not interested in the etiology of the diseases, in this thesis. Our interest is more about the effects of diseases than about the social status. Also, the occurrence of a disease, a health shock, would be considered, in what follows, as an exogenous variable, in the way of, in another register, “public policies” in macroeconomic models.

In Finland, people surviving cancer are at a higher risk of early retirement than others (Taskila-Abrandt et al, 2005). Then, people who face diseases have more chance to be unemployed (Jusot et al, 2010). In a French study, Jusot et al show that being in bad health increases the chances of becoming unemployed or inactive (Jusot et al, 2010).

Last, people who are unemployed at the time of a cancer diagnosis, have less chances to find a job two years after compared with those who have not undergone a health shock (Joutard et al,

2012) (Menhert, 2013) (Paraponaris et al, 2014) (Eischenbaum-Voline, 2008).

B. The specific question of self-employed workers

The impact of diseases on professional trajectories can be summed up by some main common traits. However, differences of behaviors (and of consequences) appear between self-employed and salaried employees, after the disease. And, these differences have not been enlightened enough.

In France, self-employed workers are defined by the INSEE (The French National Institute of Statistics) as: "*persons exercising an economic activity, by supporting risks linked to this activity. They are autonomous in the organization of their work and don't find themselves in a situation of subordination. They are members of a special regime of social protection*".

In France, self-employed come under two different schemes of Sickness Funds: farmers are members of the MSA (Mutualité Sociale Agricole-Social mutuality for farmers) and the other self-employed workers (craftsmen, shopkeepers, self-employed lawyers, architects, pharmacists, notaries, medical specialists,…) are members of the RSI (Régime Social des Indépendants-Social security regime for self-employed workers).

This heterogeneous population is growing. Over the last decade, the number of RSI members rose by 3.8% (RSI report, 2009 and 2011 data). Even though the number of farmers is decreasing in France, the population of self-employed workers is growing (+11.3%) thanks partly to the arrival of the "auto-entrepreneurs". This new status, created in 2009, reduces administrative conditions and insurance contributions to a certain extent of earnings per year. On the other hand, the deindustrialization in France and the emergence of a new economy based on immaterial assets contribute to the emergence of new entrepreneurs. As nowadays, knowledge and innovation are based as much on immaterial than on material, a lot of startups develop.

Historically, self-employed workers first refused to be part of the French general social security system (the one dedicated to the salaried population), proclaiming less reliance on the refund of costs of treatments (Sauze, 2011).
Nowadays, in equivalent structure of age and gender, the self-employed workers are characterized by an overall rate of disease in ALD30[1] which is higher by 9% to the one of salaried workers (no significant differences for cancer but substantial differences for cardio-vascular diseases, diabetes and Alzheimer). The ALD30 care management is now common for self-employed and salaried workers and the only difference may be in the role of preventive

[1]ALD = affections de longues durées. ALD are long-term diseases, most often chronic diseases. In France, 7 million people benefit from this special status (Article L 324 of the Social Security Code). Care linked to the disease are fully reimbursed.

medicine (and of a labor doctor) on the workplace. Regarding the social protection, this population remains heterogeneous: 5.7% of RSI members benefit from the CMU-C[2]. The demand for free supplementary coverage rose in the end of 2000's.

As indicated previously, differences appear between self-employed workers and salaried staff, after cancer. There are not enlightened a lot. Indeed, few international studies put forward the difficulties of self-employed workers. In a Danish study, manual workers are at a higher risk of being unemployed compared to others workers (Carlsen et al, 2008). The Finish study of Taskila et al. (2004) shows that people surviving cancer, who work in farms, mines, forests, fishing, transports and communication, have less chances to be employed than others. Furthermore, an Irish report enlightens the financial difficulties of self-employed workers after cancer (Sharp et al, 2010).

In France, the French National Survey on Cancer of 2004, was conducted by the DREES (French Direction for Research, Studies and Statistics), in partnership with three health insurance scheme and the national institute for health and medical research (INSERM). It constitutes the first representative statistical survey on life two years after cancer in our country (Le Coroller Soriano et al, 2008).
In this survey, self-employed workers distinguished themselves several times from salaried employees. Indeed, 45.4% of farmers having a cancer in 2002 and who were employed at that time, had still a job two years after compared with 67.7% for salaried employees. These rates reached 73% for craftsmen, shop keepers and business owners, 53.7% for blue collars and 74.2% for intermediary professions (Paraponaris, 2004). Moreover, 21% of craftsmen, shopkeepers and business owners declared a net loss of income caused by their diseases versus only 12.8% executives. This percentage is close to the one of blue collars (20.7%) (Malavolti, 2008). A self-employed worker has a better probability to return to work after a cancer compared with a salaried worker but this result must be qualified as the survey of Sophie Eichenbaum-Voline (et al, 2008) shows that for manual workers, such as farmers, return to work is more difficult regardless of the severity of their cancers. However, these studies rely on small samples of self-employed workers which did not allow comparisons with the general population. To the extent that they face different difficulties than salaried staff after cancer, it is important to realize studies on this population.

Another national survey on cancer was conducted by the National Institute for Cancer (INCa) and Inserm in 2014, following the survey of 2004. This survey interviewed 4349 persons diagnosed with cancer, two years after the diagnosis, with a special attention for self-employed workers.
In this survey, we show that 75% of self-employed workers fear not to have access to real estate or professional credits anymore because of their disease. This fear is extremely important among business owners and liberal professions (respectively of 91% and of 97%) (Paraponaris

[2]Free universal health care.

et al, 2014). If this fear turns out to be concrete, then the survival of their activity is seriously at stake. Recently, a survey of Ha-Vinh et al. (2005) has shown that French self-employed workers face an increased risk of discontinuation of professional activity five years after their cancer diagnosis (Ha-Vinh et al, 2015).
Furthermore, craftsmen, shopkeepers and business owners complain more about loss of income following their cancers. It is therefore necessary to highlight the difficulties they meet in order to implement public health policies adapted to their situations.
It is primordial to compare them to the general population in order to determine what is caused or not by the disease, in this case "cancer". This double comparison between self-employed workers and salaried staff surviving a cancer and between cancer survivors and the general population is one of the main goal of this thesis.

The population of self-employed workers faces situations which are different from the ones of salaried staff, probably implying different decision making. Besides, even in the way they are taking decisions, self-employed workers distinguish themselves from salaried staff. Indeed one of their main characteristics describing their taste for entrepreneurship is their very low risk aversion, which is very uncommon among the general population (Cramer et al, 2002) (Colombier et al, 2008). This main characteristic explains why they accept to face everyday risks to preserve their activity. Martine D'amours (2009), in her research report, defines 5 risks supported by self-employed workers. There is the risk of "under-employment", which is defined as the possibility of lacking contracts or clients, and thus earnings. The risk of "accident/disease/invalidity" is defined as the possibility of a loss of income caused by a physical or mental impossibility to provide the necessary and usual workload. The risk of "parenthood" is the possibility of loss of income linked to a pregnancy and to the first months of a child's life. Then, the risk of "getting older" is defined as the diminution of the work capacity or income as we get older. And to end, the risk of "obsolete knowledge" is defined as the possibility to see of reduced employability if knowledge is not updated.

Following the establishment of a disease diagnosis, self-employed workers have to face two types of uncertainty: economic uncertainty linked to the survival of their firms that salaried staff do not endure and health uncertainty linked to their own survival threatened by the disease. Seeing one of these risks concretizing, self-employed worker might worry even more about maintaining their activity.

Hence, we can wonder, to which extent, these self-employed workers would not wish to find a salaried activity after a health shock such as cancer. Does their disease contribute to modify their behaviors toward risks and thus their will to face uncertain situations? Would their disease modify their behavior of investors?

C. The concept of risk aversion

Before describing the concept of risk aversion, it is preferable to remind the readers what preferences are for economists. Preference relations correspond to asymmetric and transitive binary relations. If you prefer X to Y, you cannot prefer Y to X in the same time. Thus, the relation is asymetric. Furthermore, if you prefer A to B and B to C, you prefer A to C. In this case, the relation is transitive.

Choices A, B and C can be lotteries, that is to say baskets composed of different risky payments (A is composed of 100 euros with a probability of 90% - 0 otherwise; B is composed of 60 euros with a probability of 50% - 120 euros with a probability 50% otherwise).
According to economists, risk aversion corresponds to the preferences of an individual when he faces these risks. A person averse to risks won't be indifferent between two options, for instance A and B, proposing the same expected payoff but presenting two different levels of risks.

In utility theory, risk aversion is the negative fraction between the first derivative and the second derivative of the utility function, which links the consumption of an individual to his satisfaction. Most of economists consider that this parameter is exogenous, innate and immutable. Individual preferences would be represented by utility functions, for which risk aversion does not vary according to time and wages (CARA constant absolute risk aversion). Does risk aversion vary according to a person's health state? If health has an impact on financial investments, must we exclude that this impact could be the result of a modification of risk aversion? The impact of a health shock on financial investments is largely studied in the literature but the bias by which diseases contribute to modify decision making in the field of investments mainly remains unknown (Hariharan et al, 2000) (Rosen et al, 2004). Is it via risk aversion or other psychological variables? De facto, the impact of a disease on financial risk aversion is less studied in the literature.

Actually, the way diseases influence people's attitudes toward financial risk has received little attention in economic models. In the context of the economic theory, very few models study the link between health and risk aversion. Hammitt et al (2009) show in a theoretical model, based on an additive utility function, that health and longevity do not influence tolerance toward financial risk. We will come back to this in the second part of this thesis. If health would have an impact on risk aversion, therefore several hypothesis could be considered. A health shock could modify the marginal utility of consumption, that is to say the satisfaction you get from consuming on supplementary unit of a good, and thus risk aversion. In economics, risk aversion is the negative fraction of the second derivative of the utility of consumption on the marginal utility of consumption. One of the components of the utility function is the wage.
A decrease in longevity could reduce future earnings and the need to finance future consumer goods, thus risk aversion.
Reduction in productivity caused by a health shock could decrease future earnings and therefore

risk aversion.
Increased medical expenditures could reduce income available for consumption and saving and then risk aversion. So far, none of these hypotheses has been privileged but one of our main interests is to understand how health could influence risk aversion and prior to this, if it does really influence risk aversion.

Some experimental and empirical studies exist on this subject. Empirical studies are based on small samples. They use methods such as the Iowa Gambling Task or the Probability Task, which consist in lottery games. People suffering from mild Alzheimer's disease would have altered behaviors toward risk compared to the general population. They would make riskier and less advantageous choices compared with a healthy population (Sinz et al, 2008) (Delazer et al, 2007) (Ha et al, 2012). The same is observed for those who suffer from Parkinson (Delazer et al, 2008). On the other hand, people suffering from depression would be more risk averse than the general population (Smoski et al, 2008). Moreover, some scientific proof show that emotions caused by a disease can modify psychological variables such as risk aversion (Ha et al, 2012) (Carney et al, 2010).

Empirical studies are based on large samples and one more time on questions eliciting risk aversion thanks to hypothetical lotteries. In their article, Hammitt et al (2009) show that risk tolerance increases with better health but this study is static. In a dynamic perspective, Sahm finds that there is no alteration of the willingness to take further risks when the panel is unbalanced but there is large decline in risk tolerance of 15% after the onset of a health condition when the panel is balanced (Sahm, 2012). And according to Melnychuck et al, suffering from a depression would decrease individuals' willingness to invest in risky assets probably via the channel of risk aversion (Melnychuck, 2012).

To understand the mechanism of a modification of risk aversion is important, especially when a lot of people are concerned with their country's economic growth. In Macroeconomics, some functions include risk aversion in their determinants. In the General Theory of Employment, Interest and Money, Keynes takes the reasoning to the next step (Keynes, 1936).
According to him, investments would depend on the "*sufficient supply of individuals of sanguine temperament and constructive impulses who embarked on business as a way of life, not really relying on a precise calculation of prospective profit*." He adds "*If human nature felt no temptation to take a chance, no satisfaction (profit apart) in constructing a factory, a railway, a mine or a farm, there might not be much investment merely as a result of cold calculation*."
Thus, the taste of risk would be necessary to the economic growth of a country.
The entrepreneur has also a center place in the work of Schumpeter. He is the one who transforms the economic cycle by making it evolve, the one who takes risks, the one who also innovates (Schumpeter, 1942). Hence, entrepreneurs are of major importance for the economic growth of a country.

Risk aversion can also be linked to the introduction of inequalities as an increased tolerance toward financial risk opens the doors of entrepreneurs and self-employed jobs. In an article of 1996, Shaw explains that the wage growth is positively correlated with the tolerance toward financial risk (Shaw, 1996). De facto, the most educated people are the most inclined to take risks. This is the reason why the author suggests that behaviors toward risk, different between well-educated and others, would explain return on investment of education.
Another study conducted in Ethiopia shows that farmers present a too important risk aversion to losses and because of it, they do less rentable investments choices. This important risk aversion constitutes a poverty traps (Yessuf, 2009).

Thus, to analyze the impact of diseases on risk aversion could help anticipating, in term, their direct or indirect effects on countries' economic growth.

D. Research question and presentation of the plan

Given the ageing of the population as well as the importance of individuals' risk aversion and of entrepreneurial activities for the economic growth, it is interesting to know to which extent the tastes for risk would be influenced by diseases. If diseases have harmful effects on risk aversion then it could slow down the economic growth of a country.

The hypothesis, underlined in this thesis, is that diseases have not only a "mechanical" impact on the professional lives of individuals but also on psychological variables such as "risk aversion", that can lead people to modify their professional trajectories. To know if diseases modify the behavior of individuals directly and indirectly and to understand by which channel these modifications could happen, is at the heart of our researches.

Risk taking being a key variable for self-employed workers who play a major role in economic cycles; as a matter of fact, we have decided to pay a special attention to this population. How do they react once they face diseases? Do their use of sick leave differ after disease? Do their professional trajectories differ? Do they modify their behaviors towards risk? So many questions that these essays try to answer.

This PhD contains two parts.
In the first part of this PhD, the professional situations of self-employed workers and of salaried staff two years after cancer are analyzed with the French National Cancer Survey and the French labor force survey. This first part contains two chapters. The first chapter consists in analyzing the resort to sick leaves of these two populations. The time taken to resort to sick leaves and then the time spent in sick leave are analyzed thanks to Cox models. In a second chapter, professional trajectories of cancer survivors are analyzed thanks to Markov Models and to a two-steps logistic estimation. Then, they are compared with those of the general population. Another comparison is done between self-employed workers and salaried staff. These two chapters rely on two articles intended to economics and public health reviews.

The introduction of part 2 puts forward changes of behaviors toward risks in career and for health after cancer. One more time, a comparison between self-employed workers and salaried employees, has been done. This analyze relies on the data of the French Cancer Survey "Vican 2". In this survey, questions about risks are based on scales and thus are fragile. Therefore, we also found another survey with a different measure. In the "Health and Retirement Survey", measures on risks are those of Barsky et al (Barky et al, 1997). The method consists in asking questions on people's will to change their jobs. They have the choice between keeping the same job with the same wage or choosing another job where they have 50 % chances of doubling their income and 50 chances of decreasing it by 10%, 15% or by 20%. Yes/no questions and a two-step procedure are adopted in this questionnaire to share out people in four categories of risk aversion. This method does not compel to assume a particular form of utility function to assess risk aversion. However, Kimball, Sahm and Shapiro use a CARA function (constant relative risk aversion) in one of their articles in order to transform the ordinal measure into a cardinal measure (Kimball et al, 2008). That's why in the second part of this thesis, empirical analyses have been one on these data. This part is made of two articles.

In the second part, the impact of a health shock on risk aversion is studied within a general population thanks to lottery questions. The effect of different diseases is enlightened: cancer, diabetes, arthritis, lung diseases, psychological diseases, heart diseases, stroke and hypertension. We particularly pay attention to self-employed workers.
In a first chapter, literature on the links between health and risk aversion and a theoretical model are presented. In a second chapter, several empirical models are used in order to analyze the effect of diseases on risk aversion but also on the share of safe assets held in a portfolio. This variation can also represent the will of agents to take risks or not, and thus provide a second interesting measure. One of the presented models tackles the problem of endogeneity.

In the conclusion, several propositions for policy makers are made to improve public health policies. These propositions are based on the scientific researches of this PhD. Several ideas are also proposed but they are not based on scientific researches. They intend to launch a debate on the professional situation of self-employed workers facing cancer, and more widely a disease, in our country.

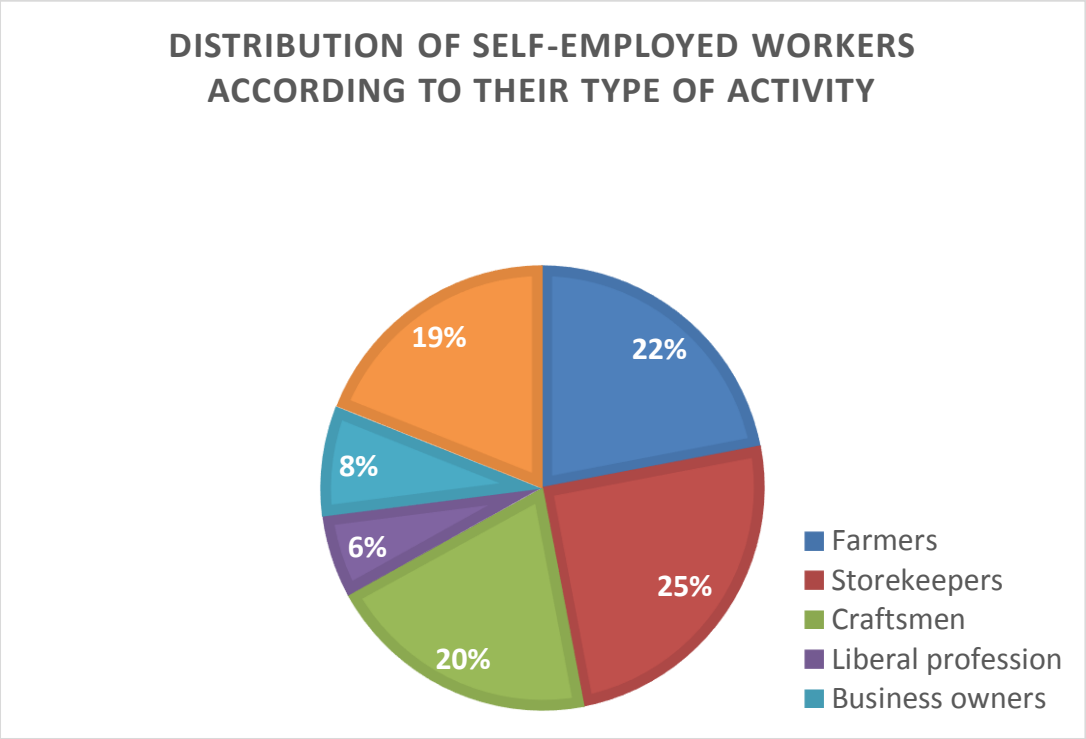
Part 1: The professional situation of self-employed workers and salaried employees facing cancer

Introduction of Part 1

In France, there is 2 Million self-employed workers, around 8% of the working population (Pignier, 2012). Inequalities among this population are not major in the building, trade, restauration and pharmaceutical sectors (Ulmann, 1997). However, they are quite important in the real estate, communication and administrative sectors.

The first part of this thesis is based on samples from the French National Cancer Survey "VICAN 2". By selecting only people working at the time of diagnosis in this survey, self-employed workers represented around 12% of respondents. 25% of them were craftsmen and craftswomen, 22% were farmers, 20% were storekeepers, 8% were business owners as shown in the next figure 1.

Figure 1. Distribution of self-employed workers according to their type of activity



Several main trends regarding the professional and financial situations of self-employed workers appeared. We presented these statistical trends in a book called *«Life two years after the diagnosis of cancer"* in 2014. They constituted the premise of this thesis. That is why, they should be borne in mind (Paraponaris et al, 2014).

First, the financial situation was judged particularly difficult by storekeepers and blue collars in France after cancer diagnosis. Indeed, 69% of storekeepers and 73% of blue collars considered that their financial situation was fragile while this rate reached 16% for liberal professions and 28% for white collars.

Second, storekeepers, craftsmen, craftswomen and business owners complained a lot of net loss income after cancer after cancer diagnosis.
Third, the richest self-employed workers were, the most affected they were by net loss income.
Fourth, an increased fear of not having access to credit because of cancer was observed. Indeed, 97% of individuals having a liberal profession and 91% of business owners feared not to have access to credit. This rate reaches 75% for self-employed workers in general and 71% for salaried staff.
Then, descriptive statistics showed that the rate of maintaining employment was similar between self-employed workers and salaried staff even by controlling the gravity of cancer (85% for salaried staff and 90% for self-employed workers). However, if long-term sick leaves were not taken into account, the rate was higher for self-employed workers than for salaried staff (81% against 71%).
Last but not least, self-employed workers were more affected by physical fatigue at work, especially farmers and storekeepers. 93% of farmers and 80% of storekeepers assessed that their work was physically exhausting while 31% of business owners and 52% of salaried claimed that.

However, these studies were only based on descriptive statistics and many demographic variables such as the age, the type of treatment (etc…) were not controlled. Furthermore, no comparison with the French general population had been done. Therefore the two next parts of this thesis propose to improve these analyses.

The first chapter of part one focuses on sick leaves. The second chapter enlightens the transitions on the labor market by doing a comparison between people surviving cancer and the French general population and by doing another comparison between self-employed workers and salaried staff surviving cancer. Unfortunately, statistical analyses on wage could not be improved as we did not dispose of enough information on self-employed workers ‘wages within the French general population and even within the French cancer survivors.

Chapter 1: Sick leave and return-to-work after cancer: a comparison of self-employed workers to salaried employees

Abstract

Aims: First, to compare the proportion of French self-employed workers and salaried employees on sick-leave after being diagnosed with cancer. Second, for those on sick-leave, to calculate and compare the time elapsed in that state. Third, to investigate whether differences exist between self-employed workers and salaried employees with regards to survival in the sick-leave state rather than returning to work.

Materials and methods: A representative sample of 2 014 French individuals diagnosed with cancer in 2010 was interviewed in 2012. All of them were employed at the time of diagnosis and among them 1 953 respondents were on sick leave. Information regarding return-to-work is available for 1 643 respondents. The analyses were made with the help of student, chi2, log-rank tests and Cox models.

Results: 39% of French self-employed workers choose not to use their sick leave after being diagnosed with cancer, compared with only 13% of salaried staff. Among those who resort to sick-leave, self-employed workers resort to it later than salaried staff after controlling for both cancer severity and after-effects. The return-to-work process is also clearly different, pinpointing the pertinence of estimating in future studies separately the models for self-employed and salaried staff surviving cancer. Self-employed workers return to work faster than salaried staff.

Conclusion: Policy makers should focus not only on return to work after cancer but also on helping self-employed workers maintain their business while having cancer. They should also take into account occupational statuses when they "design" and implement public health policies.

A. Introduction

Thanks to improvements in cancer treatments and because of a growing incidence rate of cancer (Ferlay, 2013), cancer survivors remain longer in the labor market, either as salaried staff or self-employed (Hoffman, 2005). In France, there is a growing number of self-employed workers, encouraged by new reforms and specifically the creation of the "auto-entrepreneur" status in 2009 (RSI, 2011). Historically, French self-employed workers refused to be enrolled in the social security system because they claimed to be sick less often than other employees and therefore were reluctant to pay social taxes (Sauze, 2011). Whereas farmers benefit from a special sickness fund (MSA), which was established in 1945, other self-employed workers (craftsmen, shopkeepers, lawyers, architects, physicians…) have only benefited from the RSI, another sickness fund, since 1995 for craftsmen, 2000 for shopkeepers and 2005 for liberal professions. Self-employed and salaried workers are covered almost the same way in the case of a chronic disease like cancer: all inpatient and outpatient treatment costs related to cancer are reimbursed. But daily sickness pays may differ. In 2010, the daily allowance for salaried staff represents a percentage of their wage (50% to 80%) with a maximum per day of 42.77€ or 57.03€, depending on the number of children (less or more than 3). For all self-employed workers, except liberal professionals, the daily allowance amounts to 50 % of their annual wage during the last three years, with a maximum of 49.82€ per day. Both ill self-employed and employed workers can receive these daily allowances during a maximum period of three years. Unlike salaried workers, liberal professionals do not pay compulsory contributions for sickness leave, thus they are not compensated, except if they had decided to contribute.

Although the situation of salaried staff after cancer are well documented, those of self-employed workers are not well known; very few studies focus on them. And yet, they face different difficulties. Among them, an acute need to be replaced when they need to get their treatment, the fear to lose clients if their absenteeism lasts and the financial losses generated. A study based on a French survey conducted in 2004 on cancer survivors revealed, *all other factors kept equal*, that women who were storekeepers or worked on their own account were more likely to return-to-work than salaried workers (Paraponaris, 2004). However, in this study, too few self-employed workers were interviewed which did not allow significant comparison with salaried employees.

Given the different jobs' requirements and social security system, we argue on the one hand, that the proportion of self-employed workers and salaried employees responds differently to sick-leave after cancer diagnosis. On the other hand, we argue that the time spent before taking sick-leave and the process of return-to-work are also different. From this perspective, sick-leave-related outcomes are studied through a comparison between self-employed and salaried groups of workers. To do this, we use chi2 and t-student tests to compare respectively qualitative and continuous variables. We analyze both the time spent in employment before going on sick-leave and the time spent in the sick-leave situation before returning to work by the estimation of Cox's models.

B. Materials and Methods

1. Sampling of cancer survivors

We use a dataset providing information about the living conditions of cancer survivors two years after diagnosis in 2010 from a survey conducted by the French National Institute of Cancer (INCa) and the National Institute of Health and Medical Research (Inserm) in 2012.
The resulting response rates of the French National Cancer Survey were close to the expected one 45% (Bouhnik et al., 2015).

Respondents, insured to one of the three sickness funds, were interviewed retrospectively by telephone and patients not able to answer by telephone (mostly those with lung and aerodigestive tract and lung cancer) participated by responding to a questionnaire mailed by post. Doctors following the patients were contacted in order to obtain some crucial medical information (e.g. treatments, drugs 'prescriptions). The sickness funds also shared their patient registries; this information was used either to complete medical information or to check consistency between information provided by doctors and by sickness funds: for more details about the methodology of the survey see Bouhnik *et al.*, (2015). The sample was weighted in order to ensure representativeness of people diagnosed with cancer in 2010 at the national level.
Three subsamples from the cancer survey are used. Persons already on long-term sick-leave in 2010 are not included (N_L=42) given the uncertainty that long lasting sick-leave can create between cancer diagnosed people and their employment or activity.
Sick-leave and return-to-work patterns are studied for those who were employed in 2010 (N_S=1953 with 344 censored data and N_R=1643 with 357 censored data).

2. Description of used variables

Respondents were asked whether they were employees, self-employed, company directors or helping someone in their family without being salaried in 2010. During the data collection, these three latter categories were overrepresented to make sure that a significant number of them were interviewed. In this work, the company directors, who subscribed to one of the sickness funds for self-employed workers (RSI or MSA), were also included in the self-employed workers category. Individuals helping someone in their family who were farmers (covered by the MSA) or not (covered by the RSI), were separated and then considered either as a farmer or another self-employed worker.
The other socio-demographic variables used are the age (in number of years), gender (women/men), education (graduated from High School or not) and the marital status (married or not).
The clinical variables are the prognosis at the time of diagnosis (survival rate in five years inferior or superior to 80% calculated with the gender, the age, the localization and the stage of

cancer), the type of treatment (only chemotherapy, chemotherapy and radiotherapy, radiotherapy, others).
The variables representing the quality of the professional environment are the reorganization of work (yes/no different from working time arrangements), diminished working hours (yes/no) and the score of fatigue calculated with a quality of life scale EORTC adapted to cancer survivors "QLQ" (Mitchell et al, 2011).

3. Statistical analyses: duration data

Student tests and chi2 tests were used for the descriptive statistics. Two variables are of particular interest: the time elapsed between the cancer diagnosis and the first sick-leave, if any, and the duration of the sick-leave before returning to work.
First, univariate analyses and Kaplan Meier curves are computed in order to analyze the survival function for categorical variables and whether the groups are proportional or not. Indeed, a key assumption for the use of Cox's models is the proportional hazard condition, which states that covariates are multiplicatively related to the hazard; in other words the effect of each covariate must be independent of time.
Second, the probability of having a sick-leave was analyzed with the implementation of a Cox's proportional hazards model written as: $h(t \mid x) = ho(t) \exp(\beta' x)$ where t is the time, x the vector of covariates, β the vector of coefficients and ho (t) is the so-called baseline hazard function (the hazard function under x=0). As a result, the probability of staying on sick leave before returning to work was also analyzed with the help of a Cox's proportional hazard model. STATA/SE 12.1 was used to perform the analyses.

4. Ethics

The study methodology was approved by three national ethics commissions: the CCTIRS (Comité Consultatif sur le Traitement de l'Information en Matière de Recherche dans le Domaine de la Santé, study registered under no 11-143), the ISP (Institute of Public Health, study registered under no C11-63) and the CNIL (French Commission on Individual Data Protection and Public Liberties, study registered under no 911290). Confidentiality is assured for all participants with regard to any personal responses and information provided, as all data collected are anonymised.

C. Results

1. Descriptive statistics

16% of respondents are self-employed while 84% of respondents are salaried employees. The mean age at diagnosis for self-employed workers is 51 years old while the mean age for salaried employees is 46 years old ($p<0.001$). There are no statistically significant differences regarding the relative prognosis at the time of diagnosis, between the two groups and regarding the treatments followed to cure the disease.

Table I shows the frequency in which workers went into sick-leave according to whether they were self-employed or salaried. 39% of self-employed respondents did not take any sick leave contrary to 13% of salaried (see table I).

Sick leave after a cancer diagnosis was found to be a late process for self-employed workers than for salaried staff (average length before resorting to sick leave of 8 weeks, compared to 6 weeks). Once on sick leave, self-employed workers returned to work faster according to the mean comparison t-test: they stayed on sick leave 19 weeks compared to 29 weeks for salaried employees.

Table I Samples' characteristics

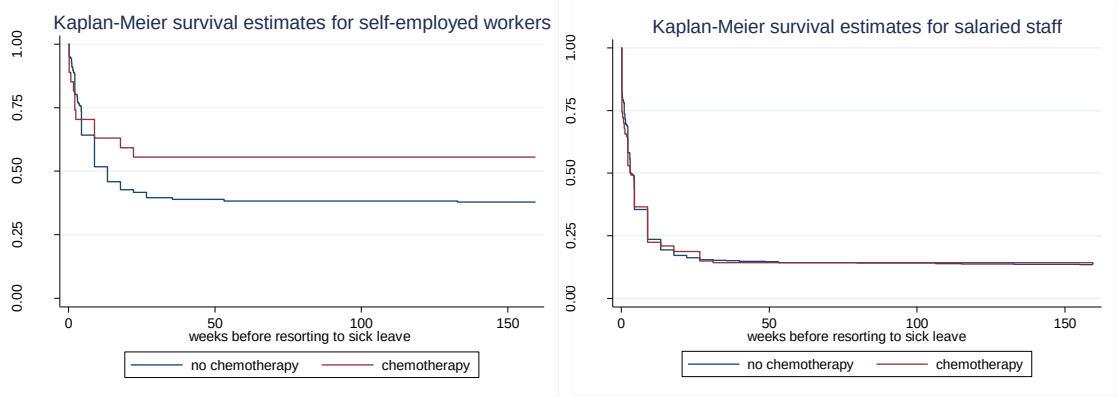
Sample characteristics N_E 2014			
Status	**Self-employed workers**	**Salaried employees**	**CHI2 or T TEST**
Proportion	**16%**	**84%**	
Gender (%)			
Men	37%	30%	0.011
Women	63%	70%	
Age			
Mean (standard deviation)	51(9)	46(8)	<0.001
Prognosis at the time of diagnosis (%)			
Survival>80%	41%	41%	0.808
Survival<80%	59%	59%	
Treatment			
Chemotherapy	8%	7%	0.713
Chemotherapy and radiotherapy	1%	1%	
Radiotherapy	2%	1%	
Others	89%	91%	
Numbers of sick leave periods			
One	42%	55%	<0.001
Several	19%	31%	
None	39%	13%	
Sample characteristics N_S 1953			
Proportion	**16%**	**84%**	
Gender (%)			
Men	37%	30%	0.007
Women	63%	70%	
Age			
Mean (standard deviation)	50(9)	45(8)	<0.001
Prognosis at the time of diagnosis (%)			
Survival>80%	58%	60%	0.641
Survival<80%	42%	40%	
Treatment			
Chemiotherapy	8%	7%	0.623
Chemiotherapy and radiotherapy	1%	1%	
Radiotherapy	2%	1%	

Others	89%	91%	
Median	4	3	<0.001
Mean of weeks before taking a sick leave	8 (12)	6 (13)	0.021
Sample characteristics N_R 1643			
Proportion	**12%**	**88%**	
Gender (%)			
Men	35%	29%	0.053
Women	65%	71%	
Age			
Mean (standard deviation)	49(8)	46(7)	0.000
Prognosis at the time of diagnosis (%)			
Survival>80%	40%	40%	0.986
Survival<80%	60%	60%	
Treatment			
Chemiotherapy	6%	7%	0.390
Chemiotherapy and radiotherapy	0%	1%	
Radiotherapy	1%	1%	
Others	93%	91%	
Median	8	22	0.003
Mean of weeks on sick leave before returning to work	19 (24)	29 (28)	<0.001

2. Univariate analyses and Cox Models

The Kaplan Meier estimations of the time spent after diagnosis before going into sick leave, according to whether individuals are self-employed or salaried, and whether they followed chemotherapy only or another group of treatments are given in Figures 2 and 3.

Figures 2 and 3



Log rank Test: chi2(1) = 1.85, Pr>chi2 = 0.173 N=315

Log rank Test: chi2(1) =0.11, Pr>chi2 = 0.745 N=1 638

It is mainly argued that the type of treatment has an influence on the probability of resorting to sick leave. Here, the treatment has not been included in the first Cox model because the log rank test is not significant for both self-employed workers and salaried staff.

In figure 4, the Kaplan Meier curve shows that the return to work after sick leave, is a different process among self-employed workers compared to salaried employees. Between 15 and 75 weeks, the survivor functions of self-employed and of salaried employees are significantly different. Salaried employees are at a higher probability of staying on sick leave compared to self-employed workers. Before 15 and over 75 weeks, they are similar.

Figure 4

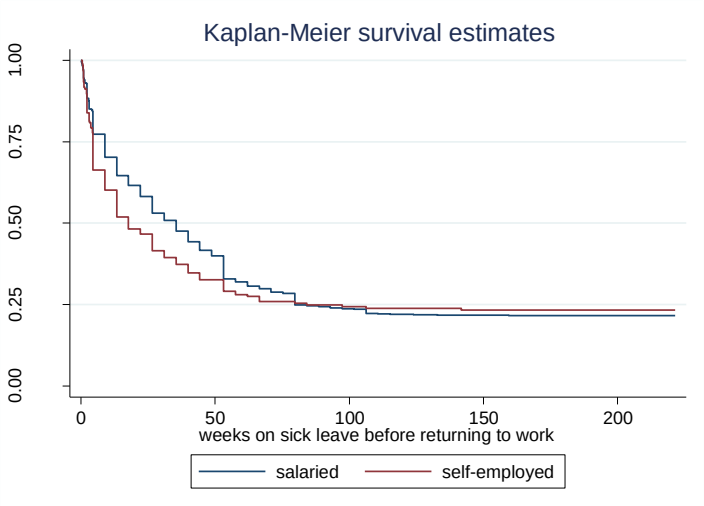
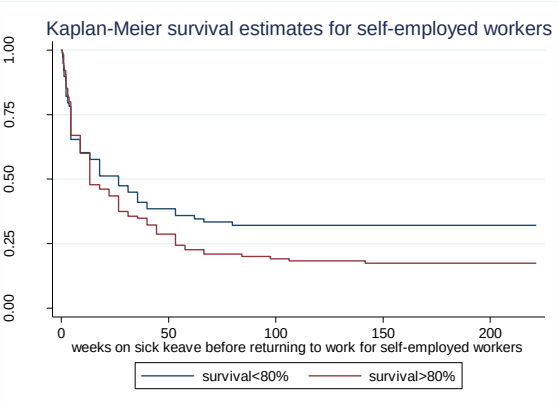
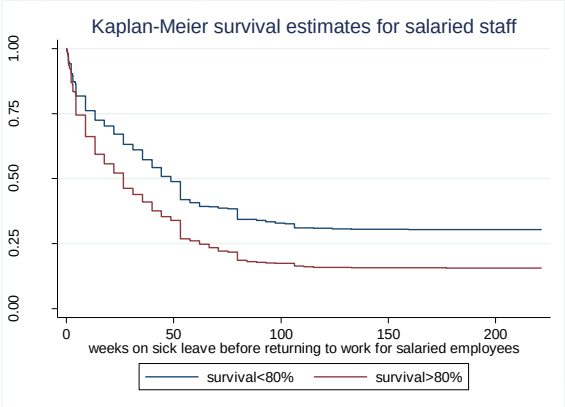


Table for figure 4: Log-rank tests for equality of survivors function of Figure 4

Period	Probability of log-rank test
< 1 week	0.20
< 10 weeks	0.30
>10 weeks	0.40
>15 weeks	**0.09**
>20 weeks	**0.04**
>50 weeks	**0.01**
>70 weeks	**0.01**
>75 weeks	**0.02**
> 80 weeks	0.30
>100 weeks	0.27
ALL	0.19

Figures 5 and 6





Log rank Test: chi2(1) = 2.86 Pr>chi2 = 0.091

Log rank Test : chi2(1) = 51.73, Pr>chi2 = 0.000

Figures 5 and 6 show that statistically significant different length is required for sick leave for salaried workers, depending on the survival prognosis at diagnosis (p=0.000). The result is the same, although less significant, for self-employed (p=0.091). As a result, the prognosis has been introduced in the estimation of the Cox's model of the time before the beginning of the first sick leave.

According to the first Cox Model presented in table II, self-employed respondents took a longer time before resorting to sick-leave compared to salaried workers and so did respondents with a good prognosis at the time of diagnosis (hazard ratio inferior to one: 0.87, p<0.05).

On the contrary, respondents who faced after-effects, benefitted from reduced working hours or job arrangement, all of which might be associated with a bad prognosis, took a shorter time to go on sick leave (HR: 1.236 with $p<0.05$, 1.191 and 1.195 with $p<0.01$). Women took a shorter time, compared to men. Furthermore, a single unit increase in age leads to a 10% increase of the rate of going on sick leave. As the hazard ratio of age² is also significant and inferior to one, it means that at a given age (53 years) however, a one unit rise in age induces smaller and smaller increases of the rate of going in sick-leave.
Living in couple, having children (whatever the number) and education level are not statistically significant.

Table II Hazard ratios estimating the time taken to go on sick- leave

Variables	HR	95% CI
Age at diagnosis	1.101***	1.051-1.522
	(0.025)	
Age^2 at diagnosis	0.999***	0.998-0.999
	(0.000)	
Gender (ref: men)	1.188*	1.043-1.352
	(0.079)	
French Baccalauréat (ref: no)	0.932	0.837-1.059
	(0.056)	
In couple (ref: no)	0.951	0.837-1.081
	(0.061)	
Number of Children	0.981	0.934-1.031
	(0.034)	
Self-employed (ref: no)	0.531***	0.454-0.622
	(0.042)	
Diminished working hours (ref: no)	1.236**	1.105-1.383
	(0.07)	
Reorganization of work (ref: no / different from working time arrangements)	1.195***	1.063-1.342
	(0.071)	
After-effects (ref: no)	1.19***	1.062-1.334
	(0.069)	
Score of fatigue	1.000	0.998-1.002
	(0.001)	
Prognosis at the time of diagnosis (ref: survival > 80%)	0.871**	0.783-0.969
	(0.047)	
Respondents'earnings contribution to the household's earnings (ref: inferior to first quartile)		
Equal to or higher than first quartile and less than third quartile	1.295	0.998-1.001
	(0.113)	
Equal to or higher than third quartile	1.185	0.987-1.424
	(0.111)	
Observations	1608 (1952)	
LR Chi2 (14)	273	
Prob>Chi2	0.00	

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

The Cox model, presented in table III, analyzes the time spent in the sick-leave situation before returning to work. It was estimated within a time interval from 10 to 50 weeks, otherwise the proportionality assumption was violated. Even so, we also present the model on the all period in table III.

Self-employed workers took a shorter time to return to work compared to salaried employees as did those who had a good prognosis at the time of diagnosis, within the time interval from 10 to 50 weeks and on the all period.
On the contrary, those who benefited from diminished working hours or suffered from after-effects took a longer time to go back to work.
The treatment variable (chemotherapy only versus others) was not significant in the model within a time interval from 10 to 50 weeks but was significant in the all model as age and age2. People, who had chemotherapy, took a longer time to go back to work. The older people were, the longer time, they took to return to work until a certain age.

Table III Hazard ratios estimating the duration on sick leave (from 10 to 50 weeks) and on the whole period

	Between 10 and 50		ALL	
Variables	**HR**	**95% CI**	**HR**	**95% CI**
Age at diagnosis	0.963	0.851-1.091	1.133***	1.061-1.211
	(0.061)		(0.038)	
Age2 at diagnosis	1.001	0.999-1.002	0.998***	0.997-0.999
	(0.001)		(0.001)	
Gender (ref: men)	0.760**	0.609-0.949	0.890*	0.775-1.022
	(0.086)		(0.063)	
French Baccalauréat (ref: no)	1.047	0.858-1.277	1.450***	1.279-1.641
	(0.106)		(0.092)	
In couple (ref: no)	0.943	0.738-1.205	1.016	0.882-1.178
	(0.118)		(0.075)	
Number of Children	0.984	0.892-1.084	0.973	0.924-1.025
	(0.049)		(0.026)	
Self-employed (ref: no)	1.373**	1.008-1.868	1.169*	0.981-1.391
	(0.215)		(0.104)	
Diminished working hours (ref: no)	0.760*	0.623-0.926	0.944	0.836-1.067
	(0.076)		(0.059)	
Reorganization of work (ref: no)	0.773**	0.632-0.946	0.945	0.836-1.076
	(0.079)		(0.069)	
After-effects (ref: no)	0.976	0.798-1.194	0.690***	0.611-0.779
	(0.100)		(0.043)	
Score of fatigue	1.003	0.999-1.006	0.993***	0.991-0.995
	(0.002)		(0.001)	
Prognosis at the time of diagnosis (ref : survival > 80%)	1.352***	1.138-1.479	1.285***	1.137-1.452
	(0.139)		(0.083)	
Respondents' earnings contribution to the household's earnings (ref: <Q1)				
Between Q1 and Q3	1.131	0.802-1.589	1.139	0.923-1.395
	(0.197)		(0.119)	
>Q3	1.181	1.178-0.215	1.256**	1.008-1.565
	(0.215)		(0.141)	
Chemotherapy (ref: no)	1.045	0.679-1.609	0.584***	0.430-0.747
	(0.230)		(0.080)	
Observations	491		1617	
LR Chi2 (53)	36		296	
Prob>Chi2	0.000		0.000	

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

D. Discussion

1. Resort to sick leave and return to work

The study, presented in this chapter, identifies that self-employed workers are less likely to take sick leave after cancer. When they do, they wait a longer time before taking it, compared to salaried workers.

In a Canadian study, Drolet et al also found that self-employed workers are less likely to report work absence (Drolet et al, 2005). Furthermore, they showed that chemotherapy prolonged absence duration. This result is not found in our study, which could be explained by the introduction of a variable "prognosis at the time of diagnosis": people with a good prognosis take more time to resort to sick leave. Furthermore, the introduction of two others variables "score of fatigue" and "secondary effects"' probably explains as well the non-significance of chemotherapy. Besides, our prognosis variable could be questioned as we divided people in two groups: those who have 80% of chance of survival 5 years after and those who have less. In fact, the distribution of self-employed workers and salaried staff at the time of diagnosis and two years after according to the severity of the disease is not statistically different making this choice of two groups appropriate. In Appendix A, a sensitivity analysis is presented. If we change the prognosis variable and we divide people in two groups (survival rate inferior or inferior to 50%), it does not change the results. We also present Cox models on the resort to sick leave only for women and for men. There are no major differences when it comes to the significance of the "self-employed worker" variable but some other variables violate the proportionality assumption. The model presented in this chapter (tale II) is better predicted.

In Norway, 75% of the long-term cancer survivors took sick leave within the first 12 months which is consistent with our rates, which reach 86% for salaried staff and 61% for self-employed workers (Torp et al, 2012). Like in Spelten's article, age and physical complaint are significant predictors of duration of sick leave (Spelten et al, 2003).

Return-to-work not only differs by gender as shown in the literature but also between self-employed and salaried workers (Spelten et al, 2003) (Marino et al, 2013) (Roelen et al, 2011). This result has rarely been described and underlines the importance of having different models for salaried employees and for self-employed workers. The sensitivity analysis in Appendix A shows that this effect stays significant for women but not for men if gender is stratified. However, some variables violate the proportionally assumption, that's why the model presented in this chapter (table III) is more reliable.

In the Netherlands, the mean duration is 42 weeks until partial return to work and 45 weeks until full return to work (Roelen et al, 2011). The results in our study refer to shorter delays for the whole population and even shorter ones for self-employed (19 weeks for self-employed, 29 for salaried until partial return to work). Another study points out that workload is a significant

predictor of the duration of sick leave (Spelten et al, 2003). People with an important workload take less time off. This could also explain the behavior of self-employed workers. As in other articles, chemotherapy is found to delay return to work (Marino et al, 2013) (Johnsson et al, 2009) (Johnsson et al, 2010).

In our Cox models, the hazard ratios are not closed to two and in this regard they represent low risks as stated in Rylander's article, which emphasizes the need to identify confounding factors (Rylander, 1992). The size of our sample is large and we selected only significant predictors to avoid any confounding factors.

2. Messages and ideas for policy makers

Our results can have major implications in terms of policy making. Policies targeting to enhance return-to-work for salaried employees are not sufficient for self-employed workers because their main problem is not only returning to work but also maintaining their business. Questioning self-employed workers on why they do not take sick leave or very few is of major importance to design public health policies adapted to their needs.

As self-employed workers constitute a heterogeneous population, further studies should deepen these analyses by stratifying them into different type of jobs (farmers, company directors, liberal professions, storekeepers, manual workers and others). To do so, over-representing this population in surveys or doing surveys only on them is necessary. These quantitative studies should also be backed by qualitative studies, which would allow to link people's speeches to statistical observations. These findings could help improving the social protection for self-employed workers or adapting it to the specificities of their occupation.

Is it a good thing or not that self-employed workers are less on sick leave and when they are, that they return-to-work faster? There is no good or wrong answer to that question.
Besides, the answer made depends on a system of values which may differ between self-employed workers and salaried employees and even across self-employed workers facing cancer. To define this system of values could be an objective for next studies.
Is this trend the result of an individual preference or are self-employed workers urge to return to work because of their business?
From an economic point of view, there is clearly a tradeoff between the loss of income and the risk of firm's failure caused by sick leaves with the risk that the self-employed worker do not get better because he/she does not take any sick leave. A slow recovery could also affect negatively the business.

A Norwegian study shows that being self-employed at the time of diagnosis is significantly and negatively correlated with work ability, which is the capacity of being put into effective operations (Torp et al, 2011). What should be now questioned is the work ability of our self-employed workers, their satisfaction at work and last but not least the survival of their firm after

cancer. A study from Taskila et al. sheds light on the work ability of cancer survivors compared to their referents. They show that those who are committed to their organization and benefit from the social support of their co-workers report being less impaired at work (Taskila et al, 2007). There is no distinction between self-employed workers and salaried employees in their study. Similarly, Johnsson et al. show that social support favor return to work (Johnsson et al, 2010). Maybe developing social support for self-employed workers could be a great idea for policy makers.

The survival of their firms is also at stake. And one of the main threat that could jeopardize their activity is probably the difficulty to have access to credits because of cancer. A French study shows that self-employed workers are at a higher probability of losing their activity during five years after cancer diagnosis (Ha-Vinh et al, 2015). More studies are necessary on these subjects.

In our French National Cancer Survey, 41% of self-employed workers work with their families. How can we protect them? We could imagine the creation of interim societies that would send them specialists to help them in their work during their recovery. However, the next question is what should be done in case of death? Maybe helping families managing the business the time of a re adaptation could be a good solution.

In this chapter, we emphasize the resort to sick-leave of self-employed workers facing cancer by comparing them to salaried employees.
If they take less sick leave and return to work faster, would it mean that they have more chances to stay employed two years after cancer? Analyzing transitions on the labor market is the next step of this thesis.

Chapter 2: Transitions on the labor market: a comparison of self-employed workers to salaried employees

Abstract

Aims: The aim of this chapter is to investigate whether mobility on the labor market of a population of cancer survivors differs two years after diagnosis with respect to the French general population by focusing on the differences between self-employed workers and salaried staff.

Materials and methods: Two samples have been used for the statistical analyses. The first one is a sample of 3 967 individuals from the French Cancer Survey. The second one is a sample of 8 066 individuals from the French Labor Force Survey. Coarsened exact matching was implemented in order to reduce the sampling bias introduced by the comparison of individuals from two different surveys. Then, mobility was analyzed by estimating transition probability matrices from 2010 to 2012 under the framework of a continuous-time Markov technique and a two-steps estimation model.

Results: Salaried employees and self-employed workers from the general population have more chances to remain employed two years after 2010 compared to salaried employees and self-employed workers surviving cancer. Furthermore, there are no significant differences between self-employed workers and salaried staff surviving cancer in terms of job retention. The only main difference is that salaried employees can systematically benefit from an unemployment insurance during at least two years contrary to self-employed workers. It depends on whether they pay a private insurance (or else) or not. In this regard, their situation might be more fragile.

Conclusion: French policies implemented in 2004 should be questioned as French workers surviving cancer in 2014 face the same difficulties as the ones observed in 2004. Furthermore, the fact that self-employed workers surviving cancer are victim of inactivity exactly as salaried staff is worrying and should be tackled.

A. Introduction

Thanks to improvements in cancer treatments and because of a growing incidence rate of cancer (Ferlay et al, 2013), cancer survivors participate longer to the labour force whatever they are salaried or self-employed (Hoffman, 2005). The literature usually shows that health shocks have a negative impact on productivity and reduces the labor supply (Strauss et al, 1998). This negative impact makes difficult the access to employment and accelerates the exit from the labor market for unhealthy individuals (Joutard et al, 2012) (Mehnert et al, 2013). Yet, little is known about how cancer may involve contrasted consequences on job tenure for self-employed and salaried cancer survivors.

In 2004, the French national survey on cancer revealed that 45.4% of farmers who were diagnosed a cancer in 2002 had still a job 2 years later compared to 67.7% of employees (Paraponaris et al, 2004). Another article based on the same survey showed that it was harder for manual workers to return to work after a cancer (Eichenbaum-Voline et al, 2008). Regarding self-employed workers, these papers however failed to give statistically significant comparisons with salaried employees because of their too small sample size.

This chapter uses the French Cancer Survey carried out in 2012 among people diagnosed with cancer 2 years earlier. First, we compare the variation in employment status potentially due to cancer between self-employed workers and salaried staff. To do this, we matched the population of the French Cancer Survey with individuals from the French Labour Force survey. Then, we used a continuous time Markov model to assess the transition probabilities. We also compare transitions on the labor market of self-employed workers and salaried employees surviving cancer by matching them with a continuous-time Markov model.
Then, we estimate a bivariate probit model. This model assesses in a first step the probability of being employed in 2010 and for those who are employed, it assesses in a second step, the probability of staying in employment two years after.

B. Materials and Methods

1. Materials

Two datasets are used for this article.
The first dataset, studying people's situation two years after the occurrence of a cancer in 2010, was conducted by the French National Institute of Cancer (INCa) and the National Institute of Health and Medical Research (Inserm) in 2012 (Bouhnik et al, 2015)[3]. Respondents, insured to one of the three sickness funds, were interviewed retrospectively by telephone in 2012 and patients not able to answer by telephone (mostly those with lung and aerodigestive tract and lung cancer) participated by responding an auto-questionnaire mailed by post. Patients' physicians were contacted in order to obtain fundamental information about the localization, the severity and the clinical characteristics of cancer, the description of the treatment (surgery, chemotherapy, radiotherapy, hormonotherapy…) and its potential side effects. Sickness funds' registries were also used either to complete medical information or to check consistency between information provided by physicians.
Persons on long-term sick leave in 2010 (N_L=42) were not considered because it was impossible to state whether the sick-leave was correlated or not to individual characteristics regarding employment at the time of diagnosis. Furthermore, mobility among workers in long-term sick-leave is low, thus we can consider that negligible information is missed (Paraponaris et al, 2014). This dataset contains 3967 individuals.

The second dataset is the French Labor Force Survey which contains 8066 respondents[4]. This national survey studies the situation of French workers on the labor market every term, and especially unemployment and changes in working situations. This survey is conducted since 1950 by the French National Institute of Statistics and Economics Studies (INSEE).

2. Variables

In the French Cancer Survey, respondents were asked whether they were salaried employees, self-employed workers, company directors or helping someone in their family without being salaried in 2010.
Self-employed workers are either storekeepers, craftsmen, farmers or even company directors and people helping someone in their family, who paid social taxes to one of the sickness funds for self-employed workers (Régime Social des Indépendants-RSI for self-employed like

[3] http://www.e-cancer.fr/Expertises-et-publications/Catalogue-des-publications/La-vie-deux-ans-apres-un-diagnostic-de-cancer-De-l-annonce-a-l-apres-cancer

[4] http://www.insee.fr/fr/methodes/default.asp?page=sources/ope-enq-emploi-continu.htm

craftsmen, shopkeepers, lawyers, pharmacists, architects, specialist physicians, etc, or Mutualité Sociale Agricole-MSA for farmers).
In the French Labor Force Survey, people were asked whether they were salaried or self-employed.

The three transitions states studied are: employment, non-employment (defined as either unemployment or no activity excluding retirement) and retirement. A not employed self-employed is someone who was self-employed before non-employment but who has no more work activity at the moment he/she answers survey questions. Hence, she/he may benefit from unemployment allowances if he paid for them.

3. Methods

Two successive matching were implemented. A coarsened exact matching is a method used to make causal inference without balance checking, developed by G. King et al (Iacus et al, 2012) (King et al, 2011).

a) The effect of cancer on employability: focus on self-employed

The first coarsened exact matching consisted in matching cancer survivors in the French Cancer survey with individuals from the French Labour Force survey. The treatment variable was being in the cancer survey or not. The idea of this technique is to create pairs of individuals in order to carry out comparisons that reveal a relatively more accurate difference (that we could infer as a "causal effect") related to cancer diagnosis in 2010. The covariates used were: occupation in 2010 (employed, not employed, retired), age, gender, education (baccalaureate/yes or no), marital status (married or not), being self-employed or not. We obtained a group of 195 self-employed workers in the French Cancer survey and a group of 195 self-employed workers in the French Labor Force Survey. We also obtained a group of 1860 salaried staff in the French Cancer Survey and a group of 1860 salaried staff in the French Labor Survey.
Two-year probability matrices were calculated for each population thanks to continuous-time Markov process estimations (see table V). The states of transitions are: being employed, being not employed, and retirement.

b) The effect of being self-employed on mobility in the labor market among cancer survivors

Due to the loss of individuals after the first described matching, we did not do this second matching on the previous matched data but on the all cancer survivors' population. That is why, this is not a double matching.
For this second coarsened exact matching, the treatment variable was being self-employed or not.

This matching has been done on the following covariates: occupation in 2010 (employed, not employed, retired), age, gender, education (baccalaureate/yes or no), marital status (married or not) and the prognosis of cancer at the time of diagnosis. After this matching, we obtained two groups containing each 626 individuals: one group of self-employed workers matched with salaried counterparts. These two groups are used to compare the transitions of self-employed workers surviving cancer to the transitions of salaried workers surviving cancer. If some significant differences appear, we would be able to deduce that one of the main reason is the type of job (being self-employed or not) as these two groups are similar for a couple of variables, which heterogeneity is observable and controlled for: age, gender, education level, marital status, occupation and prognosis at the time of diagnosis, thanks to the coarsened exact matching method. Of course, matching variables continue to play a potential role in the explanation of the transition processes for both group of workers.

c) The effect of being self-employed and of having cancer on the probability of job retention between 2010 and 2012

A bivariate probit model with sample selection has also been estimated. The first equation estimates the probability of being employed in 2010 ($P(Y_{1i})$). And the second equation estimates the probability of staying employed in 2012 only for people who were employed in 2010 ($P(Y_{2i})\ if\ Y_{1i} = 1$).

$Y_{1i} = X_i\beta_1 + u_{1i}$ (1)
$Y_{2i} = Z_i\gamma_2 + u_{2i}$ (2) $if\ Y_{1i} = 1$

In this model, $P(Y_{1i})$ and $P(Y_{2i})$ are assumed not to be independent. Thus, corr(u_{1i}, u_{2i}) is expected not to be 0. The set of observable characteristics X_i is made of socio-demographic variables such as age, gender, education, children, being self-employed or not. Z_i represents variables such as the age, the number of children, being self-employed or not, having developed a cancer or not.

4. Ethics

For the French Cancer Survey, the study methodology was approved by three national ethics commissions: the CCTIRS (Comité Consultatif sur le Traitement de l'Information en Matière de Recherche dans le Domaine de la Santé, study registered under no 11-143), the ISP (Institute of Public Health, study registered under no C11-63) and the CNIL (French Commission on Individual Data Protection and Public Liberties, study registered under no 911290). Confidentiality is assured for all participants with regard to any personal responses and information provided, as all data collected are anonymised.

C. Results

1. Descriptive Statistics

a) Comparison of the two populations

The comparison of the self-employed and the salaried samples from the French cancer survey reveals significant differences when it comes to the gender, the age, the education level, the marital status, the occupations in 2010 and 2012 but not for the prognosis at the time of diagnosis as shows by table IV. Indeed the self-employed sample is older, more educated and is made of more men than the salaried sample. Now, comparing self-employed and salaried in the two surveys also shows some significant differences, which justifies the implementation of a coarsened exact matching technique. The population of the French labor force survey is younger, more educated and the employment rate is higher.

The use of the coarsened exact matching method make these significant differences disappear (table V and table VI). After the matching, cancer survivors and the French Population are similar for each variable except for the occupational status in 2012. 81% of individuals from the French Labor Force Survey are still employed two years after compared to 71% of cancer survivors. This difference of 10 points is statistically significant at $p<0.01$. However, we don't observe any differences between self-employed workers and salaried staff surviving cancer.

Table IV. Descriptive Statistics (before matching)

	Cancer Survey			Labor Force Survey			
	Self-employed (17%)	**Salaried (83%)**	**Probability of ttest and chi2**	**Self-employed (8%)**	**Salaried (91%)**	**Probability of ttest and chi2**	**Chi2 and t tests between surveys**
Gender (%)							
Male	52	40	0.000	67	46	0.000	0.000
Female	48	60		33	54		
Age							
Mean (standard deviation)	63 (11)	56 (12)	0.000	43 (11)	39 (08)	0.000	0.000
Education (%)							
<Bac	57	53	0.050	18	26	0.000	0.000
>=Bac	43	47		82	74		
Marital Status (%)							
In a couple	78	72	0.090	37	54	0.000	0.000
Single	22	28		63	46		
Occupation in 2010							
Employed	46	52	0.000	93	72	0.000	0.000
Not employed	3	14		6	26		
Retired	51	34		1	2		
Occupation in 2012							
Employed	36	42	0.000	92	74	0.000	0.000
Not employed	7	20		7	23		
Retired	57	38		1	3		
Prognosis at diagnosis (%)							
Survival>80%	46	46	0.692	-	-		
Survival<80%	54	54		-	-		

Table V. Descriptive Statistics after matching between cancer survivors and the French population

	Cancer Survey and Labor Force Survey		
	Cancer survivors	**French Population**	**Probability of ttest and chi2**
Gender (%)			
Male	28	28	0.976
Female	72	72	
Age			
Mean (standard deviation)	47 (7)	47 (7)	0.873
Education (%)			
<Bac	41	41	0.991
>=Bac	59	59	
Marital Status (%)			
In a couple	71	21	0.968
Single	29	29	
Occupation in 2010			
Employed	82	82	0.913
Not employed	16	16	
Retired	2	2	
Occupation in 2012			
Employed	71	81	0.000
Not employed	25	15	
Retired	4	4	

Table VI. Descriptive Statistics after matching between self-employed and salaried workers surviving cancer

	Cancer Survey		
	Self-employed (50%)	**Salaried (50%)**	**Probability of ttest and chi2**
Gender (%)			
Male	51	51	1.00
Female	48	43	
Age			
Mean (standard deviation)	62 (12)	62 (12)	0.873
Education (%)			
<Bac	58	58	1.000
>=Bac	42	42	
Marital Status (%)			
In a couple	78	78	1.000
Single	22	22	
Occupation in 2010			
Employed	45	45	1.000
Not employed	3	3	
Retired	52	52	
Occupation in 2012			
Employed	45	45	0.737
Not employed	1	1	
Retired	2	2	
Prognosis at diagnosis (%)			
Survival>80%	48	46	0.405
Survival<80%	52	54	

b) Transition probabilities

In this part, Markov matrices computing the transitions probabilities from one state to another, are presented in table VII, table VIII and table IX.

Differences appear once self-employed workers and salaried staff are compared to the general population. Among those who were employed in 2010, 3% and 5% of self-employed and salaried workers respectively were not employed two years after in the French Labor Force Survey while these rates reach 14% for both self-employed and employed cancer survivors (table VII).

The main sanction is for those who are not employed at the time of diagnosis: respectively 0.5% and 1% of self-employed and salaried cancer survivors not employed in 2010 became employed two years after contrary to 15% and 21% of self-employed and salaried workers from the general population. Also among those who were not employed in 2010, 58% of salaried staff surviving cancer moved to retirement while only 18% salaried staff from the French Labor Force Survey moved to retirement.

Furthermore, transitions on the labor market are similar for self-employed workers and salaried staff surviving cancer, who were employed in 2010 (see Table IX). However, they are different for those who were not employed in 2010 but the difference is not statistically significant. Among them, 48% self-employed workers moved to retirement two years after cancer against 58% for salaried staff meaning that more self-employed workers became not employed: 48% against 41% for salaried staff.

As observations per transitions are higher in table VIII (two transitions) compared to table VII (three transitions), confidence intervals are better. Nevertheless, the same trends are observed. Given the non-significance of most of the interval confidences of these matrices, we decided to use a stronger statistical method. Hence in the next section, we propose a two-step model analyzing the probability of being employed in 2010 and then if employed, the probability of staying employed in 2012. This model allows to observe the impact of cancer on these probabilities but also the impact of the type of job (self-employed or not).

Table VII. Transitions on the labor market: probability matrices after simple matching between the population surviving cancer and the general population (confidence intervals are in brackets)

	Professional situation in 2010			Professional situation two years after in %		
				Employed	Not Employed	Retired
				%	%	%
Coarsened Exact Matching between the two surveys on the variables self-employed, age, sexe, level of education, marital status and professional situation in 2010	Employed	Cancer survey	Self-employed workers	86 [0-100]	14 [0-16]	0 [0-0]
		Labor force Survey		96 [0-98]	3 [0-5]	1 [0-1]
		Cancer survey	Salaried Staff	79 [0-100]	14 [0-16]	7 [1-100]
		Labor force Survey		94 [92-95]	5 [3-6]	1 [0.9-2]
	Not employed	Cancer survey	Self-employed workers	0,5 [0-100]	99 [0-100]	0,5 [0-100]
		Labor force Survey		15 [0-53]	67 [23-100]	18 [6-96]
		Cancer survey	Salaried Staff	1 [0-100]	41 [0-100]	58 [0-100]
		Labor force Survey		21 [17-25]	71 [66-76]	8 [6-12]
	Retired	Cancer survey	Self-employed workers	0	0	100
		Labor force Survey		0	0	100
		Cancer survey	Salaried Staff	0	0	100
		Labor force Survey		0	0	100

Table VIII. Transitions on the labor market: probability matrices after simple matching between the population surviving cancer and the general population (confidence intervals are in brackets)

	Professional situation in 2010		Professional situation two years after in %				
			Employed		Not Employed		Total
			Figures	%	Figures	%	Figures
French National Cancer survey	Employed	Self-Employed Workers	239	88 [84-91]	34	12 [9-17]	273
		Employed Workers	1388	88 [86-89]	197	12 [11-14]	1585
	Not Employed	Self-Employed Workers	1	6 [0.8-35]	16	94 [65-99]	17
		Employed Workers	9	2 [1-4]	435	98 [96-99]	444
French National Employment survey	Employed	Self-Employed Workers	570	97 [95-98]	17	3 [2-5]	587
		Employed Workers	4622	94.5 [94-95]	268	4.5 [5-6]	4890
	Not Employed	Self-Employed Workers	12	32 [20-50]	25	68 [50-80]	37
		Employed Workers	402	28 [25-30]	1050	72 [70-75]	1452

Table IX.Transitions on the labor market: probability matrices after simple matching between self-employed and salaried workers surviving cancer (confidence intervals are in brackets)

		Professional situation in 2010		Professional situation two years after in %		
				Employed	Not Employed	Retired
				%	%	%
Coarsened Exact Matching between self-employed and salaried staff on age, sexe, level of education, marital status, prognosis at the time of diagnosis andprofessional situation in 2010	French National Cancer survey	Employed	Self-Employed Workers	79 [0-82]	15 [0-18]	6 [0.4-100]
			Salaried Staff	76 [0-100]	14 [0-21]	7 [0-100]
		Not Employed	Self-Employed Workers	4 [0-16]	48 [32-100]	48 [38-94]
			Salaried Staff	0 [0-100]	52 [0-100]	48 [0-100]
		Retired	Self-Employed Workers	0	0	100
			Salaried Staff	0	0	100

2. Job Retention

This two-step estimation model, based on the matched dataset between cancer survivors and the general population, shows that the probability of being employed in 2010 increases with age (until a certain age and then it decreases). The results are presented in table X below. People with a high level of education have more chances to be employed compared to those with a small level (<French baccalauréat). Self-employed workers have more chances to be employed than salaried staff. Indeed, the probability of being employed in 2010 increased by 12.9% when the person is a self-employed worker rather than a salaried staff.

The second equation shows that people who were diagnosed cancer in 2010 have less chances to be employed two years after rather than people who were not diagnosed cancer in 2010.
Indeed, being diagnosed cancer in 2010 and having an estimated survival rate superior to 80% results in a decrease of the probability of remaining employed of 21.4 % as shows Table X compared to the probability of those who are not diagnosed cancer. The coefficient is even stronger for those who had a bad prognosis of survival compared to those who had a good prognosis. Being diagnosed cancer in 2010 and having an estimated survival rate inferior to 80% results in a decrease of the probability of remaining employed of 36.3 % compared to the probability of those who have not been diagnosed with cancer. However, there is no significant differences between employed and self-employed workers. People, who had children, have more chances to stay employed and the older we are, the less chances we have.

Table X. Two-step estimation model

Variables	Employed in 2010	Standard Errors	Marginal Effects	Employed two years after	Standard Errors	Marginal Effects
Age	0.273***	(0.028)	0.066	-0.015***	(0.004)	0.005
Age2	-0.003***	(0.001)	(-0.001)			
Gender (ref : male)	-0.312	(0.056)	(-0.070)			
Education (ref : <bac)	0.473***	(0.049)	0.012			
Married (ref: single)	0.141***	(0.051)	0.034			
Self-employed (ref: salaried staff)	0.754***	(0.119)	0.129	-0.008	(0.098)	0.011
Cancer (ref: no cancer)						
Cancer and prognosis > 80%	-0.052	(0.237)	(-0.012)	-0.948***	(0.230)	-0.214
Cancer and prognosis < 80%	-0.212	(0.235)	(-0.054)	-1.264***	(0.223)	-0.363
Children (ref:no)	0.140	(0.234)	0.034	0.619***	(0.222)	0.110
Constant	-5.024***	(0.610)		2.354***	(0.199)	
Observations	4104			4104		

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

LR test of indep. eqns. (rho = 0): chi2(1) = 44.65 Prob > chi2 = 0.0000

D. Discussion

a) Observed results

In the French Cancer Survey, self-employed workers and salaried employees are at a higher risk of unemployment compared to the French labor force population. However, there are no major differences between them. In the international literature, a Danish study shows that self-employed workers are not at a higher risk of unemployment after cancer compared to others; however manual workers are at a higher risk (Carlsen, 2008). Another article shows that self-employed workers have more chances to be employed 5 years after cancer than others (Torp, 2012).

The Markov matrices indicate interested results about transitions on the labour market. Nevertheless, these results must be analyzed with precaution because of the lack of observations for certain transitions which resulted in large confidence intervals.

The transitions on the labor market between the cancer survivors and the general population emphasize two major trends also underlined in the article of Joutard et al (Joutard et al, 2012) and other articles (Paraponaris et al, 2010) (Barney et al, 2015) (De Boer et al, 2009) (Chirikos et al, 2002).
First, the employment rate from 2010 to two years after is smaller for cancer survivors than for the general population.
Second, an undeniable difficulty for non-employed workers to find a job after a cancer persists. Joutard et al found similar results thanks to a similar French national cancer survey conducted in 2004.
We also find that the move to retirement is more important among cancer survivors than among the general population.

The only difference between self-employed workers and salaried staff surviving cancer would be that among people who are not employed in 2010, more salaried staff surviving cancer move to retirement two years after compared to self-employed workers surviving cancer. However, it needs to be backed with other data. Is it a choice or are they not able to move to retirement for financial reasons? Surveys which focused just on self-employed workers could help answering this question.

b) Survey weaknesses

When discussing the results presented in the previous section, four points need to be carefully considered.
First, the population of the French Cancer Survey is only made of cancer survivors which means that our results only concern the population who had survived to the disease two year after the cancer diagnosis.

Second, in our study, the control group from the French labor force survey could include few individuals affected by a chronic disease, specifically cancer. The technique used in Joutard et al's paper could solve this issue however differences would not be major as shown in their paper (Joutard et al, 2012).
Third, we are unable to stratify our self-employed variable in this article due to the small number of observations per category but differences between categories might appear. Over-representing this population in surveys or doing surveys only on them is necessary.
Last but not least, we implemented two successive matching methods which reduced the size of our samples. People not selected were in majority men, older and less employed than those who have been selected.

c) Public labor and health policy considerations

The originality of this chapter is to compare self-employed workers to salaried employees by matching all of them to the general population. This kind of study that has been rarely done to our knowledge. Several things should be considered by policy makers.
First, the transitions on the labor market are quite similar for self-employed workers and salaried staff surviving cancer excepted for one thing: self-employed workers seem to resort less to retirement to leave the labor market either because they cannot for financial reasons or do not want. This needs to be confirmed by other researches. Even if their situations are similar, it is important to remind that self-employed workers do not systematically benefit from the unemployment insurance. It depends on if they contributed to it or not. Thus, their situation might be very fragile and should alert the policy makers.
Second, these results underline that the situation of French workers surviving cancer has not evolved even after the public health policies implemented in 2003. The trends described in this paper are the same observed in other French papers based on older data (Paraponaris et al, 2010) (Barnay et al, 2015) (De Boer et al, 2009) (Chirikos et al, 2002). People surviving cancer are at a higher risk of unemployment than others. And those who are unemployed at the time of diagnosis have less chances to find a job.
Third, these results must be considered in the short-term as the professional situations are observed two years after the cancer diagnosis. However, the survival of the self-employed workers' firms should also be scrutinized in the long-term. This is done by a recent article which shows that a high workload is a significant factor of the firm's failure (Ha-Vinh et al, 2015). They also show that the risks of the firms' failures disappear after five years, which means that policies should focus on this five years period after cancer (Ha-Vinh et al, 2015).

In terms of policy making, this chapter enlightens the need to conduct surveys just on self-employed workers. It also puts forward the necessity of analyzing the implementation of public health polices dedicated to the remaining in activity and to the return to work after cancer. Do these policies obtain satisfying results?

Given the risk of unemployment and difficulties to maintain activity faced by cancer survivors, we can wonder if they change the way they see risks in life after cancer.

Thus, in the next part of this manuscript, we propose to analyze the impact of several diseases on the variation of risk aversion by using two types of questions.
The first type of questions consists in obtaining declarative answers. People are asked whether they changed their behaviors toward risks in their professional career or not, after cancer.
The second type of questions presents hypothetical choices to individuals. We also look at the impact of diseases on the share of safe assets held in a portfolio, which is another measure of an individual's level of risk aversion.

Part 2: Risk aversion and diseases within the general population

Introduction of Part 2

Results of Part 1 clearly show that a health shock has an impact on the professional situation of individuals. The use of sick leaves after cancer depends on the type of job. However, there are no significant differences when it comes to the transitions on the labor market, two years after cancer, between self-employed workers and salaried staff. The only difference, that would need to be confirmed, would be the use of early retirement to exit the labor market by salaried staff. The main concern of self-employed workers, put forward in the previous part, is to "maintain activity" even if they are sick.

Indeed, self-employed workers face alone all the risks of their activity. Furthermore, they are autonomous and do not have any hierarchical link in their activity contrary to salaried staff. These are also the reasons why, self-employed workers surviving cancer do not face the same difficulties than salaried staff surviving cancer. We can thus wonder if the diagnosis of a disease such as cancer modify the way they see life and especially risks in life.

Self-employed workers are well-known to be less risk averse than salaried employees (Cramer, 2002). An experiment even shows that when they have to take their decision with a group, they are willing to pay to take their decision alone because they find the group too risk averse (Colombier et al, 2008). An article of Fraser et al. shows that entrepreneurs are more optimistic than salaried staff but that their optimism and uncertainty diminish with experience (Fraser et al, 2006), thus emphasizing that their behaviors and perception change over time.

Do this peculiar characteristic of few risk aversion change after a health shock? Do self-employed workers and salaried staff change their behaviors toward risks in their professional careers after the diagnosis of a disease?

We used the data of the retrospective French Cancer Survey to answer this question. Respondents, aged under 55 years old, were asked to evaluate on a scale from one to ten their behaviors toward risks at the time of the survey and two years before at the time of their cancer diagnosis.

Ten corresponds to an extreme prudence in the sense of an attitude consisting in minimizing risks and zero corresponds to a voluntary attitude to take risks (no prudence). The questions are: "*Currently, are you prudent for your health (for your professional career)? Before the diagnosis of your disease, were you prudent for your health (for your professional career)? Do you think your behavior has changed on account of your cancer?*"

Even if the answers to these questions are retrospective and subjective and therefore criticized, they inform us on how people evaluate their behaviors toward risk in health and in their professional career before and two years after their cancer. Considering that people's points of views on their own behaviors are important and informative, we decided to present the results in this introduction.

Before observing the changes in the behaviors toward risks in health and toward risks in professional career, let us take a look at the profile of self-employed workers compared to salaried staff in these fields.

In the field of health, there are no major differences as shows figure 7.

Figure 7: Profiles toward risk in health before diagnosis

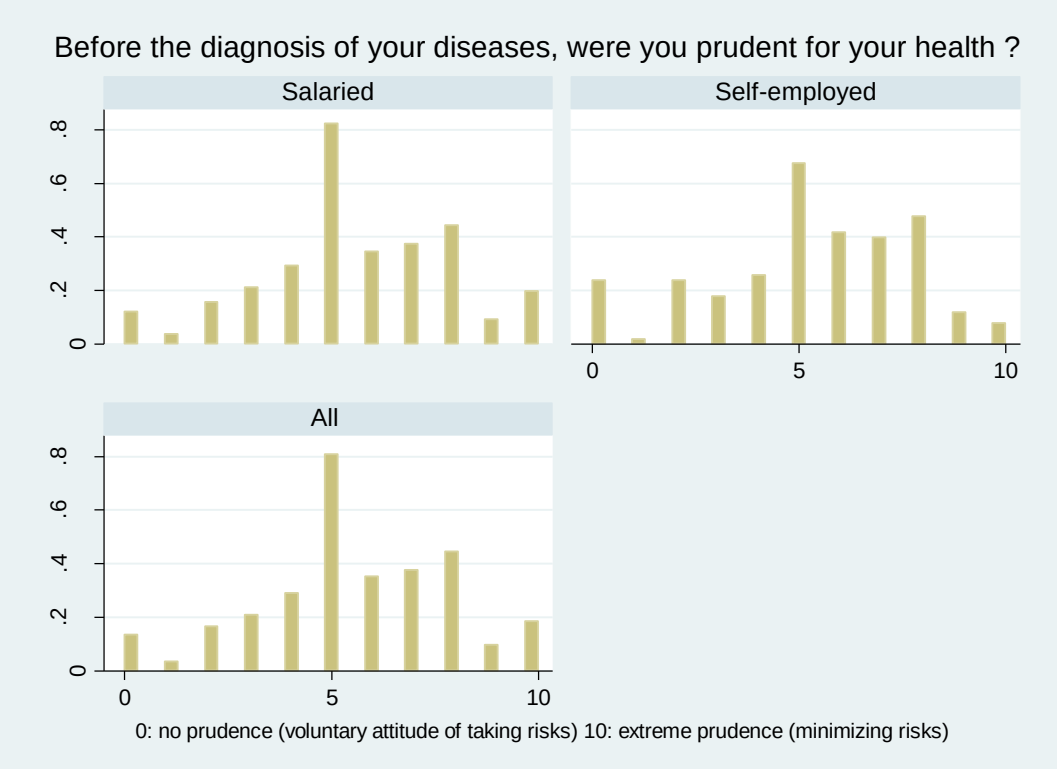


Figure 8. Profiles toward risk in health after cancer diagnosis

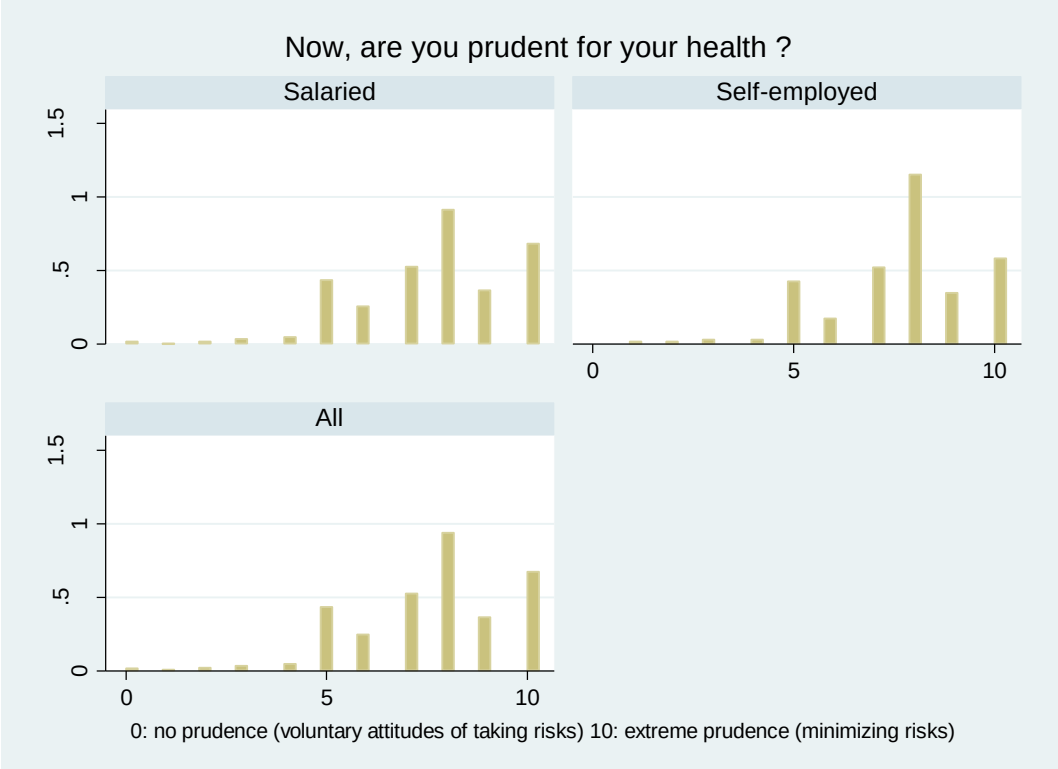
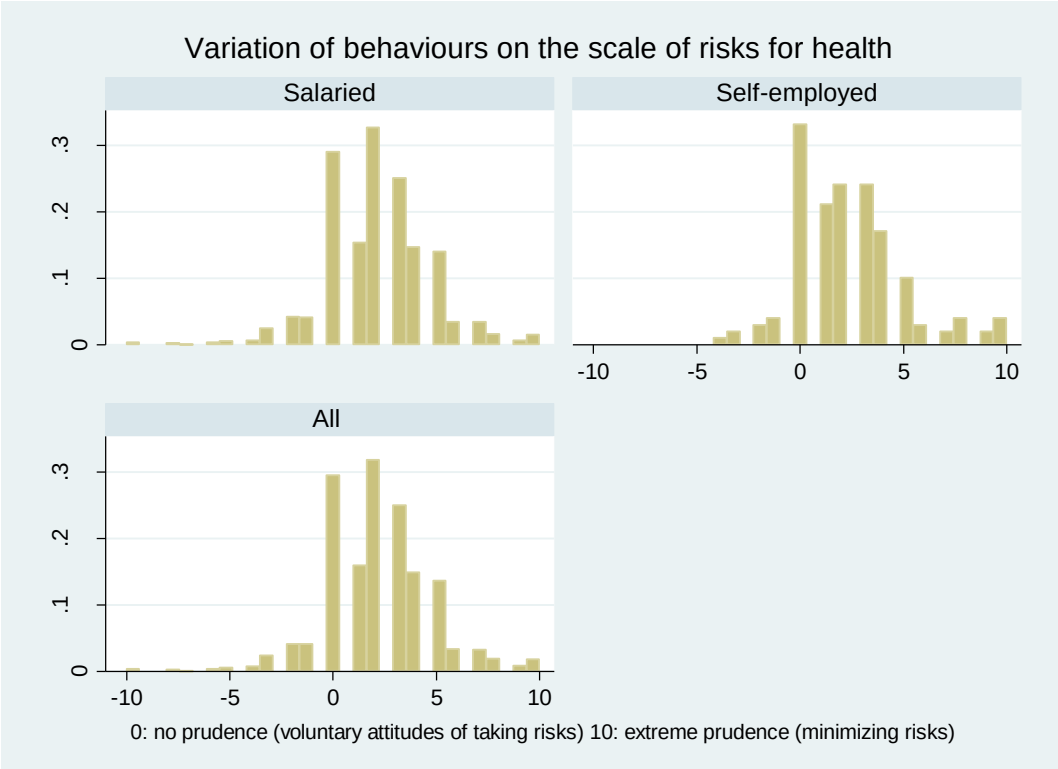


Figure 9. Variation of behaviors toward risk in health (after – before)



By looking at the figures 7 and 8 showing the distribution of behaviors toward risk in health before diagnosis and after, we observe that people become more prudent for their health after cancer (a trend to more risk aversion). 73% changed their score on the scale as underlined in Table XI which is at page 72. And, there are no significant differences between self-employed workers and salaried employees: they all changed to more risk aversion.

Figure 10: Profiles toward risk in professional career before diagnosis

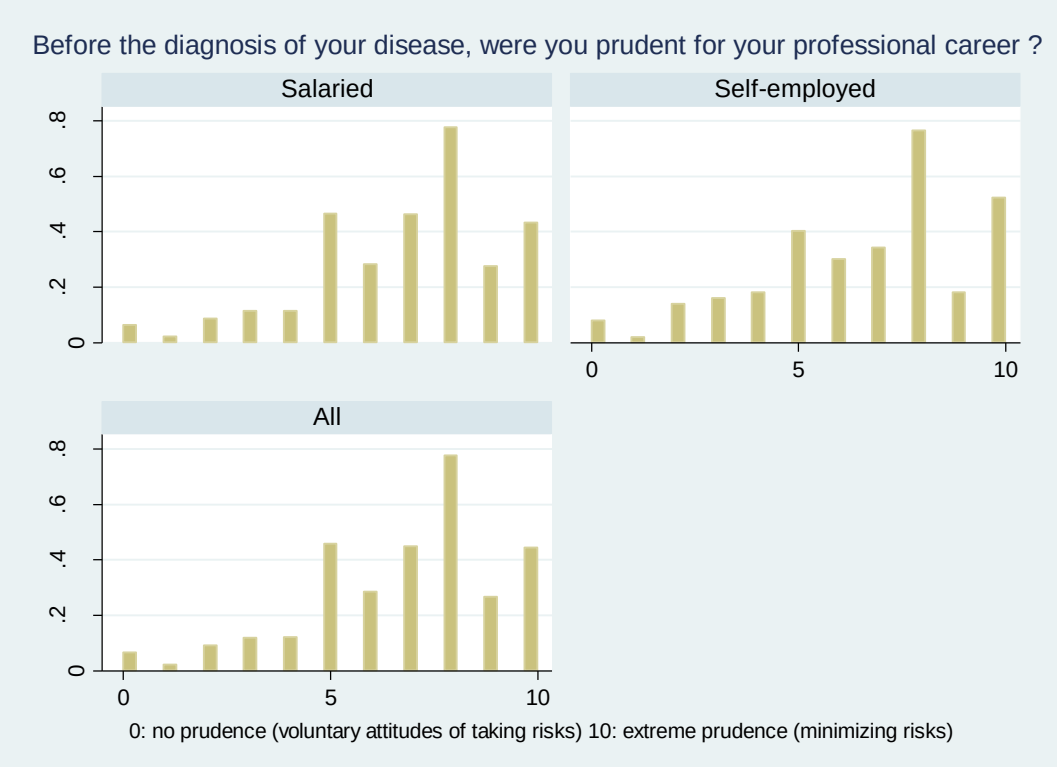


Figure 11. Profiles toward risk in professional career after cancer diagnosis

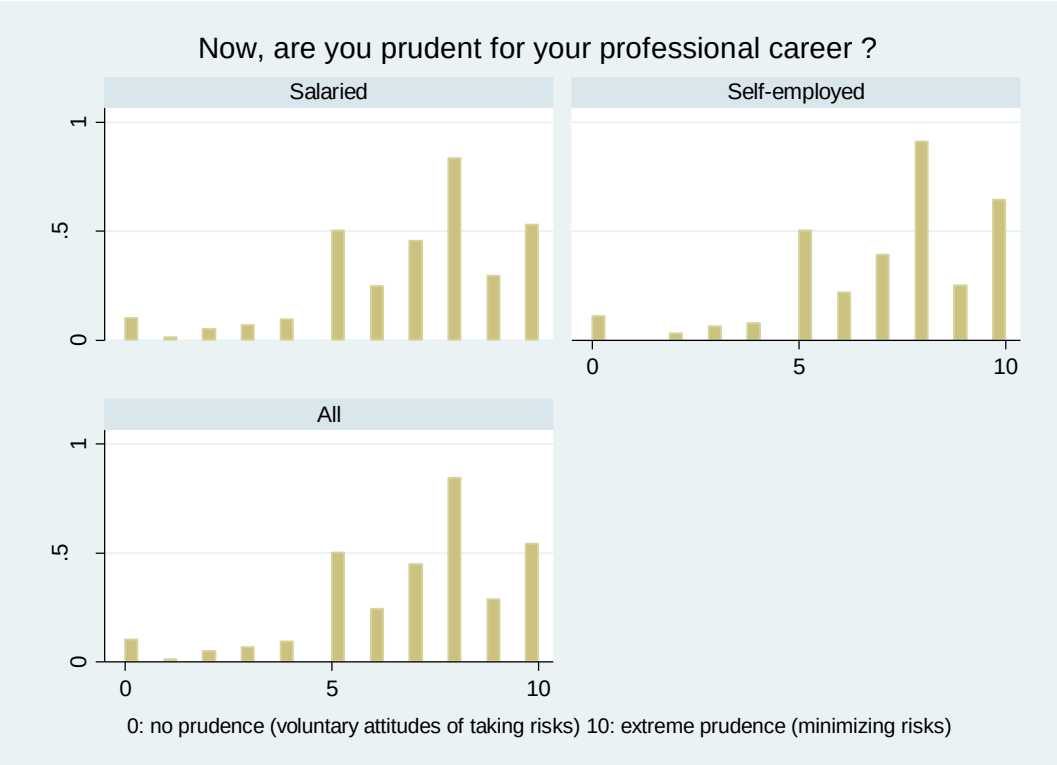


Figure 12. Variation of behaviors toward risk in professional career (before – after)

In the field of risks in career, self-employed workers are less risk averse but this difference, which can be observed in figure 10, is not statistically significant (chi 2 test : $p<0.975$).
Respondents also change their behaviors after cancer diagnosis. However, a more important proportion of people do not change compared to the variation in the field of risks in health: 47% for self-employed workers and 42% for salaried employees. And when they change, there is no trend to more risk aversion. They change in both sense: more risk aversion and less risk aversion as shows figure 12.
There is a significant difference between self-employed and salaried workers but at a 10% level (Table XI). Self-employed workers change less their behaviors than salaried staff and when they change, they change to more risk aversion for the majority of them.

Results are interesting in the sense that there is an ambiguity: a majority of individuals do not modify their behaviors toward risks in career after cancer and another majority do modify their behaviors. Salaried change either for more risk aversion or for less risk aversion. And self-employed workers have a tendency to change for more risk aversion.

Table XI. Changes in behaviors toward risk: a comparison of self-employed workers and salaried employees

Population observed	Observed variables	Yes	No	Total	Number of observation	Chi2 Test
All	Do you think that your behavior has changed since the beginning of your cancer?	75%	25%	100%	2079	
	Observed change for behaviors toward health risk	73%	27%	100%	1568	
	Observed change for behaviors toward professional risk	58%	42%	100%	1447	
Self-employed	Do you think that your behavior has changed since the beginning of your cancer?	74%	26%	100%	210	0.507
Salaried	Do you think that your behavior has changed since the beginning of your cancer?	76%	24%	100%	1746	
Self-employed	Observed change for behaviors toward health risk	79%	21%	100%	154	0.647
Salaried	Observed change for behaviors toward health risk	63%	27%	100%	1320	
Self-employed	Observed change for behaviors toward professional risk	53%	47%	100%	148	0.064
Salaried	Observed change for behaviors toward professional risk	58%	42%	100%	1241	

Chapter 1: Risk aversion and its links with diseases

Objectives: In this chapter, we present first the literature on risk aversion and its links with diseases. Then, a theoretical model looking at the influence of a change in health on risk aversion is presented. This theoretical model relies on the expected utility theory, presented in the introduction of this thesis.

Conclusion: The theoretical model shows that a change in $health$ can have an impact on the individual risk aversion in certain cases. The sign of this impact depends on the sign of $\Pi_w - \Pi_v$ which reflects the relative curvature of the two components of the utility function. It also depends on $f'(h)$ which is the marginal utility of health. It is not clear however which direction it will take. If $f'(h) > 0$ and if $\Pi_w > \Pi_v$, the change is positive, the individual becomes less risk averse while on the opposite if $\Pi_w < \Pi_v$, the variation is negative, the individual becomes more risk averse.

A. Literature overview

1. Theoretical Literature on Health and Financial risk aversion

In the expected utility theory, risk aversion is defined as below (Pratt, 1964):

$$-\frac{u''(c)}{u'(c)}$$

It is the fraction of the second derivative of the utility of consumption on the marginal utility of consumption. Consumption is the wage minus the savings.
Using individual modeling based on the expected utility theory, health could have an impact on risk aversion through several channels (Hammitt et al., 2009). For instance, it could have an impact through the marginal utility of consumption ($u'(c)$). It also could have an impact through life expectancy. A decrease in longevity may reduce future earnings and the need to finance future consumption. Thus, it can impact the wage and the risk aversion (through c). Furthermore, productivity could be a channel as well. A reduction in productivity may decrease future earnings. And last but not least, an increased medical expenditures could reduce income available for consumption and saving, thus influencing risk aversion.
So far, none of these channels is privileged but one of our main interests is to understand how health could influence risk aversion.

Restrictions on the general utility function for health and wealth u(c,h) that are most often used in the literature are the multiplicative form $u(c,h) = f(h) \times v(c)$ and the additive form $u(h,c) = q(h) + w(c)$ where h is health and c is consumption (Eeckhoudt et al, 1998) (Hammitt, 2013). All functions $u(c), v(c), w(c)$ are monotonically increasing in their arguments.

The first, multiplicative function implies that utility is proportional to health and that the marginal utility of consumption increases with health. Within the expected utility framework, however, this multiplicative utility function implies that a health change has no effect on financial risk aversion. For instance, the model developed by Hammitt et al, based on a multiplicative and a standard intertemporally additive utility function (Yaari, 1965), underlines that health and longevity do not affect risk tolerance in the standard intertemporal model with additive separability among periods (Hammitt et al, 2009). Their theoretical results are in conflict with their empirical results showing that risk tolerance increases with a better health. Other studies, either experimental or empirical, back their results.

The additive form indicates that the utility is not proportional to health and that the marginal utility of consumption is not related to health. Hence, health and risk aversion are not related.

2. Empirical Literature on Health and Financial risk aversion

Most of the studies, enlightening a link between a disease and a modified behavior toward risk, are experimental and cross-sectional and based on samples varying from 30 individuals to 93 individuals. Researchers observed at one static point in time whether people with good health are more or less risk averse than people with a deteriorated health, after an experiment in a laboratory.

Sinz, Delazer and Ha's studies demonstrate that decisions under risk are altered for patients with Alzheimer's disease (Sinz et al, 2008) (Delazer et al, 2007) (Ha et al, 2012). Sinz's study is based on a sample of 40 individuals (22 controls and 18 with mild Alzheimer's disease). They use an Iowa Gambling Task which consists in four decks of cards A, B, C and D. Decks A and B are risky decks (large gains but also large losses) and decks C and D are low risk decks (small gains but small losses). The participant makes 100 card selections one at a time and does not know the total number of cards. Sinz et al use a Probability Associated Gambling, which is an imaginary lottery game. Thanks to these lottery games, they found that decisions are different for people with mild-Alzheimer diseases who make more disadvantageous choices than healthy patients.

Delazer's study is similar and is based on a sample of 44 individuals (25 controls and 19 with mild-Alzheimer). By using a game of dice tasks, consisting in giving an imaginary starting capital of 1000 euros to individuals to allow them to bet, they found that healthy individuals show a stronger tendency toward safe and advantageous responses compared to patients with mild Alzheimer's diseases. According to Ha and al, a study based on 30 individuals (14 with mild- Alzheimer's and 16 controls), people with mild Alzheimer disease are making riskier choices in the domain of gain contrary to controls (Ha et al, 2012).

An argument put forward to explain this shift in decision-making is that AD affects the amygdala hippocampal complex which plays a key role in the emotional system (Ha et al, 2012). This argument echoes the scientific one used to explain Carney's experimental results: they show that changing physical posture can lead to changes in risk aversion. Persons experiencing high power poses exhibit more risk tolerance just after the experiment than those who experience low power poses. The suggested explanation reflects a physiological pathway: *"high power posers experience elevations in testosterone, decreases in cortisol, and increased feeling of power"* (Carney et al, 2010). Here, it gives an example of "a shock" having a short-term effect on people's behavior because of a hormonal difference. In another example, a research team found that South Koreans who experienced war as children aged 4 to 8 years, were more risk averse as adults than individuals from other cohorts (Kim et Lee, 2012). In this case, an emotional "shock" appears to have a long-term effect on people's behavior.

In another experiment, Sinz and Delazer found that patients with Parkinson's diseases and dementia make more risky and disadvantageous decisions compared to those with just Parkinson's disease by using the Iowa Gambling Task and the Probability associated Gambling Task (Delazer et al, 2008).

Other studies investigate the behavior of depressive individuals toward financial risk. By also using an Iowa Gambling Task and by giving monetary rewards , Smoski et al find that depressive adults appeared to be more risk averse but they also showed better performances compared to the control group (Smoski et al, 2008).. At the end of the game, performances are calculated thanks to the amount of money respondents earned. Chapman et al underline that individuals with obsessive personality disorder become considerably risk averse as the Bechara Gambling task progressed over the trials (Chapman et al, 2007).

All these studies show that diseases might shift one's financial risk aversion over time but they are limited by the size of their samples (less than 100 individuals).

There are only 3 studies based on large samples which elicit risk aversion thanks to questionnaires; Hammitt and Melnychuck's studies are static and Sahm's study is dynamic. Melnychuck study, a work in progress on SHARE[5] , presents evidence that depression lowers the willingness to invest in risky financial assets, plausibly through the channel of risk aversion (Melnychuk, 2012). Hammitt et al show that risk tolerance increases with better health.

In contrast to these two cross-sectional studies, Sahm (2012) uses the panel dimension of the Health and Retirement Study containing 12 003 individuals by transforming the ordinal variables on risk tolerance into a cardinal proxy, assuming a constant relative risk aversion utility function (Kimball et al, 2008). Sahm's study yields conflicting results, depending on whether a balanced or unbalanced panel is analyzed. There is no alteration of the willingness to take further risks when the panel is unbalanced but there is large decline in risk tolerance of 15% after the onset of a health condition when the panel is balanced. Furthermore, she studies the health conditions "stroke, cancer, lung or heart disease" together and not separately.

Whether a health condition has an impact on risk aversion or not and how are still open questions. They are investigated in depth, in what follows, first by doing a theoretical model and second by analyzing the impact of eight diseases called "health shocks" individually on financial risk aversion and on another measure of risk exposure: "the proportion of safe assets in a portfolio".

[5] The Survey of Health, Ageing and Retirement in Europe. http://www.share-project.org/

3. Literature on health and portfolio

One of our interests is also in how health shocks affect risk aversion; risk aversion can be measured by surveys or by revealed preference such as "the share of risky assets held in a financial portfolio". It is obvious implication that risk aversion affects the financial portfolios. Several studies show that health shocks are better at explaining a portfolio rather than health indicators like as scores (Rosen et al, 2004) (Fan et al, 2009).
Furthermore, better health is found to increase the chances to own financial assets. And if health worsens, a rise in the ownership of safe assets is observed (Rosen et al, 2004) (Fan et al, 2009). Moreover, acute health shocks like heart attacks increase the chance of having liquid or time deposit (Coile, 2009) and lead to a decrease of assets such as vehicles or estates.

However, it is less obvious how health shocks affects the structure of a portfolio. Is it directly or through the channel of risk aversion? Are there some other plausible channels?
Edwards proposes a theoretical model, based on a Cobb Douglas function, which stresses that health affects portfolios through the channel of risk aversion. It shows that a risk in health leads to a change in financial risk aversion which depends on the sign of the mixed partial derivative of utility with respect to health and to consumption. His empirical study based on HRS also puts forwards that lower health risk is associated with more risky health investments (Edwards R.D, 2005). To proxy the health risk in the future, he uses the self-assessed probability of future health events.

On the contrary, Rosen concludes that it does not go through the channel of risk aversion but he just concludes this by adding the variable "risk aversion" to a model studying the impact of health on a portfolio and by looking at whether coefficients change or not.

Some other papers focus on this issue of causality and find that is more likely that health shocks affect the portfolio rather than the reverse (Michaud and Van Soest, 2008) (Cutler et al., 2006).

B. Theoretical Model

As people age, adverse health shocks become more frequent. Understanding their effect on financial risk attitude is important for understanding behaviors in investment, insurance, and other markets and for evaluating the welfare effects of regulating those markets.
Moreover, theoretical models have not adequately investigated the relationships between health and financial risk attitude. Hence, we propose a theoretical model based on the expected utility theory.

1. The utility function

Among commonly used utility functions for health and wealth are the multiplicative form where the marginal utility of consumption is proportional to health and $v(.)$ is a monotonic increasing function such that $u(c,h) = h\ v(c)$ and the additive separable model where the utility is a sum of two monotonic increasing functions in their respective arguments health and wealth such that $u(c,h) = q(h) + w(c)$; i.e., v'(c) > 0, q'(c) > 0, and w'(c) > 0. To ensure weak risk aversion with respect to consumption, we also assume v"(c) ≤ 0 and w"(c) ≤ 0.
These two functions represent extreme cases:

$u(c,h) = h\ v(c)\ where\ \frac{\partial^2 u}{\partial c\ \partial h} = v' > 0$

$u(c,h) = q(h) + w(c)\ where\ \frac{\partial^2 u}{\partial c\ \partial h} = 0$

The first function means that the marginal utility of consumption, that is to say the satisfaction from consuming a good, depends on the health state. The second one means that satisfaction is independent from health states. One can pretend that in one's life, there are some goods for which health state matters and others for which it does not.

As it is not clear how to specify $u(c,h)$, we consider a mixture of these specifications equals to:
$u(c,h) = (1-\lambda)[h\ v(c)] + \lambda\ [q(h) + w(c)]$ with $0 \leq \lambda \leq 1$.
Indeed if $\lambda = 1$, the additive form is obtained while if $\lambda = 0$, the multiplicative form is obtained.

This picks up the intuition that the utility associated with part of one's consumption is increasing with health and the utility associated with the other part is independent of health. Note that is not clear how to measure health. We assume without loss of generality that health is measured on a scale such that h ≥ 0 and its effect is linear in the first term of the utility function.

2. One period Model

The main purpose of this paper is to observe whether an individual changes his/her behavior after a serious disease such as a cancer.
What interests us is to know how the individual reacts at the end of period one when he realizes that his health state in period two, called h , will be much lower than what he expected because he has been diagnosed with a disease. Obviously, the individual takes into account this new information, and thus changes his consumption path.

To look at the impact of a one unit increase or decrease of wealth on the utility function, we must differentiate it with respect to c (wealth).
Differentiating u with respect to c, we obtain:
$\frac{\delta u}{\delta c} = (1 - \lambda)h\, v'(c) + \lambda w'(c) > 0$ (under the assumption $v'(c) > 0$ and $w'(c) > 0$).
$\frac{\delta^2 u}{\delta c^2} = (1 - \lambda)h\, v''(c) + \lambda w''(c) \leq 0$ (under the assumption $v''(c) \leq 0$ and $w''(c) \leq 0$).

The Arrow Pratt criteria is a criteria representing risk aversion in the decision theory. It is defined like this:

$$\Pi = -\frac{\frac{\delta^2 u}{\delta c^2}}{\frac{\delta u}{\delta c}}$$

Hence, his new level of risk aversion is:

$$\Pi = -\frac{(1 - \lambda)h\, v''(c) + \lambda w''(c)}{(1 - \lambda)h\, v'(c) + \lambda w'(c)} > 0 \quad (1)$$

Equation 1 represents the new level of risk aversion regarding wealth of this individual. Even if health appears both in the numerator and the denominator, this equation does not allow us to make any conclusion on the potential impact on Π of a change of the health state.
To have this information, the risk aversion criterion needs to be derived regarding health (let's name in equation 1 the denominator D and the numerator N):

$$\frac{\partial \Pi}{\partial h} = -\frac{D\,[(1 - \lambda)v''(c)] - N[(1 - \lambda)\, v'(c)]}{D^2} \quad (2)$$

The numerator of equation (2) is:

$$N_n = (1-\lambda)^2 h\, v''v' + \lambda\,(1-\lambda)v''w' - (1-\lambda)^2 h\, v''v' - \lambda\,(1-\lambda)v'w''$$

$$N_n = \lambda\,(1-\lambda)v''w' - \lambda\,(1-\lambda)v'w''$$

$$N_n = \lambda\,(1-\lambda)\,(v''w' - v'w'') \quad (3)$$

Dividing and multiplying it by $v'w'$ leads to the following result:

$$N_n = \lambda\,(1-\lambda)\,v'w'\left(\frac{v''}{v'} - \frac{w''}{w'}\right)$$

$$N_n = \lambda\,(1-\lambda)\,v'w'\,(-\Pi_v + \Pi_w) \quad (4)$$

where Π_v = - $\frac{v''}{v'}$ and $\Pi_w = -\frac{w''}{w'}$ (risk aversion of each utility function)

$D^2 > 0, \quad v'(c) > 0, \quad w'(c) > 0.$

It can be deduced that:

$$\frac{\partial \Pi}{\partial h} = -\frac{\lambda\,(1-\lambda)\,v'w'\,(\Pi_w - \Pi_v)}{D^2} \quad (5)$$

First, this derivative is not equal to zero, except if λ equals zero or one, therefore a change in $health$ has an impact on the individual risk aversion.

Second, the sign of the person's risk aversion change due to health will depend on the sign of $\Pi_w - \Pi_v$ which reflects the relative curvature of the two components of the utility function. It is not clear however which direction it will take. If $\Pi_w > \Pi_v$, the change is positive, the individual becomes less risk averse while on the opposite if $\Pi_w < \Pi_v$, the variation is negative, the individual becomes more risk averse.

3. Model replacing h by $f(h)$

Now we can consider that the satisfaction from consuming a good is not just proportional to the health status but is a function of the health status.
Thus, we replace h in the multiplicative form by f(h) and we have the following utility function:
$u(c, h) = (1 - \lambda)[f(h)\, v(c)] + \lambda\, [q(h) + w(c)]$ with $0 \leq \lambda \leq 1$.

The level of risk aversion is:

$$\Pi = -\frac{(1 - \lambda)\, f(h)\, v''(c)] + \lambda w''(c)}{(1 - \lambda)\, f(h)\, v'(c) + \lambda w'(c)} > 0 \quad (6)$$

By doing the same calculations, it can be deduced that:

$$\frac{\partial \Pi}{\partial h} = -\frac{\lambda\,(1 - \lambda)\, v' w'\, f'(h)\, (\Pi_w - \Pi_v)}{D^2} \quad (7)$$

This time, the sign and magnitude of the person's risk aversion change also depends on his health state, more precisely on $f'(h)$.

4. Model with a multidimensional health state

Let's look at what happens if we replace the health state "h" by a multidimensional health state "$\alpha\, h_m + (1-\alpha)\, h_p$", with h_m for mental health and h_p for physical health.
We consider now a generalization of these specifications equals to:
$u(c, h) = (1 - \lambda)\big[f\big(\alpha\, h_m + (1 - \alpha)\, h_p\big)\, v(c)\big] + \lambda\, [q\big(\alpha\, h_m + (1 - \alpha) h_p\big) + w(c)$
with $0 \leq \lambda \leq 1$.

Differentiating u with respect to c, we obtain:
$\frac{\delta u}{\delta c} = (1 - \lambda)\, f(\alpha\, h_m + (1 - \alpha)\, h_p)\, v'(c) + \lambda w'(c) > 0$ (under the assumption $v'(c) > 0$ and $w'(c) > 0$).
$\frac{\delta^2 u}{\delta c^2} = (1 - \lambda)\, f(\alpha\, h_m + (1 - \alpha)\, h_p)\, v''(c) + \lambda w''(c) \leq 0$ (under the assumption $v''(c) \leq 0$ and $w''(c) \leq 0$).

Hence, his new level of risk aversion is now:

$$\Pi = -\frac{(1 - \lambda)\, f(\alpha\, h_m + (1 - \alpha)\, h_p)\, v''(c) + \lambda w''(c)}{(1 - \lambda)\, f(\alpha\, h_m + (1 - \alpha)\, h_p)\, v'(c) + \lambda w'(c)} > 0 \quad (6)$$

Differentiating the risk aversion criterion with respect to mental health, we obtain:

$$\frac{\partial \Pi}{\partial h_m} = -\frac{D\,[(1-\lambda)\, f\prime(\alpha\, h_m + (1-\alpha)\, h_p)\, \alpha\, v''(c)] - N[(1-\lambda)\, f'(\alpha\, h_m + (1-\alpha)\, h_p)\, \alpha\, v'(c)]}{D^2} \quad (8)$$

The numerator of equation (8) is:

$$N_n = (1-\lambda)^2 f\big(\alpha\, h_m + (1-\alpha)\, h_p\big)\, f'\big(\alpha\, h_m + (1-\alpha)\, h_p\big) v'' v' \alpha + \lambda\,(1-\lambda) f'\big(\alpha\, h_m + (1-\alpha)\, h_p\big)\, v'' w' \alpha - (1-\lambda)^2 f(h) f'(h) v'' v' \alpha - \lambda\,(1-\lambda) f'(h) \alpha\, v' w''$$

$$N_n = \lambda\,(1-\lambda)\, f'(h)\, v'' w' \alpha - \lambda\,(1-\lambda)\, f'(h)\, v' w'' \alpha$$

$$N_n = \lambda\,(1-\lambda)\, f'(h)\, \alpha\, (v'' w' - v' w'')$$

Dividing and multiplying it by $v'w'$ leads to the following result:

$$N_n = \alpha\, \lambda\,(1-\lambda)\, f'(h)\, v' w' \left(\frac{v''}{v'} - \frac{w''}{w'}\right)$$

$$N_n = \alpha\, \lambda\,(1-\lambda)\, f'(h)\, v' w'\, (-\Pi_v + \Pi_w)$$

where Π_v = - $\frac{v''}{v'}$ and Π_w = $-\frac{w''}{w'}$ (risk aversion of each utility function)

$D^2 > 0, \;\; v'(c) > 0, \;\; w'(c) > 0.$

It can be deduced that:

$$\frac{\partial \Pi}{\partial h_m} = -\frac{\lambda\,(1-\lambda)\, f'(h)\, v' w' \alpha\, (\Pi_w - \Pi_v)}{D^2}$$

Similarly, it can be deduced that:

$$\frac{\partial \Pi}{\partial h_p} = -\frac{\lambda\,(1-\lambda)\, f'(h) v' w' (1-\alpha)\, (\Pi_w - \Pi_v)}{D^2}$$

If health is multidimensional, it does not change the sign of the impact but the magnitude of it (α or $1-\alpha$) The sign of the impact depends on individual characteristics regarding risks.

5. Conclusion

This theoretical model shows that a change in $health$ can have an impact on the individual risk aversion.

The sign of the person's risk aversion change due to health will depend on the sign of $\Pi_w - \Pi_v$ which reflects the relative curvature of the two components of the utility function and of $f'(h)$ which is the marginal utility of health. It is not clear however which direction it will take. If $f'(h) > 0$ and if $\Pi_w > \Pi_v$, the change is positive, the individual becomes less risk averse while on the opposite if $\Pi_w < \Pi_v$, the variation is negative, the individual becomes more risk averse.

In order to better understand these theoretical results, the next chapter proposes empirical analyses looking at the impact of eight diseases on the variation of risk aversion measured by lottery questions based on jobs opportunities. The impact of the same eight diseases on the variation of safe assets, another measure of risk aversion, is also put forward.

Chapter 2: Influence of diseases on risk aversion and on the proportion of safe assets held in a portfolio through time

Abstract

Aims: First, to enlighten the impact of eight diseases (cancer; diabetes; heart problems; stroke; arthritis or rheumatism; chronic bronchitis or emphysema; hypertension and mental health problems) on people's preferences toward financial risks in a dynamic perspective. Second, to analyze the impact of these eight diseases on the variation of safe assets held in a portfolio.

Materials and Method: Data from the Health Retirement Study are used. The sample is made of 2 987 individuals. To observe the impact of the eight diseases on the variation of risk aversion, we used a bivariate probit model with a sample selection which can be presented as a difference-in-difference model). This model is backed by an ordered logit and others bivariate probit models. To analyze the impact of the eight diseases on the proportion of safe assets held in a financial portfolio, we implemented a regression analyzes and a difference in differences model.

Results: People's reaction to health shocks depends on the disease they face: cancer and arthritis favor moves to less financial risk aversion whereas diabetes, mental health problems (such as depression) and lung diseases induce moves to more risk aversion. Only psychological diseases have an impact on the variation of safe assets: people with psychological diseases tend to save more.

Conclusion: These results can have tremendous implications in several fields: finance, bank, vaccination. In some extent, they lead us to reconsider the natural tendency towards more risk aversion for ageing people.

A. Introduction

The way diseases influence people's attitudes towards financial risk has received little attention in economic models. Although there exists some papers showing that attitudes towards financial risks can change after a health "shock", few papers try to analyze the impact of diseases on financial risk aversion (Carney et al, 2010) (Kim et Lee, 2012) (Sahm, 2012).

However, it deserves more attention because people's attitudes towards risk can be affected by a wide range of factors, from the trivial to the profound. Furthermore, few papers analyze the impact of the variation of risk aversion on the variation of safe assets.

As people age, adverse health shocks become more frequent. Understanding their effect on financial risk attitude and on a portfolio is important for understanding behaviors in investment, insurance, and other markets and for evaluating the welfare effects of regulating those markets.

Hence, this article deepens this subject in a dynamic perspective. Does a change in health, such as the occurrence of a disease, lead to a change in risk aversion in the field of professional career? Does a change in health, such as the occurrence of a disease, lead to a change in the variation of safe assets held in a financial portfolio?

An empirical study will bring more insight. This empirical study will contain two parts. First, the variation of risk aversion measured with hypothetical lottery questions related to job decisions will be analyzed through time. Second, the impact of diseases on another measure of risk exposure "the proportion of safe assets held in a portfolio" will be put forward.

B. Materials and Methods

1. The Health and Retirement Study

The models rely on the Health Retirement Study aggregate panel Data file. This data file has been carried out by the RAND Center for the Study of Aging and includes six cohorts We decided to focus on two waves (2002 and 2006) for which the questions on risk aversion were the same to avoid supplementary measurement errors in the responses. The sample obtained includes 2 987 individuals.

2. The description of variables

a. The measure of risk aversion

The measure of financial risk aversion is constructed from hypothetical gamble questions. The first one is: *"Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee your current total family income for life. The second is possibly better paying, but the income is also less certain. There is a 50-50% chance the second job would increase your total lifetime income by 20% and a 50-50% chance that it would cut it by 10%. Which job would you take? The first job or the second job?*"
If the respondent chooses the second job, she/he is then asked a second question: "*Suppose the chances were 50-50% that it would either increase your income by 20% or cut it by 15%. Would you take the first job or the second job?"*
If the respondent chooses the first job, she/he is asked the following question: *"Suppose the chances were 50-50% that it would either increase your income by 20% or cut it by 5%. Would you take the first job or the second job?"*
The sample is split into four categories from the least to the most risk averse individuals.

These questions are "*status-quo-bias–free questions*"(Kimball and al, 2012). In order to avoid using any predefined form for individuals' preferences that could bias estimates, we decided not to transform the original responses. Kimball and al adopted an alternative strategy consisting in harmonizing the measure of risk aversion across HRS waves by transforming the ordinal variables on risk tolerance into a cardinal proxy assuming constant relative risk aversion utility function (Kimball et al, 2008). By doing this, the upper and inferior bounds of the probability of being in a risk tolerance interval are calculated thanks to a CRRA function (constant relative risk aversion), which introduces a bias in this probability and in the univariate normal cumulative density distribution. Several studies point out the limit of this method (Kapteyn et al., 2011) (Dohmen et al., 2012). This is the reason why we are using the ordinary variable like other articles (Hammitt et al, 2011).

The variable for risk aversion is an ordinal variable containing four values: 1 for vary low financial risk averse individuals, 2 for low financial risk averse individuals, 3 moderate financial risk averse individuals and 4 for highly risk averse individuals.

b. The measure of safe assets

Financial assets are constituted of safe assets (checking and savings accounts, money market funds, CDs, government savings bonds, T-bills and other savings), bonds (corporate, municipal and foreign bonds, and bond funds), risky assets (stocks and mutual funds), and retirement accounts (IRAs and Keoghs).

c. The health shocks variables

The health shocks variables are defined according to the outbreak of some diseases between t (2002) and t+1 (2006). The questionnaire asked: "*Since we last talked to you, has a doctor told you that you have…?*" Eight diseases are considered: cancer; diabetes; heart problems; stroke; arthritis or rheumatism; chronic bronchitis or emphysema; hypertension and emotional/nervous/psychiatric problems. The health shocks variables have been constructed such that respondents do not have the disease in 2002 (and before) but develops it after 2002 and before 2006.
For instance, the variable shock cancer is coded one if the individual answers no to the questions asked in 2002 *"Do you have a cancer in 2002?"* and *"Has a doctor ever told you that you have a cancer?"* but yes to the question *"Did you develop a cancer since last wave ?"* in 2006. The initial health condition, the income and wealth are controlled in our model.

d. Sociodemographic variables

The sociodemographic variables are the age (categorical variable), the gender (women/men), the marital status (married, divorced, widowed, not married), the religion (Catholics, Protestant, Jewish, Others), and the race (White, Black, Hispanic, Others).

3. Ethics

This article has been written by following the ethical principles of the Declaration of Helsinki developed by the World Medical Association (WMA).

4. Empirical analyzes

a. Biprobit model

Two symmetric bivariate probit models with sample selection have been estimated. In the first equation, determinants of financial risk aversion (female, degree, age, marital-status, religion, income and self-reported health) are identified (models of Y_{1i} and Y_{3i}). In the second equation, the influence of eight health shocks on the variation of financial risk aversion is assessed (models of Y_{2i} and Y_{4i}).

The first model looks at the probability $P(Y_{1i})$ to be in a low/moderate/very high level of risk aversion rather than a very low level of risk aversion in period t. Then, low/moderate/vey high risk averse individuals are selected and the probability $P(Y_{2i})$ that they become less risk averse in t+1 is computed, considering -among other things- a potential health event. The model can be written as follows:

$$Y_{1i} = X_i\beta_1 + u_{1i} \quad (1)$$

$$Y_{2i} = Z_i\gamma_2 + H_i\theta_2 + u_{2i} \text{ if individual i is in low/moderate/very high level of risk aversion} \quad (2)$$

In this model, $P(Y_{1i})$ and $P(Y_{2i})$ are assumed not to be independent. Thus, corr(u_{1i}, u_{2i}) is expected not to be 0. The set of observable characteristics X_i is made of socio-demographic variables. H_i includes each of the eight potential health events and Z_i indicates changes in some key characteristics, such as marital status: spouse's death, or job status: retirement.

The probability $P(Y_{3i})$ to be in a very low/low/moderate level of risk aversion in period t rather than in a very high level is calculated in the second model. Then, very low/low/moderate risk-averse people are selected and the probability $P(Y_{4i})$ that they become less risk averse in t+1 is calculated, once again taking into account -among other things- the event of a health shock. The selected sample is not the same as the one considered in the first model, and only transitions toward less risk tolerance are studied in the equation (4):

$$Y_{3i} = X_i\beta_3 + u_{3i} \quad (3)$$

$$Y_{4i} = Z_i\gamma_4 + H_i\theta_4 + u_{4i} \text{ if individual i is in very low/low/moderate level of risk aversion} \quad (4)$$

Let's us discuss the choice of this structural modeling, in two successive behaviors. As stated earlier, the dependent variable "answers to the hypothetical gamble" is a static ordered variable with four items from "more risk averse" to "less risk averse". However, in our own perspective, we intrinsically aim at dealing with the dynamic aspect of our dataset, i.e.: the variations between 2002 and 2006, variations which could not be independent of the initial state of the variable in 2002. Therefore, we selected a modeling strategy in which the probability of changing the answer between t and t+1 would depend on the initial level of risk aversion in t

through a sample selection method. We made two selections: those who are particularly risk averse in 2002 (models Y_{1i} and modeled changes toward less risk aversion in Y_{2i}) and those particularly not risk averse (models Y_{3i} and modeled change toward more risk aversion in Y_{4i}). Nevertheless, neither theory nor any rational could help determining the "starting point" (people who are very averse? not very averse?), thus we propose both symmetric strategies.

This modeling strategy has also the advantage of treating the potential endogeneity issue. Indeed, being risk averse or not could increase or decrease the probability of some health events which, in longitudinal data, could cause endogeneity between some health shocks and the level of risk averse. Exposition to risk factors improves the probability to have develop cancers, for instance. However, in the two models considered in the paper, the outcome is not made of the level but the change in risk tolerance between two periods, so that the health events occur before the measured net variation. Another relevant point is that our risk averse metrics is limited to a "financial" field. Consequently, the metrics observed in 2002 risk averse level are not correlated to any health shocks occurring after 2002 and before or in 2006 (a thing that we verified in the data by multivariate regressions).

Regarding many aspects, the model, as it stands, is a very efficient difference in differences. Difference-in-differences with qualitative variables such as our models are backed up by a growing literature (Ai et al, 2003) (Puhani, 2011).

The measure of risk aversion for an individual i at age a_t (in t) can be modeled as follows:

[A] $$R_{ia_t} = \alpha_0 + \sum_{j=29}^{70} I_{\{a_j=a_{it}\}}\alpha_{a_j} + X_i\beta + H_{it}\theta + Z_{it}\gamma + m_i + \varepsilon_{it}$$

where: $I_{\{a_j=a_{it}\}}$ is a dummy variable which gives the age of individual i at time t (ranging from 29 to 70 years),

X_i is a set of time-invariant characteristics of individual i,

H_{it} is the vector of the eight health events for individual i at time t,

Z_{it} is a set of time-dependent states (living alone/in couple, being employed/unemployed, participating/not participating to the labor force,…) for individual i at time t,

m_i is an individual random effect, potentially correlated with H_{it},

ε_{it} is the idiosyncratic error term.

In period t+1, equation [A] can be written as follows:

[B] $$R_{ia_{t+1}} = \alpha_0 + \sum_{j=29}^{70} I_{\{a_j=a_{it+1}\}}\alpha_{a_j} + X_i\beta + H_{it+1}\theta + Z_{it+1}\gamma + m_i + \varepsilon_{it+1}$$

Subtracting equation [A] from equation [B] gives:

[C] $$\Delta R_{iat+1} = \alpha_{\Delta a_{it+1}} + \Delta H_{it+1}\theta + \Delta Z_{it+1}\gamma + \Delta\varepsilon_{it+1}$$

where: $\alpha_{\Delta a_{it+1}} = \alpha_{a_{it+1}} - \alpha_{a_{it}}$

Equation [C] is a difference-in-difference equation that gives the variation of risk aversion according to the change in age, health shocks and other events that occurred between t and t+1. It also suppresses the potential source of endogeneity between m_i and H_{it}.

We have to distinguish individuals who become:
Less averse: $\Delta R_{iat+1} > \pi_+$ with $\pi_+ > 0$,
More averse: $\Delta R_{iat+1} < \pi_-$ with $\pi_- < 0$.

And then, we can estimate two probabilities:
[D] P(less averse) = $\phi\ \mu_0 + \alpha_{\Delta a_{it+1}} + \Delta H_{it+1}\theta + \Delta Z_{it+1}\gamma$ with $\mu_0 \equiv\equiv -\pi_+$
[E] P(more averse) = $\phi\ \mu_1 - \alpha_{\Delta a_{it+1}} - \Delta H_{it+1}\theta - \Delta Z_{it+1}\gamma$ with $\mu_1 \equiv\equiv -\pi_-$

Equations [D] and [E] are equivalent to equations (2) and (4) in the biprobit models.

b. Ordered logit

An alternative strategy could consist in modeling the level of risk aversion in 2006 with an ordered logit by introducing the level of risk aversion in 2002 among the independent variables. In this case, the probability of changing his/her level of financial risk aversion is a function of socio-demographic variables (age, gender, occupations …), of health states (developing a cancer, diabetes…) and of the initial level of risk aversion.

Given the ordinal response variable, we estimate an ordered logistic regression model using the maximum-likelihood ratio. The model can be written as follow:
$Y_i = Z_i\beta + Health\ shock_{ji}\theta + RA_i\gamma + Retire_i\delta + Spouse\ dead_i\mu + u_i$
$Y_i > 0\ if\ RA_{t+1} > RA_t$
$Y_i = 0\ if\ RA_{t+1} = RA_t$
$Y_i < 0\ if\ RA_{t+1} < RA_t$

Z_i represents the socio-demographic variables. RA_i is the initial level of risk aversion of each individual while $Health\ shock_{ji}$ contains the eight diseases. The variable *spouse dead* takes the value one when the *spouse dies* between 2002 and 2006, it takes the value zero otherwise. *Retire* takes the value one when the respondent retires between 2002 and 2006.

In HRS, there is a peculiar design effect (people are interviewed per region) which needs to be taken into account when doing models (region included with the cluster option) to avoid any potential source of heteroskedasticicity.

We might think that health is endogenous to risk aversion. However, we measure the change in risk aversion between points in time before and after the diagnosis. In addition, the measure of risk aversion is not a general one but a measure of financial risk aversion linked to job opportunities; it is not obvious how financial risk aversion would affect health.

c. Two-step estimations models with selection on health

In order to back the two first models, we also propose models in two steps. Here, the sample has been split in two subsamples.
In 2002, only individuals who have never been diagnosed with one of the eight diseases are selected. They account for 742 individuals in the sample. The numbers of people, who have been already sick, account for 2245 individuals.
In the 1st equation, the probability of being never sick is calculated and then *"never sick people"* are selected. Among them, the probability of move to more financial risk aversion (then to less) is calculated in a 2nd equation (first and second model).
The alternative has also been done. In a first step, the probability of having been "*already sick"* is calculated, and in a second step the probability of move to more (and then less) financial risk aversion is calculated (third and fourth model).

These models are Heckman selection models and can be written as:
$\text{Neversick}_{1i} = X_i\beta_1 + u_{1i}$ (1)
$\text{More risk averse} = Z_i\gamma_2 + H_i\theta_2 + u_{2i}$ if individual i has never been sick (2)

$\text{Neversick}_{1i} = X_i\beta_1 + u_{1i}$ (3)
$\text{Less risk averse} = Z_i\gamma_2 + H_i\theta_2 + u_{2i}$ if individual i has never been sick (4)

d. Regression analysis and differences–in- differences estimations

First, a regression analysis looking at the influence of health shocks on the share of safe assets held in the portfolio in 2006 has been done:

$$S_{2006} = \alpha + Z\,\beta + Health\ Shock\ \theta + RA\,\gamma + Retire\ \delta + Spouse\ dead\ \mu + \varepsilon$$

S_{2006} represents the portfolio share in safe assets in % held in 2006. Z represents the socio-demographic variables. RA is the initial level of risk aversion of each individual while Health Shock contains the eight diseases. The variable *spouse dead* takes the value one when the spouse dies between 2002 and 2006, it takes the value zero otherwise. *Retire* takes the value one when the respondent retires between 2002 and 2006.

Then, a difference in differences method with kernel matching has been implemented. This method consists in calculating the effect of the treatment (the occurrence of a disease) on the outcome (the variation of the portfolio share in safe assets) by comparing the average change over time in the outcome variable for the treatment group to the average change over time for the control group. The covariates used for the kernel matching are the age of each respondent, the gender, the degree and whether the person is married or not.

The estimator diffs in diff is:

$$\Delta = E\ (S^{2006} - S^{2002}\ /T = 1) - E\ (S^{2006} - S^{2002}\ /T = 0)$$

One of the limits of this method is the small size of samples which do not allow the use of a lot of covariates but at least, individual effects and time effects should have disappeared.

C. Results

1. Descriptive statistics

As of the 2002 wave, the average and median age of the sample are both 56 years old. Women represent 68.5% of people. 77% are White while 14% are Black. Of the sample 64% are Protestant and 25% are Catholic. 15% of the sample is retired and 5 % are partly retired. An additional 16 % report they are not working. 11% of working respondents are self-employed, 51% are salaried.

990 individuals (one third) developed at least one of the eight diseases between t (2002) and t+1 (2006). All of them have learnt about the disease after their interview in 2002. However, it does not mean that these people had never been sick. For instance, someone who faces a cancer between 2002 and 2006, never had cancer before but he could have endured a stroke for instance. People, who were never sick in the past, account for 742 individuals.

Table XII. Change of risk aversion over time for the all sample (2 987 respondents)

Risk aversion in 2002	**Risk aversion in 2006**					
	Frequency in 2002	Very Low	Low	Moderate	High	**Fraction moving to more RA**
Very Low	**.1235**	.2222	.1003	.1626	.5149	**.8765**
Low	**.0917**	.1642	.1496	.1971	.4891	**.7441**
Moderate	**.1637**	.1002	.1145	.2147	.5706	**.5706**
High	**.6211**	.0749	.0685	.1170	.7396	**0**
Frequency in 2006		**.1055**	**.0873**	**.1460**	**.6612**	

The Markov matrix in table XII clearly shows a tendency of the population to move, between 2002 and 2006, to more financial risk aversion. Within every 2002 risk-aversion category, between 57.06 % and 87.65 % of respondents shift to the most risk averse category in 2006. It is interesting to know whether health shocks favor this move to more financial risk aversion or not. In other words, there is this baseline trend to move to more risk aversion and we look at how health shocks lead to departure from the trend.

Descriptive statistics emphasize the necessity to study the influence of diseases separately.
In table XIII for instance, cancer seems to favor a move to less financial risk aversion while psychiatric problems or diabetes have the opposite effect.
32% of respondents, who were diagnosed with a cancer between 2002 and 2006, move to less financial risk aversion compared with only 22% of those who did not develop one of the eight diseases. On the contrary, 27% of those diagnosed with diabetes move to more risk aversion compared with 21% for those who did not develop one of the eight diseases.

Table XIII. Move to more risk aversion depending on health shocks

	Move to more RA	**Do not move**	**Move to less RA**	**Total %**	**Number of observations**
No shock	30%	48%	22%	100%	1997
Cancer	20%	48%	32%	100%	87
Diabetes	27%	57%	16%	100%	147
Psychiatric problems	25%	60%	15%	100%	126

2. The effects of diseases on risk aversion

a. Biprobit Model

Estimation of equations (1) and (2) of table XIV reveal that women were at higher probability to be risk averse in 2002 compared to men, a result which has already been described in other studies (Hryshko et al., 2011). People who studied more than 12 years are less likely to be risk averse, as well as self-employed workers and non-working people compared to salaried workers, which is in line with the literature (Cramer et al., 2002) (Brown et al, 2011) (Di Mauro et al., 2011). Being separated or divorced rather than married also decreases significantly the probability to be risk averse in 2002. Having modest earnings (from Q1 to Q2) decreases the probability of being risk averse, compared to people with earning inferior to Q1. Last, compared to white people, Black individuals are less likely to be risk averse than White individuals.

Health events do not seem to have the same impact on change in risk aversion, thus justifying that several health shocks must be distinguished. Hence, cancer (+13.2%) and arthritis (+8.5%) significantly increase the probability to become less risk averse in 2006, conditionally to have been in very low, low or middle level of risk aversion in 2002. To the opposite, lung diseases (-7.6%) and psychiatric problems (-8%) significantly decrease the same probability. Last, among the other events which occurred between 2002 and 2006, retirement is significantly associated with the augmentation of the probability to become less risk averse in 2006 (+4.5%).

The correlation coefficient of the two error terms from equation (1) and (2) is estimated to be 0.973 ($p<0.001$), meaning that the omitted variables in (1) are highly correlated with the ones omitted in (2). The null hypothesis that the correlation coefficient is zero is strongly rejected, justifying the estimation strategy.

Unsurprisingly, estimation of equation (3) and (4) gives symmetrical results to the previous ones in table XV. But it also reveals a negative contribution of old age to the probability to be in very low/moderate/low level of risk aversion rather than in a very high level of risk aversion in 2002. Hispanic individuals and other than white people are also at smaller probability than white to be risk averse. And so are people with low earnings (smaller than Q1) compared to people with earnings higher than Q3. People living alone (never married) are also at reduced probability, compared to people living as a couple.

Bivariate probit models with sample selection[6]

Table XIV Estimation of equations (1) and (2)

	Equation (1)			Equation (2)		
VARIABLES	**Coefficient**	**SE**	**Marginal Effect**	**Coefficient**	**SE**	**Marginal Effect**
Female (ref: male)	.227***	.0325	.047			
Age (ref: <49)						
49-54	.041	.107	.008			
55-59	.030	.145	.006			
60+	-.008	.146	-.002			
Degree (ref:<=12 years)	-.148***	.053	-.029			
Earnings (ref:≥Q3)						
<Q1	.103	.063	.020			
[Q1 ; Q2)	-.140**	.066	-.029			
[Q2 ; Q3)	.052	.078	.010			
Race (ref: white)						
Black	-.118**	.047	-.024			
Hispanic	-.003	.046	-.001			
Others	-.044	.197	-.009			
Job (ref: non-self-employed)						
Self-employed	-.452***	.092	-.109			
Not working	-.212***	.057	-.044			
Marital Status (ref: married)						
Separated or Divorced	-.156***	.019	-.033			
Widowed	.057	.224	.011			
Never Married	.139	.185	.026			
Religion (ref: protestant)						
Catholics	-.069	.0610	-.014			
Jewish	-.140	.127	-.030			
Others	-.153	.130	-.033			
Self reported health Status	.048	.057	.009			
Health shocks						
cancer (ref:no)				.360***	.113	.132
diabetes (ref:no)				-.206	.159	-.062
arthritis (ref:no)				.243***	.019	.085
heart problems (ref:no)				-.030	.099	-.010
stroke (ref: no)				.049	.146	.016
lung (ref:no)				-.260**	.127	-.076
psychiatric problems				-.272***	.094	-.080
hypertension				-.148	.116	-.046
Retirement (ref:no)				.133***	.019	.045
Spouse death (ref:no)				.088	.084	.030
Constant	-.825***	.042		1.116***	2.148***	
Observations		2,987			2,618	

*** p<.01, ** p<.05, * p<.1

$\hat{\rho} = .973$ (.006), Wald test for H0: $\rho = corr(u_1, u_2) = 0$, Chi2(1) = 318.49, p=0.000

[6] If these models are run only on people who had never been sick in their lives, only shock cancer is significant.

Table XV Estimation of equations (3) and (4)

	Equation (3)			Equation (4)		
VARIABLES	**Coefficient**	**SE**	**Marginal Effect**	**Coefficient**	**SE**	**Marginal Effect**
Female (ref: male)	-.089***	.018	-.034			
Age (ref: <49)						
49-54	-.091	.096	-.034			
55-59	-.126	.104	-.048			
60+	-.163*	.091	-.061			
Degree (ref:<=12 years)	.202***	.040	.076			
Earnings (ref:≥Q3)						
<Q1	-.252***	.075	-.094			
[Q1 ; Q2)	-.124	.076	-.046			
[Q2 ; Q3)	-.068	.051	-.026			
Race (ref: white)						
Black	.076**	.031	.029			
Hispanic	-.316*	.068	-.107			
Others	-.296***	.184	-.113			
Job (ref: non-self-employed)						
Self-employed	.228***	.045	.089			
Not working	.178***	.032	.068			
Marital Status (ref: married)						
Separated or Divorced	.133	.081	.051			
Widowed	-.040	.145	-.014			
Never Married	-.294**	.117	-.105			
Religion (ref: protestant)						
Catholics	-.019	.045	-.007			
Jewish	.047	.225	.018			
Others	.038	.113	.014			
Self reported health Status	.002	.015	.001			
Health shocks						
cancer (ref:no)				-.160***	.014	-.094
diabetes (ref:no)				.281***	.085	.145
arthritis (ref:no)				-.035	.098	-.020
heart problems (ref:no)				.038	.106	.022
stroke (ref: no)				.007	.161	.004
lung (ref:no)				-.253	.272	-.151
psychiatric problems				.084	.111	.047
hypertension				.047	.134	.026
Retirement (ref:no)				-.081	.078	-.047
Spouse death (ref:no)				-.018	.076	-.011
Constant	-.526***	.115		-.196**	.085	
Observations		2,987			1,132	

*** p<.01, ** p<.05, * p<.1

$\hat{\rho} = .875$ (.077), Wald test for H0: $\rho = corr(u_1, u_2) = 0$, Chi2(1) = 16.74, p=0.000

b. Ordered Logit

Few variables violate the proportionality assumption. That's why we decided to present readers the ordered logit. However, a gologit2, relaxing the hypothesis of proportionality assumption for variables which violate it, is presented in appendix C. When it comes to the results, no major differences are observed (see Table XVI).

People who develop a cancer or arthritis between 2002 and 2006 have more chances to move to less financial risk aversion in 2006 rather than the others. People who develop diabetes are more likely to become more financial risk averse. Indeed, developing a cancer is associated with a 6% decrease in the odds of shifting to a more risk averse group. Similarly, developing arthritis is associated with a 5% decrease in the odds of shifting to a more risk averse group while developing diabetes leads to a 7% increase in the odds of shifting to a more risk averse group.

Another shock plays a role. Losing his/her spouse between 2002 and 2006 is associated with a 2% decrease in the odds of shifting to a more risk averse group. This decrease is 2% for those who go on retirement.

The other socio-demographic variables which are associated with an increase in the odds of shifting to a more risk averse group are being a female rather than a male, older people (<60+) compared to younger people (<49), those who have their earnings in the first quartile (the poorest) rather than the fourth (the richest) and those who have their earnings in the second quartile rather than the fourth.

On the contrary, the variables which are associated with a decrease in the odds of shifting to a more risk averse group are the degree>12 years, being Black rather than White, being an self-employed worker rather than a salaried one, not working rather than working.
Here there is a result of major importance: self-employed workers, all other things kept equal, do not shift to a more risk averse group but on the contrary to a lesser one.
Finally and logically, the more risk averse one is, the less chances there is to move to more financial risk aversion.

Table XVI. Ordered Model

The dependent variable is the change of risk aversion between 2002 and 2006 (-1 related to more risk aversion, 0 to no change and 1 to less risk aversion).

Variables	Coefficients	SE	Marginal Effects
Female (ref: male)	0.161*	0.089	**2.36**
Age (ref: <49)			
49-54	0.089	0.111	1.34
55-59	0.066	0.098	0.99
60+	0.230**	0.098	**3.6**
Degree (ref:<=12 years)	-0.163**	0.080	-2.45
Earnings (ref: 4th Quartile)			
1st Quartile	0.257**	0.115	**3.95**
2nd Quartile	0.180**	0.083	**2.78**
3rd Quartile	0.156	0.121	2.39
Religion (ref: Protestant)			
Catholics	0.017	0.062	0.26
Jewish	0.080	0.071	1.23
Others	-0.109	0.184	-1.58
Race (ref: White)			
Black	-0.237***	0.037	**-3.36**
Hispanic	0.165	0.203	2.58
Others	0.057	0.179	0.86
Job (ref: non-self-employed)			
Self-employed	-0.654***	0.065	**-8.28**
Not working	-0.244**	0.107	-3.56
Marital Status (ref: married)			
Separated or Divorced	0.046	0.154	0.64
Widowed	-0.233**	0.109	-3.25
Never Married	0.0385	0.113	0.58
Shock cancer (ref:no)	-0.492***	0.104	**-6.31**
Shock diabetes (ref:no)	0.432***	0.141	**7.27**
Shock arthritis (ref:no)	-0.340***	0.077	**-4.66**
Shock heart problems (ref:no)	0.084	0.177	1.29
Shock stroke (ref: no)	-0.130	0.350	-1.86
Shock lung (ref:no)	-0.059	0.241	0.87
Shock hypertension	0.179	0.157	2.80
Shock psychiatric problems (ref :no)	0.288	0.193	4.67
Retire (ref:no retirement)	-0.141**	0.056	-2.05
Spouse dead (ref:no)	-0.168**	0.083	**-2.38**
Averse2 (ref: averse1)	-0.812**	0.351	-9.77
Averse3 (ref:averse1)	-1.474***	0.085	-16
Averse 4 (ref:averse1)	-4.099***	0.016	-70
Constant	-4.825***	0.262	
Constant	-1.297***	0.184	
Log likelihood = -2323.6891	Prob > chi2 = 0.000		
Observation: 2987			

c. Two-step models with sample selection on health

The first and second models back very well the theoretical model because they answer to the question: if health stays "relatively the same" over a long period and then a sharp decline in health occurs, what happens to financial risk aversion?
Developing psychiatric problems decreases the chances to become less financial risk averse while going on retirement increases it (first model in table XVII).
Developing cancer decreases the chances to become more risk averse as losing his/her spouse between 2002 and 2006 (second model in table XVIII).
Developing a cancer, or arthritis, or going on retirement or losing her/his spouse increase the chance of becoming less financial risk averse (third model not presented).
Diabetes and psychiatric problems increase the chances to become more financial risk averse (fourth model not presented).

The correlation coefficients of the two error terms from equation (1) and (2) and from equations (3) and (4), presented in table XVII and table XVIII are estimated to be -.374 and -.335, meaning that the omitted variables in (1) are highly negatively correlated with the ones omitted in (2) (same for equation (3) and (4)).

The different models presented reach the same results: some health shocks explain a change in risk aversion ceteris paribus. However, they also inform us that the initial level of health state plays a role.

Table XVII and Table XVIII Biprobit model with selection on the health state

Table XVII

VARIABLES	Equation [1]			Equation [2]		
	Coefficient	SE	Marginal Effect	Coefficient	SE	Marginal Effect
Female (ref: male)	-.123***	.020	-.037			
Age (ref: <49)						
49-54	-.065	.124	-.019			
55-59	-.373***	.111	-.112			
60+	-.449***	.124	-.117			
Degree (ref:<=12 years)	.094**	.040	.028			
Earnings (ref:≥Q3)						
<Q1	-.136	.140	-.040			
[Q1 ; Q2)	-.089	.069	-.026			
[Q2 ; Q3)	-.021	.054	-.006			
Race (ref: white)						
Black	-.019	.035	-.006			
Hispanic	.094*	.054	.29			
Others	-.148	.189	-.042			
Job (ref: non-self-employed)						
Self-employed	.025	.110	.007			
Not working	-.193	.163	-.056			
Marital Status (ref: married)						
Separated or Divorced	-.060	.110	-.018			
Widowed	-.074	.128	.022			
Never Married	.015	.159	.004			
Religion (ref: protestant)						
Catholics	-.025	.081	-.007			
Jewish	.075	.061	-.023			
Others	.019	.040	-.006			
Smoke (ref: do not ever smoke)	-.143**	.058	-.043			
Drink (ref: do not ever drink alcohol)	.131***	.039	.036			
Body Mass Index	-.065***	.002	-.020			
Physical activity (ref: do not practice physical activity)	.131***	.023	.039			
cancer (ref:no)				-.882**	.414	-.17
diabetes (ref:no)				.280	.185	.092

VARIABLES	Equation [1]			Equation [2]		
	Coefficient	SE	Marginal Effect	Coefficient	SE	Marginal Effect
arthritis (ref:no)				.109	.068	-.009
heart problems (ref:no)				-.032	.329	-.009
hypertension				.051	.128	.015
psychiatric problems (ref: no)				-.180	.151	-.049
Retirement (ref:no)				.016	.129	.003
Spouse death (ref:no)				-.211***	.041	-.058
Averse1				1.578***	.138	
Constant	-.825***	.042		-.475**	.219	
Observations	2,905			724		
Rho = -.374 Wald test of indep. eqns. (rho = 0): chi2(1) = 5.46 Prob > chi2 = 0.0194						

Table XVIII

VARIABLES	Equation [3]			Equation [4]		
	Coefficient	SE	Marginal Effect	Coefficient	SE	Marginal Effect
Female (ref: male)	.115***	.031	-.034			
Age (ref: <49)						
49-54	-.087	.126	-.025			
55-59	.372***	.114	-.112			
60+	-.469***	.127	-.122			
Degree (ref:<=12 years)	.088**	.043	.027			
Earnings (ref:≥Q3)						
<Q1	-.156	.139	-.045			
[Q1 ; Q2)	- .123**	.059	-.036			
[Q2 ; Q3)	-.039	.056	-.011			
Race (ref: white)						
Black	-.031	.031	-.009			
Hispanic	.111**	.047	.034			
Others	-.149	.158	-.042			
Job (ref: non-self-employed)						
Self-employed	.071	.130	-.022			
Not working	-.196	.162	-.057			
Marital Status (ref: married)						
Separated or Divorced	-.056	.112	-.016			
Widowed	-.065	.138	-.019			
Never Married	-.008	.130	-.003			
Religion (ref: protestant)						
Catholics	-.043	.073	-.012			
Jewish	.082	.061	.025			
Others	.033	.035	.010			
Smoke (ref: do not ever smoke)	-.127**	.051	-0.38			
Drink (ref: do not ever drinks)	.122***	.046	.036			
Body Mass Index	.065***	.003	-.020			
Physical activity (ref: practises physical activity)	.131***	.057	.039			

VARIABLES	Equation [3]			Equation [4]		
	Coefficient	SE	Marginal Effect	Coefficient	SE	Marginal Effect
cancer (ref:no)				.382	.403	.127
diabetes (ref:no)				-.464	.358	-.109
arthritis (ref:no)				.193	.135	-.046
heart problems (ref:no)				-.170	.356	-.060
psychiatric problems				-.523**	.217	-.119
hypertension				-.155	.192	-.042
Retirement (ref:no)				.266	.162	.082
Spouse death (ref:no)				-.188	.327	-.05
Averse4				.562***	.052	.15
Constant	-.825***	.042		-.721***	.096	
Observations	2,905			724		
Rho= -.335 Wald test of indep. eqns. (rho = 0): chi2(1) = 8.29 Prob > chi2 = .0040						

3. The influence of diseases on the share of safe assets in a portfolio

In a first step, we did a regression presented in table XIX looking at the impact of the health shocks on the level of safe assets in 2006. Two health shocks are associated with an increase in the share held in safe assets: psychiatric diseases and having a stroke.

Table XIX. Regression: Predictors of the share held in safe assets in 2006

Variables	Portfolio's shares in safe assets in 2006
Female	-2.149
	(1.696)
Earnings (/1000)	-0.109***
	(0.024)
Degree	-17.580***
	(1.566)
Job status (ref: salaried)	
Self-employed	-3.305
	(2.525)
Not self-employed	-1.622
	(1.849)
Shock : Cancer	-0.104
	(4.447)
Stroke	19.880***
	(6.887)
Heart	0.774
	(3.519)
Diabetes	2.515
	(3.553)
High Blood Pressure	-2.187
	(2.515)
Lung	5.061
	(4.756)
Shock Arthritis	-0.689
	(2.495)
Psychiatric diseases	8.487**
	(3.846)
Going on retirement	-2.138
	(1.940)
Spouse dead	12.200**
	(4.870)
Constant	71.29***
	(2.127)
Observations	2714
R-squared	0.073

In a second step, we looked at the impact of the health shocks on the variation of safe assets held in portfolio between 2002 and 2006 (in table XX).

Table XX.

Average change in the share of assets that are safe between 2002 and 2006 and standard deviation of that change				
Shocks	**Mean**	**Standard Deviation**	**Observations**	**T Test: Shock - No Shock**
Cancer	2.13	4.91	75	0.83
Stroke	3.11	7.19	33	0.99
High Blood Pressure	0.38	2.41	252	0.25
Diabetes	3.27	4.09	120	0.99
Heart attacks	2.79	3.86	125	0.99
Psychiatric Problems	6.12	3.64	100	0.45
Arthritis	1.11	2.55	266	0.44
Lung diseases	-2.81	3.95	64	0.31
No Shocks	**2.91**	**0.94**	**1739**	

As shown in table XX, the proportion of safe assets in financial assets has clearly diminished, after the occurrence of a lung disease. On the other hand, it has increased after the occurrence of a cancer, stroke, high blood pressure, diabetes, heart attacks, psychiatric problems and arthritis.

For some diseases such as stroke, diabetes or psychiatric problems, the variation is higher than the one observed for people who had none of the eight diseases. Reversely, the variation is smaller for cancer, high blood pressure, heart attacks and arthritis.

However, these statistics provide only limited evidence that diseases have an influence on how individuals allocate their savings between safe and risky assets. The subsamples are small and dispersions around the means are high. And none of the student tests between the mean of “each shock” and the mean of “no shock” is significant.

Moreover, some external factors such as macroeconomics conditions can play a role that is not controlled here. That’s why; we implemented difference in differences with kernel matching (table XXI).

Theses difference in differences show that only one of the eight health shocks has a significant impact on the variation of the portfolio share in safe assets: psychiatric diseases have a positive influence as the percentage of assets hold in safe assets increases. People reduce their exposure to financial risk after the occurrence of a psychiatric disease.

Table XXI. Diff in diffs: variation of the portfolio share in safe assets – diff in diffs' coefficients of health shocks

Diff in diffs: variation of the portfolio share in safe assets	
Treatment variables	Results diffs in diff
Cancer	0.132
Diabetes	0.188
Arthritis	0.729
Psychiatric Problems	0.021**
Lung diseases	0.330
Heart problems	0.357
Stroke	0.639
High Blood Pressure	0.766

D. Discussion

1) The determinants of risk aversion

The more people are educated, the more tolerant they are to financial risk (Hammitt et al, 2005). Hammitt et al's findings are consistent with Hryshko et al findings: *"children of educated parents are less risk averse in adulthood"* (Hryshko et al, 2011). In a more dynamic perspective, we also find that educated people have more chances to become less financial risk averse through time.

Age is also significant in some studies. Younger people are less averse of risks to income according to some scholars (Gollier, 2005). In our study, younger people have more chances to become less risk averse through time.

Self-employed workers tend to be less risk averse (Cramer et al, 2002) (Colombier et al, 2005). Similarly, the probability of becoming less risk averse for self-employed workers between 2002 and 2006 in our study is major (8%).

2) The impact of health shocks on risk aversion

The Markov matrix clearly shows a tendency of the population to move, between 2002 and 2006, to more risk aversion. This trend is also emphasized in the article of Mandal et al (Mandal et al, 2014). We also observe that health shocks can counter-influence this baseline trend.

Indeed, our results give some evidence for health shocks to change people's behavior towards risks. They stress the importance to attach to the kind of the disease people have to face and not to consider all the health events as being the same. To our knowledge, this study is the first one comparing, separately, the impact of different diseases on behaviors towards financial risk.

People with cancer and arthritis are found to favor moves to less financial risk aversion linked to job opportunities, while people with diabetes, lung diseases and mental health problems favor moves to more risk aversion. Whether this change in level of risk aversion is transitory or likely to be permanent remains largely unsolved and deserves to be put on the research agenda.

3) Lottery questions

However, these results present some limitations. Questions to measure risk aversion are based on jobs. Thus, they may be less relevant for retired persons for instance, which could explained why going on retirement is found to favor move to less risk aversion. Retired people represent 18% of the sample.

Furthermore, their explanatory power might be less meaningful than simpler intuitive measures of risk preference as explained by Kapteyn et al in their paper (Kapteyn et al, 2011) (Dohmen et al., 2012). To do similar research on other panels in different countries with different type of questions will bring more information. In our paper, this is one of the reasons why, we also study risk exposure with shares held in safe assets.

4) The impact of diseases on the variation of safe assets

Psychological diseases not only impact risk aversion measured with hypothetical lottery questions on jobs but also revealed preferences measured with the variation of the structure of a portfolio.

Indeed, our empirical model shows that psychiatric diseases have a direct impact on the share of safe assets held in a financial portfolio. It increases the share held in safe assets.
Melnychuck emphasizes the same effect in her study (Melnychuk, 2012). According to a study of Smoski et al (2008), people suffering from depression would be more risk averse than the general population (Smoski et al, 2008). Our result also echoes other findings such that if health worsens, a rise in the ownership of safe assets is observed (Rosen et al, 2004) (Fan et al, 2009).

5) Comparison

We used two measures of risk aversion. One of this measure refers to lottery questions while the other one corresponds to the variation of shares held in safe assets. Both of them embody the behaviors of individuals towards risks. However, we do not obtain the same results. Several health shocks impact risk aversion when it is measured with lottery questions. Only psychological diseases lead to a change in the structure of the financial portfolio. People, who suffer from psychological diseases, save more. And, this is a really interesting result. Psychological diseases have an impact on both measures of risk aversion.

6) The link between the theoretical model and the empirical analyses

What strikes us is that both the theoretical and the empirical models predict a change in financial risk aversion when the individual health state decreases. And the magnitude of this change would depend on whether the initial level of health is good or not.

In the two-step models, cancer has an impact on risk aversion among people who had never been sick and also among people who had already been sick in the past (but endured another disease such that cancer). The magnitude of the impact is stronger in the first case that in the second case meaning that the impact would be stronger when the initial level of health is good.

However there is an ambiguity that is not solved here. The theoretical models says that the sign of the change depends on the curvature of the utility function, to be more precise on the difference $\Pi_w - v$ while empirical models show that the sign of it depends on the type of diseases that individual faces. Would it mean that diseases could have an influence on the difference $\Pi_v - \Pi_w$? In another proposed model, h is not one dimensional as we have assumed. The model has multiple dimensions of h and diseases would affect these differently. However, by doing this, only the magnitude of the impact changes.
Further researches on this subject are being done. We are looking at what happen if consumption "c" is decomposed in three types of consumption. One type of consumption for which the marginal utility of consumption if positively proportional to health. One type of consumption for which the marginal utility of consumption if negatively proportional to health. And last but not least, one type of consumption for which the marginal utility of consumption is independent of the health state.

7) Diseases impact people's professional trajectories via the channel of risk aversion

Generally, diseases are known to impact directly the financial and professional situations of persons: loss of earnings, reduced productivity, and difficulty to find a job if unemployed (Menhert et al., 2013). Diseases should also impact people's financial and professional situation through another channel: psychological variables such as risk aversion.

Our results support the framework developed by Loewenstein et al. (2001), in which a health variation is expected to lead to emotional reactions that may result in some preferences reassessment toward risk. Loewenstein et al. also emphasize that anticipatory emotions play a critical role on risk aversion. The reason why some diseases favor move to more risk aversion while others favor moves to less risk aversion might be that they spark to different anticipatory emotions. These emotions could depend on whether the diseases are life-threatening or not or on whether it requires a radical change of habits or not.

For instance, one of the reasons why cancer would make on average people less risk averse is the 'struggle against death' the disease implies. Persons suffering from cancer are fighting to survive (and indeed our respondents succeed, at the date of the interview!), thus they probably consider that job-market risky situations are not so frightening. And they are inclined to reveal a lower risk-aversion in the proposed lottery. On the contrary, diabetes is not a victorious struggle against death and, rather, leads to a radical change of habits, for the all life. A meticulous organization must be adapted: controlling the level of sugar, regular injections, changing alimentary habits and adapting physical activity. Furthermore, the treatment of diabetes lasts a whole life while the treatment of cancer is punctual. Then, these sick people with diabetes have to be more prudent in a lot of domains. It might explain why diabetes leads to more aversion to job market risk. Depressive adults might have fewer desires in life; hence they tend to become more financially risk averse. The action to take risks is carried by some desires; otherwise what would be the purpose of taking them. Besides, this result confirms

another survey which shows that depressive adults are more risk averse compared to control groups (Smoski et al., 2008). Of course, all these explanations are only suppositions that need to be clarified and verified.

8) The necessity of pursuing researches in this field

Rationalizing the reasons why diseases would lead to different reactions toward financial risk is a difficult task. To do this, adding questions on peoples' mental representation and desires in life in economic surveys would be of major interest.

9) Applications

These results should lead to further research because they might have tremendous implications in several fields: among them finance and health insurance. If risk aversion determines how an individual invests, then a health shock might change his portfolio in a direct way as observed for psychiatric diseases but also in an indirect way via the channel of risk aversion. Indeed, a change of risk aversion will affect investments in the long term.

If it determines whether an individual would chose an insurance or not, then it might change his strategy to be insured. Or even more interesting, this might change the strategies of some insurers refusing access to ill clients.

To end, behaviors toward risks can play a role in inequalities as it has been proved that entrepreneurs and highly qualified persons present less financial risk aversion.

Conclusion générale

A. Les principaux résultats de cette thèse

Tout au long de ces 2 parties, respectivement consacrées à la situation professionnelle et financière des indépendants et des salariés suite à un cancer ainsi qu'à l'impact des maladies sur les comportements face aux risques financiers, sont apparus plusieurs aspects à prendre en considération.

Tout d'abord, les indépendants, dans le cadre de leur activité professionnelle, font face au cancer différemment des salariés. Ils ont nettement moins recours à l'arrêt-maladie que les travailleurs salariés et ce certainement pour des raisons professionnelles : peur de perdre sa clientèle ou même de la décevoir, peur des pertes de revenus (etc). En effet, 39 % d'entre eux ne prennent jamais d'arrêts maladie suite à un cancer. Ce taux est de 13 % pour les travailleurs salariés. Par ailleurs, quand les indépendants ont recours aux arrêts maladie, ils y recourent plus tardivement et retournent plus vite au travail.

Les indépendants sont victimes comme les salariés d'une sortie accélérée du marché du travail vers la retraite ou l'inactivité, suite à un cancer. Ceux qui sont en situation de non emploi au moment du diagnostic ont beaucoup moins de chances de retrouver un emploi comparativement à la population générale. Par ailleurs, le taux de maintien en emploi est nettement inférieur à celui de la population générale française.

Pour finir, les indépendants se plaignent de subir des pertes financières plus importantes à cause de leur cancer que les travailleurs salariés. Toutefois, le manque de données sur les salaires des indépendants dans l'enquête emploi n'a pas permis de faire des comparaisons avec la population française non atteinte de cancer. Pour l'heure, aucune autre étude française n'a été réalisée sur ces sujets.

Le second aspect, mis en avant par cette thèse, montre que les maladies peuvent avoir un impact sur les comportements face aux risques financiers des gens. Encore plus surprenant, cet impact peut être différent selon les maladies: plus ou moins d'aversion face au risque financier.
En effet, dans l'enquête américaine « HRS », le cancer et l'arthrose pousseraient les gens à devenir moins averses, c'est-à-dire moins craintifs, vis-à-vis du risque financier dans le domaine de la carrière tandis que le diabète et les maladies psychologiques telles la dépression inciteraient les gens à plus d'aversion. Les maladies psychologiques inciteraient aussi les individus à investir plus dans les actifs dits « sûrs ».

Ces résultats sont importants dans la mesure où ils vont à l'encontre d'un courant économique qui base ses raisonnements sur le fait que le goût pour le risque des individus est immuable. Par ailleurs, ces changements de comportements vis-à-vis du risque après une maladie peuvent conduire à des modifications des trajectoires professionnelles.

Par exemple, les indépendants sont très connus pour leur goût pour le risque mais si cette faible aversion au risque est modifiée après une maladie, il se peut qu'ils soient plus réticents à continuer leur activité d'entrepreneurs et préfèrent en conséquence se tourner vers des métiers salariés. C'est pourquoi, nous avons aussi cherché à analyser les changements de comportements des indépendants vis-à-vis du risque après à un cancer.

Dans l'enquête française sur le cancer menée en 2010, les indépendants changent de comportements vis-à-vis du risque lié à leur carrière dans une moins forte proportion que les salariés. Toutefois, ceux qui changent deviennent en moyenne plus averses aux risques financiers. Or, comme expliqué précédemment, une de leurs caractéristiques principales est justement une faible aversion vis-à-vis du risque financier associée à leur choix d'activité d'indépendants. En modifiant une de leur caractéristique psychologique, la maladie pourrait donc amener les indépendants à de plus grands ajustements que leurs homologues salariés. Ainsi, les chocs de santé auraient des impacts directs sur les trajectoires professionnelles des actifs mais aussi des impacts indirects via la modification de variable psychologique telle l'aversion au risque.

La maladie entraîne aussi des changements d'attitudes face au risque santé avec une tendance vers plus de prudence pour les salariés et les indépendants.

Les maladies en fonction de leur type ont donc des effets différents sur la prise de décision des individus. Elles ne poussent pas nécessairement les gens à devenir plus averses, pouvant ainsi freiner l'activité économique d'un pays.

Les raisons pour lesquelles ces maladies auraient des effets différents pourraient se trouver dans les sentiments qu'elles impliquent que Loewenstein et al. appellent des sentiments anticipatoires (Loewenstein et al, 2001). Par exemple, la lutte pour la survie qu'implique le cancer pourrait mener les gens à relativiser les risques sur le marché du travail et ainsi à se montrer moins craintifs à la prise de risque. A l'inverse, le diabète implique des changements radicaux d'habitudes tels modifier ses habitudes alimentaires, les injections, le contrôle du sucre, surveiller ses blessures (…). Le traitement du cancer est ponctuel alors que celui du diabète est à vie.
De manière générale, les personnes souffrantes de diabètes doivent être plus prudentes dans de nombreux domaines ce qui pourrait expliquer qu'ils prennent moins de risques.
Quant aux personnes souffrants de dépressions, elles pourraient exprimer moins de désirs dans la vie et donc devenir plus averses. Toutes ces explications sont seulement des hypothèses qui nécessitent d'être vérifiées à l'aide d'enquêtes quantitatives mais aussi qualitatives.

B. Les principaux messages destinés aux pouvoirs publics et aux politiques

Les messages destinés aux pouvoirs publics, qui vous seront présentés, reposent sur les recherches scientifiques menées tout au long de cette thèse.

Les résultats de cette thèse mettent l'accent sur la nécessité de prendre en compte le type d'activité des personnes souffrant d'un cancer lors de la mise en place des politiques de santé. Les travailleurs indépendants ne font pas face aux mêmes difficultés et problématiques que les travailleurs salariés. Il est donc primordial de prendre en compte ces différences.
Par ailleurs et sauf erreur de ma part, dans les différents plans cancer (2003 à 2019), il est rarement fait référence aux travailleurs indépendants en tant que catégorie de travailleurs. En revanche, de nombreuses mesures s'adressent directement aux salariés. Encore plus surprenant, aucun des représentants du régime sociale des indépendants et de la mutualité sociale agricole ne figurent pas parmi les comités de direction des Plans Cancer. Prévoir des mesures destinées à cette population et les représenter devient une urgence.

Les politiques d'aide aux indépendants survivants à un cancer doivent être axées sur le retour à l'emploi certes, mais aussi et surtout sur le maintien dans l'emploi, puisque 39% d'entre eux n'ont recours à aucun arrêt maladie contre 13% pour les salariés. La plupart d'entre eux ne s'arrêtent pas de peur de perdre leur clientèle, de la décevoir, de subir des pertes de revenus conséquentes et peut-être même qu'ils ne souhaitent pas s'arrêter de travailler. Connaître les raisons de ce non recours aux arrêts maladie permettrait aux acteurs de la santé publique d'avancer dans le combat contre les difficultés professionnels suite à un cancer. Afin de choisir les politiques les plus adaptées, il est nécessaire de demander aux indépendants comment nous pourrions les aider à maintenir leur emploi.

Les difficultés d'accès au crédit rencontrées suite à une maladie peuvent avoir des effets dramatiques sur la dynamique professionnelle. Par exemple, si l'indépendant est un promoteur immobilier recourant systématiquement au crédit pour son activité, comment fera-il suite à un cancer ? Et un manager d'hôtels ? Dans l'enquête nationale française sur le cancer menée en 2010, 91% des chefs d'entreprise craignent de ne pas avoir accès aux crédits à terme suite à leur cancer. Ce taux est de 97% pour les professions libérales (Paraponaris et al. 2014). Se concentrer sur ces points est essentiel dans la mesure où la survie de plusieurs petites et moyennes entreprises, constituant une grande partie du tissu industriel français, peut être en péril. En effet, la France compte en 2011, 138 000 petites et moyennes entreprises et 3 millions de microentreprises soit 99,6% du tissu industriel français (chiffres Insee). Malgré la nouvelle politique mise en place instituant le droit à l'oubli au bout de 15 années après un cancer dans le domaine bancaire, les acteurs concernés devraient renforcer les mesures dans ce sens et raccourcir cette durée. En 15 ans, les indépendants ont le temps de faire faillite.

Dans la mesure où la maladie modifie la psychologie des individus et, comme l'atteste la deuxième partie de cette thèse, le goût pour le risque, il se peut que certains indépendants perdent leur goût de l'entrepreneuriat. Les politiques de reconversion prennent alors du sens. Cependant, ces politiques doivent viser cette catégorie particulière d'indépendants qui change

de comportements et devient plus averse vis-à-vis du risque financier et serait donc plus désireuse de se tourner vers une activité salariée. Toutefois, cette population ne représente pas la majorité des indépendants. Les indépendants apprécient très souvent de ne pas avoir de hiérarchie et sont peu enclins à changer de métier (Benz, 2008). Des politiques d'aide à la reconversion ont déjà étés mises en place par le RSI et ne peuvent qu'être encouragées.

Jusqu'à présent, très peu d'études se sont concentrées sur la situation des indépendants face au cancer. Pourtant, cette population hétérogène se distingue. Il faudrait désormais analyser en profondeurs la survie des entreprises lorsque les indépendants subissent un choc de santé. Une étude récente montre qu'il y a un risque élevé de faillite 5 ans après un cancer (Ha Vinh et al, 2014). Cette étude souligne aussi qu'un travail physique intense se révèle être un facteur prédictif de l'échec de l'entreprise pour des sujets atteints d'un cancer. Cette observation nous renvoie à la difficulté des travailleurs artisans et agriculteurs à poursuivre leur activité. Des études de ce type stratifiant les indépendants par type de métiers devraient être menées.

Un autre axe de recherche pourrait consister à comprendre pourquoi les indépendants ne prennent pas ou peu d'arrêts maladie ? Les réponses à cette question permettraient de mieux les aider dans leurs démarches de maintien en activité ou de mise en arrêt maladie. Cela apporterait aussi des éléments de réponses à la question « est-ce bien ou pas qu'une grande partie des indépendants ne prennent pas d'arrêts maladies deux ans après un cancer» ?

Se poser la question de l'efficacité et de la satisfaction au travail après une maladie comme le cancer est aussi primordial. Par « *work ability* », les chercheurs entendent la capacité de faire efficacement des tâches une fois au travail. Une étude norvégienne montre que la « *work ability* », calculée à l'aide d'un score, après un cancer est négativement corrélée avec le travail indépendant (Torp et al, 2011). A l'inverse, elle est positivement corrélée avec un environnement psychosocial de travail favorable. Ainsi, demander aux indépendants comment ils ressentent leur environnement professionnel après la maladie pourrait aider.

De plus, la question des pertes de revenus chez les indépendants est cruciale. Nous n'avons pas pu faire de comparaisons dans cette thèse faute de données nationales en population générale. En effet, les travailleurs indépendants ne communiquent pas assez leur salaire mensuel dans les enquêtes nationales peut-être parce qu'ils raisonnent en salaire annuel ou peut-être parce qu'ils ont peur que ces informations soient communiquées aux administrateurs. Et pourtant, collecter ces données est nécessaire pour les aider à surmonter au mieux la maladie financièrement. D'ailleurs, une étude irlandaise montre que les travailleurs indépendants souffrent plus particulièrement de pertes de revenus suite à un cancer que les autres travailleurs (Sharp et al, 2010).

Si les indépendants sont tout aussi victimes que les salariés de l'inactivité à la suite de leur cancer, il faut rappeler qu'ils n'ont pas systématiquement d'assurance chômage contrairement aux salariés. Cela dépend de s'ils ont payé ou pas pour se couvrir de ce risque. Que se passe-t-il pour ceux qui ne sont pas protégés ? Analyse les difficultés de cette population est urgent et important.

Une partie des résultats de cette thèse sur les transitions sur le marché du travail plaide pour un questionnement des politiques de santé visant à améliorer la vie professionnelle des survivants d'un cancer et de leur mise en place. Le propose ici n'est pas d'atténuer les efforts effectués par les différents acteurs de la lutte contre le cancer qui ont été, nous le savons, immenses et importants. Il existe en France une réelle volonté de lutter contre le cancer depuis une douzaine d'années. Toutefois, il est de notre devoir de chercheur de pointer du doigt le fait que la situation des travailleurs indépendants et salariés ne s'est pas beaucoup améliorée depuis 2004. Ils sont toujours autant sujets à une sortie de l'emploi accélérée en comparaison à la population générale. Encore plus inquiétant, une étude menée par notre équipe montre que l'écart entre 2004 et 2012 s'est aggravé et ce en contrôlant l'« effet crise ». Que déduire de cette information ? Chaque centime d'euros dépensé pour lutter contre le cancer compte. Comment faire pour que nos politiques soient plus efficaces sur le terrain ? Un débat sur ce sujet est nécessaire.

Pour finir, compléter les études quantitatives par des études qualitatives serait une grande plus-value. Ceci permettrait de lier les discours à des observations statistiques et constituerait ainsi une base solide d'observations indiquant précisément quelles sont les difficultés des travailleurs indépendants face au cancer et comment les aider.

C. Idées visant à améliorer la situation des travailleurs indépendants face au cancer

Les idées qui suivent sont des propositions ne résultant pas de recherches scientifiques menées tout au long de cette thèse. Leur seul but est de lancer un débat public sur ces sujets dans notre pays.

Des représentants de la MSA et du RSI pourraient intégrer le comité de direction du Plan Cancer actuel (2013-2019) afin de les représenter.

Des accords régionaux pourraient être signés entre les agences régionales de santé, chargée de mettre en place les mesures du Plan Cancer sur le terrain, et la MSA et le RSI.

On pourrait imaginer que lorsque l'indépendant découvre qu'il a un cancer, on lui propose deux options. Soit prendre des arrêts maladie, soit se faire aider par une personne extérieure compétente le temps du traitement et de sa remise en forme (ou un mixe des deux). Cette personne serait issue d'une société d'intérim financée soit par la solidarité nationale soit via des assurances privées.

Prévoir la relève de leur activité en cas de décès est important et n'est pas seulement le résultat d'un calcul économique « froid » dont le but serait de préserver les entreprises françaises d'une faillite suite à des perturbations dues à la disparation de leurs chefs. Dans l'enquête nationale sur le cancer, 41% des indépendants travaillent en famille. Nombreux sont ceux travaillant avec

leurs conjoints. Que se passe-t-il pour la famille si l'indépendant décède et si en plus de ce décès la pérennité de l'entreprise est en jeu parce que la compétence du travailleur indépendant n'est pas immédiatement remplaçable ? Dans ces cas-là, il n'y a pas de raisons valables pour que ces familles ne puissent pas bénéficier comme les autres familles françaises de la solidarité nationale. Il est aussi de notre devoir de protéger ces familles. Encore une fois, on pourrait leurs proposer les services temporaires de spécialistes le temps de se réadapter. Outre cet enjeu majeur, celui de la sauvegarde d'entreprises constitue un réel enjeu économique pour la croissance française.

D. Les autres applications de cette thèse

Cette thèse peut avoir d'autres applications notamment dans le domaine de la banque, de l'assurance et celui de la vaccination, domaines dans lesquelles l'aversion au risque joue un rôle important dans les prises de décision.

Les résultats de cette thèse montrent que les maladies en fonction de leur type peuvent avoir des impacts directs sur le portfolio des gens mais aussi sur leur aversion au risque, variable clé de plusieurs modèles financiers. Connaître les maladies dont souffrent les gens peut permettre d'anticiper leur comportement financier.

Dans le domaine de l'assurance santé, cette thèse montre qu'il n'est pas forcément pertinent pour les assureurs de refuser l'accès aux clients malades à leur assurance car plus de la majorité d'entre eux deviennent plus prudents pour leur santé. Toutefois, il y a une ambiguïté dans le domaine des risques financiers puisque en fonction des maladies, les individus deviennent plus ou moins averses aux risques financiers.

Enfin, l'aversion au risque serait une variable clés des décisions de vaccination, ainsi ces résultats pourraient éclairer certains décideurs de ce domaine.

General Conclusion

A. Main results

Throughout these two chapters, respectively dedicated to the impact of diseases on the professional and financial situation of self-employed workers facing cancer and on people's behavior toward financial risks, several findings were made.

First of all, self-employed workers face cancer in a different way from salaried staff. Self-employed workers take less sick leaves compared with salaried employees. This is probably due to professional reasons: fear of losing or disappointing their customers, fear of losing money because of the lack of allowances or replacement revenues (etc). Indeed, 39% of self-employed workers never take a sick leave after a cancer. This rate is only 13% for salaried staff. When self-employed workers resort to sick leave, they take them later and return to work faster than salaried staff.

Moreover, salaried staff who survive cancer are victims of an accelerated exit from the labor market through retirement or inactivity as salaried staff surviving cancer. Those who are not employed at the time of diagnosis are less likely to return to work compared to the general population.

Finally, self-employed workers complain above all about losing financial earnings because of their disease. Nevertheless, the lack of French data in the French labor force survey did not allow any comparison with the French general population. So far, there is no study done on that subject.

The second finding, emphasized in this thesis, demonstrates that diseases have an impact on people's behavior towards financial risks in the field of professional career, in the American survey "HRS". More surprising, the impact can be different according to the type of disease: more or less aversion. Cancer and arthritis push people to become less risk averse. Meanwhile, diabetes and psychological diseases such as depression would encourage people to be more risk averse. Psychological diseases would also encourage people to invest more in "safe assets" rather than in "risky" assets.

These results are important as there is a modern economic theory claiming that risk aversion is innate and immutable. Furthermore, changes in risk aversion can lead to changes in professional trajectories. For instance, self-employed workers are well known for their tastes for risks. If their tastes for risks change after cancer, they might be reluctant to stay self-employed. That is why, we have also analysed self-employed worker's behavior change towards risks after cancer in this thesis.

In the French National Survey of 2010 on cancer, self-employed workers change their risk aversion for their career less than salaried staff. However, those who change, become more risk averse in majority. Yet, one of their main characteristics is a very low risk aversion towards financial risk, which is associated with their choice of profession. By modifying one of their psychological characteristics, disease could lead self-employed workers to reconsider their professional activity and to modify their investments decision. Thus, health shocks could impact directly and indirectly via the modification of risk aversion professional trajectories/careers.

Diseases also lead to change of behaviors towards health risk with a trend to more prudence for both salaried staff and self-employed workers.

Diseases have different impacts on people's behaviors according to their type. They do not necessarily push entrepreneurs to become more risk averse, slowing down the economic activity of a country.

The reasons why diseases would have different effects could be found in the emotions that they imply and which Loewenstein et al. call anticipatory emotions (Loewenstein et al, 2001). For instance, the struggle for survival that cancer implies could lead people to relativize risks in the labor market and thus to take more risk. Conversely, diabetes implies radical behavior change such as modifying eating habits, injections, sugar control. The treatment for cancer is punctual while the treatment for diabetes is for the whole life. People suffering from diabetes have to be more careful which could explain a higher risk aversion in the field of financial risk linked to job. As for people suffering from depression, they could express less desire in life and then becoming more risk averse. All these explanations are only hypotheses that need to be verified with quantitative but also qualitative surveys.

B. Main messages for policy makers

Messages for policy makers are based on the empirical results found during this thesis.

The results of this thesis emphasize the necessity to take into consideration the characteristics of self-employed workers in public health policies. Furthermore, there is no real reference to self-employed workers in the successive French Government's "Plans Cancer" (2003-2019). The Plan Cancer are public health policies fighting against the negative consequences of cancer on individual's lives.

On the contrary, a variety of measures are taken in favour of salaried employees. Even more surprising, the MSA (social security for farmers) and the RSI (social security for self-employed workers) are not represented in the steering committee of the Plan Cancer.

The policies helping self-employed cancer survivors should not only focus on return to work but also on maintaining business since 39% of them do not take any sick leave compared with

13% for salaried staff. Most of them do not take sick leave because they are afraid of losing or disappointing their customers, of losing earnings (etc). Knowing the reasons for this refusal to take sick leaves should allow public health actors to adopt policies that would help self-employed workers.

Difficulties to get credits after cancer can have dramatic impacts on the activities of self-employed workers. How do a property developer, who always resort to credits for his/her activity; pursue his/her business if he/she does not have access to credits because of the diagnosis of a disease? Or a hotel developer? Or a lawyer wishing to have his/her own office?
In the French Cancer Survey conducted in 2010, 91% of the business owners fear not to have access to credit because of their cancer. This rate reaches 97% for liberal professions (Paraponaris et al. 2014). Concentrating on these points is essential as the survival of small and medium-sized enterprises which are a major part of the French industrial fabric could be seriously endangered. In 2011, France had 138,000 small and medium sized enterprises and 3 million microcompanies (Insee figures).Despite the new legislation (banks must not take into account the fact that their clients suffered from cancer 15 years ago), measures should be reinforced. In 15 years, self-employed workers have time to go bankrupt.

Diseases modify the psychology of individuals and the taste for risk, and as it is shown in the second part of this thesis, some self-employed workers may lose their taste for entrepreneurship after a disease. Consequently retraining policies take sense, but they must apply to this particular category of self-employed people who change their risk behavior towards more risk aversion and become attracted by a salaried work. The RSI has started to implement retraining policies.
However, this category does not represent the majority of self-employed workers. We should keep in mind that a lot of self-employed workers want to stay self-employed even when they face difficulties. They appreciate having no hierarchy and not only value outcomes but also the process leading to outcomes (Benz et al, 2008).

Until now, very few studies have emphasized the professional situation of self-employed workers after cancer.
Analyzing the survival of their firms in depth, when they are diagnosed cancer, would be helpful. A recent article shows that there is a high risk of bankrupt 5 years after cancer (Ha Vinh et al, 2014). This study also underlines that an intense physical work is a predictive factor of the entrepreneur's failure. Other studies like this one should be done by stratifying self-employed workers according to their type of activities.

Another study could aim at understanding why most self-employed workers do not resort to sick leave. It would help them better and answer the following question: "*is it a good thing or not that self-employed workers do not resort to sick leaves two years after cancer??*"

Analyzing efficiency and satisfaction at work after cancer for this population is also important.

By “work ability”, researchers mean the capacity of performing tasks efficiently. A Norwegian study shows that “work ability” (calculated with a score) is negatively correlated with a self-employed work after a cancer (Torp et al, 2011). On the contrary, it is positively correlated with favorable psychosocial environment. Thus, asking self-employed workers how they feel their environment could help.

Furthermore, the question of the loss of income could be of major importance. Unfortunately, we could not do any comparison with the French general population in this thesis because of no available data on self-employed workers ‘income. In the French labor force survey, a lot of self-employed workers do not give their monthly income because they might be afraid of their communication with Administration or because they reason in annual income. Yet, to collect data is necessary to help them. Besides, an Irish study points out that self-employed workers suffer from much income loss after cancer.

If self-employed workers are victim of inactivity as salaried surviving cancer, it is important to remind that contrary to salaried staff, they do not systematically benefit from unemployment insurance. It depends on whether they paid for it or not. Analyzing this weakened population is urgent.

At last, adding quantitative surveys to qualitative surveys could be a a major issue. This would allow to link cancer survivors’ speeches to statistical observations and thus, would constitute a very useful basis of work for policy makers.

Furthermore, one part of the results of this thesis calls for a reexamination of health policies aiming at improving the professional life of workers after cancer. No doubt significant progress has been made by the various actors in the fight against cancer. However, it is our researchers ‘duty to point out that the situation of self-employed workers and of salaried staff have not improved much since 2004. Cancer sufferers are penalized by an accelerated exit of the labor market after cancer. Moreover, a study conducted by our team shows that between 2004 and 2012 their situations worsened even by controlling the “economic crisis effect”.

C. Ideas to improve the professional situation of self-employed workers facing cancer

The following ideas are just proposals aimed at contributing to the French debate. They are not based on scientific researches.

Representatives of the MSA and of the RSI should integrate the steering committee of the actual Plan Cancer (2013-2019) in order to represent every category of self-employed workers.

Regional agreements could be signed between the ARS (Regional Agency in charge of implementing government health policies, RSI and MSA.

We could imagine that when self-employed workers are diagnosed with cancer, they are offered two options. First, option consists in taking sick leaves. Second option consists in being helped by a competent person (even a mix of both). This person would come from a temporary (interim) agency and would be paid by the social solidarity fund or by private insurances.

Foreseeing the succession of the firms is important and is not only the result of a "cold" economic calculation that plans to preserve the survival of the firms. In the French Cancer survey, 41 % of self-employed work with their families. A lot of them work with their marital partner. What happens to them if the self-employed worker die? It is also the duty of French social protection to protect families. One more time, there is no reason why the family of a self-employed worker should not benefit from national solidarity. They could be proposed a help during the time of a business re-ajustment. Ensuring the survival of firms is also important for the economic growth.

D. The other applications of this thesis

This thesis offer other application that can be applied to banking, insurance and vaccination, areas in which risk aversion play an important part in decision-making.
Diseases according to their type can have direct impacts on people's financial portfolio but also on their risk aversion. Thus, a good knowledge of diseases can allow to anticipate individuals' financial behavior.
As far as insurance is concerned, this thesis shows that it may be irrelevant to refuse health insurance to patients because more than half of them are more careful about their health. However there is an ambiguity concerning financial risks because according to the disease, people become more or less financial risk averse.
At last, risk aversion would be a key variable for the decisions concerning vaccination. Thus, these results could be used to inform the policy makers of this sector.

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Appendix A Sensitivity Analysis

Use of sick leave

WOMEN

VARIABLES	HR	95% CI	PVALUE
Age at diagnosis	1.103***	1.042 - 1.167	0.001
Age^2 at diagnosis	0.999***	0.998 - 0.999	0.001
French Baccalauréat (ref: no)	0.957	0.840 - 1.090	0.510
In couple (ref: no)	0.865**	0.750 - 0.998	0.046
Number of Children	0.973	0.920 - 1.030	0.353
Self-employed (ref: no)	0.486***	0.402 - 0.588	0.001
Diminished working hours (ref: no)	1.260***	1.108 - 1.434	0.001
Reorganization of work (ref: no / different from working time arrangements)	1.208***	1.056 - 1.382	0.006
After-effects (ref: no)	1.194***	1.046 - 1.363	0.009
Prognosis at the time of diagnosis (ref: survival > 80%)	0.834***	0.735 - 0.947	0.005
Score of fatigue	0.999	0.997 - 1.001	0.493
Earnings (ref: inferior to first quartile)			
Equal to or higher than first quartile and less than third quartile	1.347***	1.105 - 1.643	0.003
Equal to or higher than third quartile	1.269**	1.026 - 1.569	0.028
Observations	1,347		

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

MEN

VARIABLES	HR	95% CI	PVALUE
Age at diagnosis	1.123***	1.037 - 1.217	0.005
Age^2 at diagnosis	0.999***	0.998 - 0.999	0.001
French Baccalauréat (ref: no)	1.161	0.945 - 1.426	0.155
In couple (ref: no)	1.192	0.918 - 1.548	0.187
Number of Children	1.008	0.912 - 1.114	0.874
Self-employed (ref: no)	0.584***	0.445 - 0.768	0.001
Diminished working hours (ref: no)	1.227*	0.982 - 1.534	0.072
Reorganization of work (ref: no / different from working time arrangements)	1.211	0.960 - 1.528	0.106
After-effects (ref: no)	1.204	0.962 - 1.508	0.105
Prognosis at the time of diagnosis (ref: survival > 80%)	0.966	0.796 - 1.172	0.726
Score of fatigue	1.003*	1.000 - 1.007	0.074
Earnings (ref: inferior to first quartile)			
Equal to or higher than first quartile and less than third quartile	1.128	0.789 - 1.611	0.509
Equal to or higher than third quartile	0.950	0.652 - 1.386	0.791
Observations	575		

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

DIFFERENT PROGNOSIS: SURVIVAL > 50%

VARIABLES	HR	95% CI	PVALUE
Age at diagnosis	1.109***	1.060 - 1.160	0.001
Age^2 at diagnosis	0.999***	0.998 - 0.999	0.001
Gender (ref: men)	1.077	0.958 - 1.211	0.215
French Baccalauréat (ref: no)	1.020	0.914 - 1.138	0.723
In couple (ref: no)	0.934	0.825 - 1.058	0.282
Number of Children	0.982	0.936 - 1.031	0.471
Self-employed (ref: no)	0.516***	0.442 - 0.603	0.001
Diminished working hours (ref: no)	1.256***	1.124 - 1.404	0.001
Reorganization of work (ref: no / different from working time arrangements)	1.206***	1.075 - 1.355	0.001
After-effects (ref: no)	1.206***	1.077 - 1.351	0.002
Score of fatigue	1.000	0.998 - 1.002	0.685
Prognosis at the time of diagnosis (ref: survival > 50%)	0.855**	0.733 - 0.997	0.045
Earnings (ref : inferior to first quartile)			
Equal to or higher than first quartile and less than third quartile	1.290***	1.086 - 1.533	0.004
Equal to or higher than third quartile	1.178*	0.981 - 1.415	0.079
Observations	1,922		

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

Return to work

WOMEN

VARIABLES	HR	95% CI	PVALUE
Age at diagnosis	1.142***	1.050 - 1.242	0.002
Age^2 at diagnosis	0.998***	0.997 - 0.999	0.001
French Baccalauréat (ref: no)	1.543***	1.332 - 1.787	0.001
In couple (ref: no)	1.058	0.896 - 1.250	0.504
Number of Children	0.927**	0.870 - 0.987	0.019
Self-employed (ref: no)	1.212*	0.986 - 1.491	0.068
Diminished working hours (ref: no)	0.952	0.828 - 1.095	0.495
Reorganization of work (ref: no / different from working time arrangements)	1.109	0.961 - 1.278	0.157
Score of fatigue	0.994***	0.992 - 0.997	0.001
After-effects (ref: no)	0.699***	0.606 - 0.806	0.001
Prognosis at the time of diagnosis (ref: survival > 50%)	1.197**	1.037 - 1.382	0.014
Earnings (ref: inferior to first quartile)			
Equal to or higher than first quartile and less than third quartile	1.066	0.840 - 1.353	0.597
Equal to or higher than third quartile	1.122	0.870 - 1.446	0.376
Chimiotherapy (ref:no)	0.478***	0.330 - 0.694	0.001
Observations	1,158		

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

MEN

VARIABLES	HR	95% CI	PVALUE
Age at diagnosis	1.032	0.914 - 1.165	0.611
Age^2 at diagnosis	0.999	0.998 - 1.001	0.223
French Baccalauréat (ref: no)	1.196	0.935 - 1.530	0.154
In couple (ref: no)	0.913	0.673 - 1.238	0.558
Number of Children	1.123**	1.005 - 1.254	0.040
Self-employed (ref: no)	1.085	0.777 - 1.517	0.631
Diminished working hours (ref: no)	0.939	0.724 - 1.217	0.634
Reorganization of work (ref: no / different from working time arrangements)	0.960	0.730 - 1.263	0.771
Score of fatigue	0.992***	0.988 - 0.996	0.001
After-effects (ref: no)	0.687***	0.540 - 0.873	0.002
Prognosis at the time of diagnosis (ref: survival > 50%)	1.486***	1.185 - 1.864	0.001
Earning (ref: inferior to first quartile)			
Equal to or higher than first quartile and less than third quartile	1.355	0.880 - 2.085	0.168
Equal to or higher than third quartile	1.774**	1.120 - 2.811	0.015
Chimiotherapy (ref:no)	0.629**	0.437 - 0.904	0.012
Observations	459		

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

DIFFERENT PROGNOSIS: SURVIVAL <50%

VARIABLES	HR	95% CI	PVALUE
Age at diagnosis	1.136***	1.063 - 1.214	0.001
Age^2 at diagnosis	0.998***	0.997 - 0.999	0.001
Gender (ref: men)	0.890*	0.775 - 1.022	0.099
French Baccalauréat (ref: no)	1.450***	1.279 - 1.644	0.001
In couple (ref: no)	1.017	0.880 - 1.174	0.822
Number of Children	0.974	0.925 - 1.026	0.325
Self-employed (ref: no)	1.168*	0.981 - 1.391	0.081
Diminished working hours (ref: no)	0.945	0.836 - 1.068	0.364
Reorganization of work (ref: no / different from working time arrangements)	1.067	0.941 - 1.209	0.310
Score of fatigue	0.993***	0.991 - 0.996	0.001
After-effects (ref: no)	0.690***	0.611 - 0.780	0.001
Prognosis at the time of diagnosis (ref: survival > 50%)	1.286***	1.138 - 1.453	0.001
Earnings (ref: inferior to first quartile)			
Equal to or higher than first quartile and less than third quartile	1.139	0.927 - 1.400	0.215
Equal to or higher than third quartile	1.259**	1.010 - 1.568	0.040
Chimiotherapy (ref:no)	0.584***	0.452 - 0.755	0.001
Observations	1,617		

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

Appendix B Robustness check

	Probability of Having cancer or not	Probability of being employed
age	0.051***	0.015***
	(0.002)	(0.002)
sexe	0.494***	0.216***
	(0.033)	(0.038)
bac	-0.403***	0.153***
	(0.035)	(0.043)
_cons	-2.989***	0.839***
	(0.099)	(0.096)
cancer		-2.050***
		(0.078)
independant		0.045
		(0.049)
athrho		
_cons	1.234***	
	(0.108)	
N	7932	
chi2	3366.422	
df_m	8.000	
r2_p		

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix C Gologit Model

Variables	Probability of moving from 1 to 2 (less risk averse to more risk averse)	Probability of moving from 2 to 3	Probability of moving from 3 to 4
Female (ref: male)	0.425*** (0.128)	0.226* (0.106)	0.101 (0.092)
Shock Cancer (ref: no)	-0.404 (0.210)	-0.404 (0.210)	-0.404 (0.210)
Shock Diabetes (ref: no)	-0.039 (0.297)	0.544* (0.261)	0.513* (0.205)
Shock Arthritis (ref: no)	-0.298* (0.125)	-0.298*(0.125)	-0.298* (0.125)
Shock Heart Diseases (ref: no)	0.159 (0.182)	0.159 (0.182)	0.159 (0.182)
Shock Stroke (ref: no)	-0.145 (0.305)	-0.145 (0.305)	-0.145 (0.305)
Shock Lung (ref: no)	-0.032 (0.244)	-0.032 (0.244)	-0.032 (0.244)
Shock Psychological Diseases	0.283 (0.206)	0.283 (0.206)	0.283 (0.206)
Shock High Blood Pressure	0.126 (0.133)	0.126 (0.133)	0.126 (0.133)
Retirement	-0.519*** (0.142)	-0.275*(0.118)	-0.133 (0.103)
Death of spouse (ref: no)	-0.220 (0.276)	-0.220 (0.276)	-0.220 (0.276)
Shock marital status (ref: no)	-0.070 (0.149)	-0.070 (0.149)	-0.070 (0.149)
Age			
49-54	0.173 (0.154)	0.173 (0.154)	0.173 (0.154)
55-59	0.121 (0.137)	0.121 (0.137)	0.121 (0.137)
60+	0.299 (0.164)	0.299 (0.164)	0.299 (0.164)
Degree (ref <=12 years)	0.053 (0.125)	-0.054 (0.100)	- 0.258 (0.085)
Earnings (ref: first quartile)			
First Quartile	0.271 (0.146)	0.271 (0.146)	0.271 (0.146)
Second Quartile	0.225 (0.130)	0.225 (0.130)	0.225 (0.130)
Third Quartile	0.185 (0.114)	0.185 (0.114)	0.185 (0.114)
Religion (ref: Protestant)			
Catholics	-0.011 (0.098)	-0.011 (0.098)	-0.011 (0.098)
Jewish	0.010 (0.222)	0.010 (0.222)	0.010 (0.222)
Others	-0.198 (0.143)	-0.198 (0.143)	-0.198 (0.143)
Race (ref: White)			
Black	-0.164 (0.117)	-0.164 (0.117)	-0.164 (0.117)
Hispanic	0.217 (0.173)	0.217 (0.173)	0.217 (0.173)
Others	0.001 (0.262)	0.001 (0.262)	0.001 (0.262)
Job (ref: salaried)			
Self-employed	-0.693*** (0.146)	-0.693*** (0.146)	-0.693*** (0.146)
Not working	-0.209 (0.127)	-0.209 (0.127)	-0.209 (0.127)
Marital Status (ref: married)			
Separted or Divorced	0.093 (0.125)	0.093 (0.125)	0.093 (0.125)
Widowed	-0.288 (0.177)	-0.288 (0.177)	-0.288 (0.177)
Never married	0.024 (0.273)	0.024 (0.273)	0.024 (0.273)
Level of risk in 2006 (: very low risk aversion)			
Low risk aversion	0.383 (0.208)	0.030 (0.175)	-0.171 (0.163)
High risk aversion	0.977***(0.196)	0.530***(0.159)	0.198 (0.141)
Very high risk aversion	1.284*** (0.156)	1.001***(0.132)	0.906***(0.119)
Constant	0.958***(0.226)	0.580**(0.213)	0.070 (0.2014)

N	2987
chi2	277.285
df_m	47.000
r2_p	0.046

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Résumé

Les chocs de santé ont des conséquences contrastées sur les trajectoires d'emploi, dépendant aussi bien de facteurs tenant à l'épidémiologie des maladies qu'à des facteurs d'organisation du marché du travail. Le cancer a ainsi des effets à la fois transitoires et durables sur la situation d'activité et d'emploi des personnes qui y survivent. Notre étude approfondie du cas des travailleurs indépendants montre qu'ils sont caractérisés par des réponses à la maladie les différentiant des travailleurs salariés dans la fréquence et la durée des arrêts-maladie mais également dans le processus de maintien à l'emploi. Certains de ces résultats sont réductibles à des traits de caractère des indépendants, comme leur attitude à l'encontre des risques. Ces résultats tiennent aussi aux modalités de la participation au marché du travail des indépendants et de leurs conditions d'exercice, le plus souvent moins protégées par les dispositifs d'assurance sociale que les travailleurs salariés, car laissées à leur discrétion. Les études utilisées sont l'enquête française sur le cancer « VICAN 2 » financée par l'INCa, l'enquête emploi, et l'enquête américaine « HRS». Tout d'abord, cette thèse souligne la nécessité de faire des études qualitatives et quantitatives seulement sur les indépendants, qui différent substantiellement des travailleurs salariés. Les résultats soulignent aussi que l'aversion au risque n'est pas une caractéristique innée et stable. Les travaux empiriques, étayés par une modélisation théorique, montrent que les chocs de santé peuvent amener les individus à reconsidérer leur goût du risque, à la baisse (maladies chroniques stables) ou à la hausse (survie au cancer).

Abstract

Consequences of health shocks on professional trajectories are contrasted, depending on epidemiological factors and on the organization of the labor market. In particular, cancer has both transitory and permanent effects on the activity and on the employment status of survivors. Self-employed workers are characterized by responses to the disease that differentiate them from salaried staff, with regards to the frequency and the duration of sick leave and also with regards to their employment status. These results are linked in part to the character traits of self-employed workers, such as their attitudes toward risks. They are also due to the different modalities of their participation to labor force and their unique working conditions, as they are generally less protected by social insurance than salaried employees. The surveys used by this study are two French surveys: « VICAN 2 » survey on cancer funded by INCa, and the labor force survey carried out by INSEE, and the American Health and Retirement Survey (HRS) from the University of Michigan.
This thesis underlines the importance of conducting qualitative and quantitative surveys specifically on self-employed workers to evidence their unique difficulties. Results also underline that risk aversion is not an innate and immutable characteristic. Empirical studies and theoretical model developed in this thesis demonstrate that diseases can lead people to reconsider their appetite for risk, often in a downward trend (chronic diseases) and sometimes in an upward trend (survival to cancer).