Université de Montréal

Comportements Individuels et Immigration à l'Ère du Vieillissement Démographique

par

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Résumé

Cette recherche démontre que, compte tenu des tendances passées dans les comportements individuels face à la participation au marché du travail, l'augmentation de l'âge normal de la retraite n'est ni urgente ni nécessaire au Canada si son seul objectif est de pallier une augmentation de la durée de la retraite. Par ailleurs, si l'accueil d'un nombre toujours grandissant d'immigrants alimente la croissance de la main-d'œuvre, il entraîne aussi un déficit fiscal non négligeable. Celui-ci est toutefois en bonne partie lié au sous-emploi de cette main-d'œuvre potentielle; sous-emploi qui affecte aussi la population native, alimentant ainsi les risques de pénurie de main-d'œuvre.

D'une part, et contrairement à l'opinion répandue selon laquelle l'allongement de la vie a été accompagné d'un rétrécissement du nombre d'années dédiées au travail, la durée de vie au travail en 2016 a augmenté de 4,96 ans et représente une part plus importante de l'espérance de vie, soit 3,55 points de pourcentage, comparé à son niveau en 1981. En outre, bien que l'évolution de la structure par âge de la population ait exercé une pression à la baisse (−11,7%) sur la croissance de l'offre agrégée de travail, les changements de comportement individuel quant à la participation au travail (19,3%) et les heures travaillées (5,8%) ont plus que compensé cet effet, entre 1981 et 2016.

Au cours de cette période, les comportements individuels, notamment la participation des femmes au marché du travail, ont connu de profonds changements. Si ces changements étaient déjà connus et pleinement documentés, la quantification de leur contribution à l'offre individuelle et agrégée de travail le sont moins. Cette étude vient combler ce vide. Par

exemple, et comme on pouvait s'y attendre, la participation des femmes au marché du travail a été la principale source de l'offre additionnelle de travail entre 1981 et 2016, contribuant 9,6 ans (contre 0,25 an pour les hommes) au changement de la durée de vie au travail. Au vu de ces résultats, le vieillissement de la population n'a pas encore entraîné une diminution de la durée de la vie active qui justifierait une augmentation de l'âge normal de la retraite au Canada.

D'autre part, si l'immigration explique à elle seule 32,9% de l'augmentation de l'offre de travail entre 1981 et 2016, cette contribution n'est pas à coût nul. Par exemple, entre 1997 et 2015, les immigrants, comparés aux natifs du même âge, ont reçu 110$ de plus et contribué 3 520$ de moins en transferts publics. Ainsi, au même âge, l'immigrant moyen a reçu 3 640 en transferts nets de plus que le natif moyen. Toutefois, 85% de ce surplus provient des déséquilibres sur le marché du travail, dont le sous-emploi de cette main-d'œuvre potentielle.

En effet, les résultats de cette recherche montrent que le sous-emploi représente un défi important dans un contexte de vieillissement de la population et de pénurie de main-d'œuvre appréhendée. S'il touche plus durement la population immigrante, il affecte aussi les natifs. Ainsi, en moyenne entre 1981 et 2016, 20,1% des travailleurs canadiens ont été en situation de sous-emploi, alors que le plein emploi aurait contribué à l'ajout de 1,5 million (±0,2) de travailleurs équivalent temps plein.

Ces résultats découlent de l'application de plusieurs méthodes notamment la méthode de Sullivan (Sullivan, 1971), le modèle de changement continu (Horiuchi et al., 2008) ainsi que l'optimal matching et l'analyse des clusters sur un large éventail de données. Les sources de données incluent les recensements, les estimations de la population, les enquêtes sur la main-d'œuvre, la santé, et la consommation, au Canada et aux États-Unis.

Cette recherche vient nuancer certaines des conséquences prétendues du vieillissement de la population sur la main-d'œuvre canadienne, tout en apportant un nouvel éclairage sur les solutions à mettre de l'avant afin de faire face à certains défis au cours des prochaines décennies. Si l'immigration peut ici jouer un rôle non négligeable, un meilleur arrimage entre l'offre et la demande de travail réduirait le sous-emploi parmi l'ensemble de la population canadienne, tout en améliorant leur niveau de vie. Les discussions sur l'augmentation de l'âge normal de la retraite ou des quotas d'immigration ne peuvent ignorer un tel constat.

Mots-Clés : Vieillissement Démographique, Durée De Vie Au Travail, Âge Normal De La Retraite, Offre De Main-D'Œuvre, Taux De Participation, Heures Travaillées, Immigration, Transfert Public, Compte National De Transfert, Décomposition Démographique, Modèle De Changement Continu, Cadre D'utilisation Du Travail, Sous-Emploi, Analyse En Grappes.

Abstract

This research demonstrates that, given past trends in individual behaviour in the labour market, increasing the normal retirement age is neither urgent nor necessary in Canada if its sole purpose is to offset an increase in the duration of retirement. Moreover, while the inflow of ever-increasing numbers of immigrants fuels labour force growth, it also creates a significant fiscal deficit. However, this deficit is largely related to the underemployment of this potential workforce, which also affects the native population, thus fuelling the risk of labour shortages.

On the one hand, and contrary to the widespread opinion that population ageing has led to shrinking worklife for financing longer lifespan, Worklife Duration increased by 4,96 years and 3,55 percentage points of life expectancy over the last four decades. Furthermore, although the change in the age structure of the population has put a slight downward pressure (−11,7%) on the growth of aggregated labour supply, changes in individual behaviour regarding labour participation (19,3%) and worked hours (5,8%) have more than compensated for this effect between 1981 and 2016.

During this period, individual behaviours, including women's participation in the labour market, have undergone profound changes. While these changes were already known and fully documented, their contribution to individual and aggregate labour supply is less so. This study fills this gap. For example, and not surprisingly, women's participation in the labour market was the main source of additional labour supply between 1981 and 2016, contributing 9,6 years (compared to 0,25 year for men) to the change in worklife duration. Given these

results, population aging has not yet resulted in a decrease in working life which would justify an increase in the normal retirement age in Canada.

On the other hand, while immigration alone accounts for 32,9% of the increased labour supply between 1981 and 2016, this contribution is at not zero cost. For example, between 1997 and 2015, immigrants, compared to natives at the same age, received $110 more and contributed $ 3 520 less, in public transfer. As a result, the average immigrant has received $3 640 in net transfer more than the average native. However, 85% of this deficit arises from the labour market imbalances such as the underemployment of this potential labour supply.

Indeed, the results of this research show that underemployment represents a major challenge in the context of an aging population and a perceived labour shortage. While it affects the immigrant population most severely, it is also prevalent among native workers. Thus, on average, between 1981 and 2016, 20,1% of Canadian workers were underemployed, while full employment would have contributed an additional 1,5 million (±0,2) full-time equivalent workers.

This study uses various methods, including the Sullivan method (Sullivan, 1971) and the model of continuous change (Horiuchi et al., 2008), as well as optimal matching and cluster analysis on a wide range of data. The data sources include censuses, population estimates, labour force, and health and consumer surveys in Canada and the United States.

This research brings new evidence to the debates around the consequences of population aging on the Canadian workforce while shedding new light on the solutions to be put forward for facing the challenges in the coming decades. While immigration can play an important role, a better match between labour supply and demand would reduce underemployment among the Canadian population while improving their standard of living. Discussions about increasing the normal retirement age or immigration quotas cannot ignore such a finding.

Keywords: populating aging, worklife duration, normal retirement age, labour supply, participation rate, worked hours, immigration, public transfer, national transfer account, demographic decomposition, model of continuous change, labour utilization framework, underemployment, cluster analysis.

Table des matières

Liste des tableaux

Liste des figures

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Chapitre 1

Introduction générale et revue de littérature

1.1. Contexte de l'étude

Le vieillissement démographique se manifeste par une augmentation de la proportion des personnes âgées, habituellement de 65 ans et plus, dans la population. L'ONU estime qu'une personne sur six dans le monde aura plus de 65 ans (16%) d'ici 2050, contre une sur onze en 2019 (9%) et une sur 17 (6%) en 1990 (Nations, 2019). Si pour la population mondiale, ces chiffres annoncent l'une des plus importantes transformations sociales du XXIe siècle (Bloom et al., 2015; D'Addio et al., 2010), ils constituent la réalité que traversent plusieurs pays depuis quelques décennies déjà. Au Canada, plus de 6 millions de personnes étaient âgées de 65 ans ou plus en 2014, ce qui représente 15,6 pour cent de la population. En 2030, les aînés seront plus de 9,5 millions et représenteront 23% des Canadiens (EDSC, 2014).

L'accélération du vieillissement démographique dans les pays à revenu élevé au cours des dernières décennies est sans doute liée aux vieillissements des baby-boomers, soit les personnes nées entre 1946 et 1965 (Yuqian & Hou, 2022). En 2000, les baby-boomers représentaient 31% de la population canadienne alors qu'ils étaient âgés de 35 à 54 ans, la période la plus productive du cycle de vie. Âgés de 55 à 74 ans en 2020, ils sont des millions à se retirer du marché de travail. Ce retrait massif des baby-boomers a inspiré plusieurs études dont les résultats débouchent pour la plupart sur des inquiétudes de pénurie de main-d'œuvre

et de surcharge des finances publiques; pénurie, car il y aura relativement moins de personnes pour travailler et soutenir la production, et surcharge, car les gouvernements recevront relativement moins de contributions pour financer des dépenses grandissantes, suivant l'accroissement de l'effectif des personnes à charge.

Les impacts attendus du vieillissement démographique sur les performances économiques sont au centre de débats académiques et politiques et font régulièrement la une des journaux. Alimentées par les discours d'inquiétudes sur les effets négatifs du vieillissement démographique, les propositions pour augmenter les quotas d'immigration ou l'âge de la retraite, dominent les discussions. Mais ces propositions ne font pas l'unanimité, car nombreux sont ceux qui soutiennent que les effets négatifs du vieillissement démographique sur l'économie seront très en deçà des inquiétudes et qu'il existe des mesures plus adaptées pour y faire face. D'ailleurs, à lui seul, le changement dans les comportements individuels vis-à-vis du travail apporterait déjà une compensation non négligeable aux effets du vieillissement des populations.

En effet, au même titre que la structure par âge de la population active, les comportements individuels que sont la participation au marché du travail et le nombre d'heures travaillées affectent le niveau et la croissance de l'offre de travail. De ces derniers dépend en bonne partie le niveau de croissance des recettes publiques à travers les taxes et contributions des travailleurs et des entreprises. De ce fait, toutes choses égales par ailleurs, le changement de la structure par âge de la population entraine pénurie de main-d'œuvre ou surcharge des finances publiques seulement si les comportements individuels ne s'ajustent pas à cette nouvelle structure. Par conséquent, les comportements individuels jouent sans doute un rôle non négligeable dans le niveau et la croissance de la main-d'œuvre disponible, tout comme ils le font pour les recettes publiques à travers les taxes et contributions des travailleurs et des entreprises.

Ainsi, les comportements individuels constituent des variables stratégiques d'intervention de politiques publiques capables d'amoindrir l'impact des effets économiques appréhendés du vieillissement de la population. Cependant, contrairement aux tendances démographiques, les comportements individuels vis-à-vis du marché du travail sont plus difficiles à prévoir. Pour cette raison, leur intégration dans l'analyse des effets économiques du vieillissement démographique est nécessaire (St-Maurice et al., 2018), mais presque inexistante dans la littérature. Cette thèse permettra, entre autres, de mieux comprendre l'impact des changements de comportements individuels sur l'offre de travail au Canada. Les pénuries de main-d'œuvre étant l'un des effets potentiels du vieillissement démographique, l'immigration est le remède le plus souvent mis de l'avant. De ce fait, cette étude accordera une attention particulière aux impacts économiques de l'immigration au-delà de son effet sur la croissance de la main-d'œuvre. Elle explorera aussi les sources alternatives de main-d'œuvre additionnelle. Mais avant, une brève revue des recherches sur les effets appréhendés du vieillissement démographique s'impose.

1.2. Vieillissement et main-d'œuvre

Les implications du vieillissement démographique sur le marché du travail sont souvent extrapolées des changements qui surviennent dans la structure par âge de la population. Deux mécanismes par lesquels ces changements affectent le marché du travail (Barrett, 2015; Carrière et al., 2015) sont souvent discutés. D'une part, la proportion de la population en âge de travailler diminue, augmentant les risques de pénurie de main-d'œuvre. D'autre part, la proportion des travailleurs plus âgés augmente, réduisant la productivité, selon l'hypothèse d'une baisse de productivité avec l'âge. Ainsi, l'augmentation du risque de pénurie et la diminution de la productivité sont les principales sources d'inquiétudes, mais aussi de controverses quant à la nature et à l'ampleur des effets du vieillissement démographique sur la main-d'œuvre. Ces points ont été abordés par plusieurs auteurs.

Aux États-Unis par exemple, Maestas et al. (2016) estiment qu'une augmentation de 10% de la proportion des personnes âgées de 60 ans et plus implique une diminution du PIB par habitant de 5,5%, dont deux tiers sont attribuables au ralentissement de la croissance de la main-d'œuvre et un tiers à la diminution de la productivité. Au Canada, l'existence de pénurie fait encore l'objet de vifs débats. Et pourtant, la question de pénurie de main-d'œuvre n'y est pas nouvelle. En effet, dans la décennie suivant la Deuxième Guerre mondiale, la demande de main-d'œuvre d'une économie en croissance rapide dépassait périodiquement la capacité d'expansion de l'offre de travail, causant des pénuries de professionnels et de travailleurs qualifiés (Newton et al., 1981). Dans les années 2000, plusieurs études ont révélé des pénuries pour certaines professions dans certaines provinces (Grimmett & Echols, 2002; Spurgeon, 2000). Par exemple, une étude nationale publiée par l'association des infirmières et infirmières du Canada prévoyait que le Canada (sans le Québec) connaitrait une pénurie de 59 000 à 113 000 infirmières à l'horizon 2011 (Spurgeon, 2000). Selon la même source, les estimations pour le Québec étaient d'un déficit de 11 000 infirmières entre 2001 et 2015. Autre exemple récent, en 2002, Grimmett and Echols (2002) utilisent une analyse qualitative par entrevue avec les présidents de syndicats locaux des enseignants et administrateurs de la Colombie-Britannique, et concluent que la province fait face à une pénurie imminente d'enseignants et d'administrateurs.

Face à ces résultats, nombreux sont ceux qui soutiennent que dans une économie active et en mutation, les pénuries cycliques sur le court terme dans certains secteurs et régions sont fréquentes et normales, que la croissance de la main-d'œuvre ralentisse ou non (Bélanger & Bastien, 2013; R. Lefebvre et al., 2012; McDaniel et al., 2015). Ainsi, les pénuries de main-d'œuvre se sont produites de façon intermittente au Canada au cours des dernières décennies avec une durée moyenne de moins d'un an et ne seraient pas liées au vieillissement démographique (R. Lefebvre et al., 2012). Plus récemment, les pénuries rapportées seraient plus liées à des difficultés d'embauches auxquelles font face certains employeurs et non à une pénurie généralisée de main-d'œuvre (McDaniel et al., 2015). Étant donné le manque

d'évidence, Bélanger and Bastien (2013) considèrent que l'affirmation d'une pénurie de main-d'œuvre au Canada, en raison de la retraite des baby-boomers et de la faible croissance de la main-d'œuvre, pourrait être exagérée. Il faut admettre que les pénuries plus criantes au cours des deux dernières années remettent en question l'avis de Bélanger et Bastien (2013). Cependant, les pénuries ressenties depuis 2020 au Canada et ailleurs sont en bonne partie liées à la crise sanitaire de la Covid-19 et cette thèse se concentre sur les effets du vieillissement démographique sur la croissance de la main-d'œuvre à moyen et long terme.

Autant que la question de pénurie, celle de la productivité soulève des divergences d'opinions. L'âge médian de la population canadienne s'est accru de 26,2 ans en 1971 à 41,1 ans en 2021 (Tableau : 17-10-0005-01) et pourrait atteindre 45 ans en 2036 (Annuaire du Canada 2010, no.11-402-X au catalogue). Selon l'opinion générale, cette tendance implique une diminution de productivité qui serait due à une relation en forme de «U» inversé entre l'âge et la productivité, les plus hautes performances se situant entre 30 et 50 ans selon les industries (Frosch, 2011; Skirbekk, 2004; Tang & MacLeod, 2006). Cependant, cette théorie ne semble pas tenir compte du fait qu'une population plus âgée a probablement un niveau d'éducation plus élevé, entre autres à cause de la relation entre hausse des niveaux de scolarité et baisse de la fécondité, source principale du vieillissement démographique. L'éducation étant une indication de la productivité, on en déduit qu'une population plus âgée est potentiellement une population plus productive.

Cet effet d'une amélioration de la productivité qui accompagnerait le vieillissement démographique n'est pas sans conséquence. Par exemple, Marois et al. (2020) démontrent qu'un ratio de dépendance démographique plus sophistiqué qu'un simple rapport de groupes d'âge, intégrant la productivité, donne un aperçu moins intimidant du vieillissement démographique. Le fait que la productivité se reflète largement dans les salaires horaires[1] permet aussi de mettre en évidence la relation entre vieillissement des populations et

[1]Ceci est contesté par plusieurs, notamment, pour les syndicats où le salaire est lié à l'ancienneté et non nécessairement à la productivité.

productivité. Utilisant cette approche, Burtless (2013) montre aiinsi que les travailleurs de 60 à 74 ans sont plus productifs que les travailleurs plus jeunes.

Il existe aussi une association moins directe entre vieillissement et productivité qui pourrait aussi jouer dans la réduction des effets négatifs du vieillissement démographique (Tang & MacLeod, 2006). Par exemple, le vieillissement démographique peut avoir un effet positif sur la croissance de la productivité du travail à travers son influence sur l'intensité du capital physique et la formation du capital humain. En effet, l'accroissement des salaires à la suite d'une diminution de la croissance de la main-d'œuvre encouragera la substitution de la main-d'œuvre par le capital physique (automatisation) d'une part, et incitera les générations futures à accroitre leur capital humain d'autre part (Fougère et al., 2009). Ceci inclut non seulement les jeunes prolongeant leur durée d'études, mais aussi un nombre croissant de personnes âgées optant pour des formations de remise à niveau de compétence afin de rester actives plus longtemps sur le marché du travail.

En d'autres termes, face au vieillissement démographique, la réponse des agents économiques à divers niveaux, et plus particulièrement le changement de comportements individuels, contribue à l'accroissement de la productivité du travail au sein de la population. Mais le rôle des comportements individuels va au-delà d'un simple pont entre vieillissement et productivité.

1.3. Le rôle des comportements individuels

Alors que la littérature actuelle souligne l'importance de l'évolution de la structure par âge de la population sur la main-d'œuvre, le rôle des comportements individuels est rarement pris en compte dans l'évaluation des implications du vieillissement démographique. La plupart des études supposent une inertie des comportements individuels sur le parcours de vie, ce qui n'est pourtant pas souvent le cas. Au Canada, parallèlement au vieillissement démographique, les dernières décennies ont connu un changement dans les comportements individuels vis-à-vis du marché de travail quant à l'entrée, la participation et la retraite (Carrière &

Galarneau, 2011; Donner & Lazar, 1974; Fallick & Pingle, 2007; Fougère et al., 2009; Officer & Andersen, 1969). Ces facteurs peuvent amoindrir ou aggraver la pénurie et la productivité de la main-d'œuvre. Mais, leurs effets ne sont pas souvent pris en compte dans l'analyse de l'impact du vieillissement démographique.

D'abord, les jeunes, non seulement, passent plus de temps dans le foyer parental, mais aussi, prolongent leurs études, reportant ainsi leur entrée sur le marché du travail (Clark, 2007; Fleury, 2009). Par exemple, Clark (2007) note qu'au Canada en 1971, les trois quarts des jeunes adultes (âgés de 18 à 34 ans) commençaient leur vie active en moyenne à l'âge de 22 ans, alors qu'en 2001 cette proportion n'était que de 50%. En comparant les transitions vers l'âge adulte de deux cohortes québécoises, celles de 1942-51 et 1962-71, Fleury (2009) montre que l'insertion professionnelle a été repoussée d'environ une année pour les hommes, et trois pour les femmes.

À l'autre extrémité de la vie active, la participation des adultes âgés de 55 ans et plus au marché du travail a connu une évolution des plus spectaculaires au cours des quatre dernières décennies, notamment chez les femmes (Aaronson et al., 2014; Aaronson et al., 2006; Beach, 2008; Carrière & Galarneau, 2012a; Fougère et al., 2009; Schirle, 2008). Par exemple, Fougère et al. (2009) estiment que pour une cohorte accédant au marché du travail en 2018 comparé à une autre en 1974, le temps alloué au travail de la cohorte entrant sur le marché de travail en 2018 augmentera de 14%, 23,5% et 46,7% respectivement pour les groupes d'âge 57-60, 61-64 et 65-68. Les mêmes tendances s'observent dans d'autres pays de l'OCDE où la participation des hommes âgés de 55 à 64 ans est à la hausse depuis les années 90, renversant les tendances observées depuis les années 60 (Burtless, 2013).

Enfin, la participation des adultes de 25-54 ans a connu un changement remarquable au cours des trois dernières décennies, notamment chez les femmes (Carrière et al., 2020; Coglianese, 2018; Fallick & Pingle, 2007; Ruggles, 2015). Par exemple, au Canada entre 1976 et 2018, le taux de participation des femmes âgées de 25-54 ans est passé de 52% à 83.2%, réduisant l'écart

de participation entre hommes et femmes de 31,2 à 7,6 points de pourcentage (Statistique Canada, Tableau 14-10-0327-01). Si la participation des femmes a augmenté au cours des dernières décennies, les tendances sont à la baisse chez les hommes avec un taux de participation de 90% en 2015 alors qu'il était de 97% en 1965. Ces mêmes tendances s'observent aux États-Unis où, par exemple, il n'y a que 88% des hommes du même âge sur le marché du travail en 2015 alors qu'on en comptait 97% en 1960 (Coglianese, 2018).

Alors que les études récentes soulignent l'apparition de changements importants dans les comportements des individus face au marché du travail, elles sont pour la grande majorité focalisées sur la participation et rares (Carrière & Galarneau, 2012b) sont celles qui discutent des changements dans le nombre d'heures travaillées dans un contexte de vieillissement démographique. Dans la plupart de ces études, les heures travaillées sont, soit complètement ignorées, soit fixées au même niveau, sans différenciation dans le temps ou par catégories socioéconomiques, ce qui ne traduit pas les tendances des dernières décennies.

En effet, après une transition des semaines uniformes de 60 heures du début du siècle vers des semaines variables de 37 à 40 heures dans les années 60 (Sunter & Morissette, 1994), le déclin des heures travaillées s'est poursuivi tout au long des années 1980, en partie à cause de l'apparition de l'emploi à temps partiel. Devenant populaire à peu près au même moment où les femmes ont commencé leur entrée massive sur le marché du travail, et dans le but de concilier travail et famille, le travail à temps partiel est aussi le régime privilégié par les étudiants, leur permettant ainsi de demeurer plus longtemps aux études tout en ayant un pied dans le marché du travail. Même récemment, le travail à temps partiel est le moyen par lequel les personnes âgées prolongent leur retraite tout en augmentant leur temps de loisir.

De nos jours, la distribution des heures travaillées est bimodale dans la plupart des pays développés, avec une concentration entre 35 et 40 heures et une autre entre 15 et 20 heures (Dolton, 2017). Ces changements ont aussi entrainé un déplacement de l'âge où l'on atteint le

taux maximal d'emploi à temps plein chez les moins de 35 ans, passant d'environ 25 ans dans les années 1970 à 31 ans au cours de la dernière décennie (Galarneau et al., 2013).

Ainsi, alors que les heures travaillées ont diminué continuellement au cours des dernières décennies, cette diminution n'est pas nécessairement négative pour la main-d'œuvre, car elle a introduit une flexibilité dont le résultat est une participation plus étendue de la force potentielle de travail. Ces changements rendent l'inclusion des heures travaillées aussi essentielle que celle des taux de participation dans l'estimation de l'offre de travail aux plans individuel et agrégé. En fait, si les taux de participation illustrent la portée horizontale ou l'étendue de la main-d'œuvre, les heures travaillées renseignent sur sa portée verticale ou sa profondeur. Ignorer l'une de ses deux dimensions ne peut correctement représenter l'évolution du niveau de l'offre de travail.

En somme, l'inclusion des comportements individuels quant à la participation au marché du travail et aux heures travaillées favorisera une mesure plus précise et un suivi plus rigoureux de l'offre agrégée de travail; mesure essentielle à l'élabouration de politiques publiques réduisant l'éventualité d'une pénurie de main-d'œuvre. Dans le cas contraire, on obtient un portrait limité et biaisé des effets du vieillissement démographique sur la main-d'œuvre, tout comme des politiques appropriées pour y faire face.

1.4. Pallier les effets du vieillissement démographique

Au nombre des mesures proposées pour pallier les effets du vieillissement démographique, l'augmentation de quota d'immigration et de l'âge d'éligibilité à certains programmes pour les personnes âgées (âge normal de la retraite) sont celles le plus souvent discutées. Face à l'entrée de plus en plus tardive des jeunes dans la vie active et à l'accroissement de l'espérance de vie, l'augmentation de l' âge normal de la retraite paraît justifier, et contribuerait à rééquilibrer les systèmes de retraite sans peser sur les revenus des travailleurs et des retraités (D'Amours et al., 2013; Hering & Klassen, 2010; Hicks, 2012; Institut Canadien des Actuaires, 2019).

Par exemple, Institut Canadien des Actuaires (2019) propose que l'éligibilité à la Sécurité de la vieillesse (SV) soit déférée de 65 à 67 ans. La SV et le Supplément de revenu garanti (SRG) constituent le premier pilier des revenus de retraite publique au Canada. Ils sont financés par les revenus généraux de l'État et ciblent tous les résidents canadiens de 65 et plus sans distinction d'historique de travail. En 2017, les programmes de la SV et du SRG représentaient la plus grosse[2] dépense budgétaire, s'élevant à environ 50 milliards de dollars contre 42 milliards de dollars pour les prestations de retraite du RPC (Régime de pensions du Canada) et du RRQ (Régie des Rentes du Québec). Le RPC et le RRQ constituent le deuxième pilier des revenus de retraite publique au Canada. Ce sont des régimes contributifs financés par les cotisations obligatoires des entreprises et des travailleurs. Ces régimes sont conçus pour limiter[3] l'effet de l'âge effectif de la retraite par une réduction des allocations en cas de retraites prises avant 65 ans et par une bonification après cet âge. Selon Hering and Klassen (2010), augmenter l'âge d'éligibilité à la retraite de 65 à 67 ans sans pénalité (et de 60 à 62 avec pénalité) est une option financièrement efficace, équitable sur le plan intergénérationnel et politiquement acceptable pour améliorer ces régimes.

Si les régimes publics de pensions de retraite n'ont pas connu de grand changement regardant l'âge d'éligibilité depuis leur création dans les années 1960 (Chawla & Wannell, 2004), les tendances montrent que les Canadiens prennent leur retraite de plus en plus tardivement, et surtout depuis le milieu des années 1990 (Carrière & Galarneau, 2011; Carrière et al., 2015; Gomez & Gunderson, 2009; P. Lefebvre et al., 2012). Par exemple, les résultats de P. Lefebvre et al. (2012) indiquent que l'âge probable à la retraite a augmenté d'environ deux [4] ans entre 1994 et 2007 pour les hommes et les femmes. De plus, il est important de noter que les études sur l'espérance de vie en bonne santé selon le statut socioéconomique montrent des écarts

[2]Source: La Bibliothèque du Parlement. https://tinyurl.com/y3utn3nd

[3]Par exemple, si la perception de la pension commence avant 65 ans, le versement diminuera de 0,6% chaque mois jusqu'à une réduction maximale de 36%. Au contraire, si la perception de la pension commence après 65 ans, le paiement augmentera de 0,7% chaque mois, avec une augmentation maximale de 42%. Voir https://tinyurl.com/27a8psj6 pour plus d'information.

[4]Ceci ne représente que la moitié de l'accroissement entre 1994 et 2002 d'après Gomez and Gunderson (2009)

importants en faveur des mieux nantis. Ainsi, devoir travailler plus longtemps pourrait signifier un accroissement des inégalités socioéconomiques à l'intérieur même des générations (Carrière et al., 2015). Par conséquent, augmenter l'âge normal de la retraite pourrait avoir des conséquences inattendues.

Encore plus polarisée que le débat sur l'augmentation de l'âge normal de la retraite, la question de l'immigration a pris une nouvelle tournure dans le contexte du vieillissement démographique. Pour certains, à défaut de rajeunir significativement la population, l'augmentation des quotas d'immigration peut non seulement combler une pénurie éventuelle de main-d'œuvre, mais aussi réduire le fardeau fiscal du vieillissement de la population (Akin, 2012; Chojnicki & Ragot, 2012; Dungan et al., 2013; Dustmann et al., 2016; Hering & Klassen, 2010; İleri, 2019). Selon les simulations de Dungan et al. (2013), l'augmentation des quotas d'immigration est susceptible d'avoir un impact positif sur les transferts publics. İleri (2019) constate aussi que l'immigration de travailleurs qualifiés réduit les inégalités salariales.

Ainsi, le nombre d'immigrants admis au Canada depuis les années 1990 est resté relativement élevé, avec une moyenne d'environs 235 000 nouveaux immigrants par an (Canada, 2016). En 2017, le pays a accueilli plus de 286 000 résidents permanents et le gouvernement adopta un plan pluriannuel pour accroitre le niveau annuel à 340 000 d'ici 2020 (Rapport annuel au Parlement sur l'immigration 2018). Au recensement de 2016, on dénombrait 7 540 830 personnes (soit 21,9 % de l'ensemble de la population canadienne) nées à l'étranger et venues au Canada par l'intermédiaire du processus d'immigration.

Pour d'autres, l'immigration est coûteuse pour les pays d'accueil (Borjas, 2014; Fehr et al., 2003; Grubel & Grady, 2012; Javdani & Pendakur, 2013; Latif, 2015). Au Canada, les résultats de Grubel and Grady (2012) montrent que pour l'année d'imposition 2005-2006, l'immigrant moyen a couté environ $6,051 de plus qu'un natif en transferts publics nets. Dans une publication ultérieure (Grady & Grubel, 2015), les auteurs maintiennent leur position et urge le gouvernement à réduire les quotas d'immigration, écrivant …*the number of annual*

immigrants needs to be reduced to bring about a substantial reduction in total fiscal burden imposed by new immigrants on Canadian taxpayers.

Si le débat de l'immigration est devenu plus vif dans le contexte du vieillissement démographique, il était déjà au centre des discussions les plus animées, même au-delà du monde académique et politique. L'opinion publique sur cette question se manifeste souvent par une hostilité envers les immigrants sous le prétexte qu'ils occasionnent des coûts nets pour le contribuable (Dustmann & Preston, 2007). Selon l'enquête sociale européenne de 2008, 44% des citoyens pensent que les immigrants sont à la charge des natifs, car ils reçoivent plus d'avantages de l'État que ce qu'ils versent en taxes et impôts (Dustmann & Frattini, 2014).

Au Canada, les sentiments sont moins polarisés, même si les études empiriques existantes n'ont ni dissipé les doutes ni clarifié le rôle de l'immigration dans un contexte de vieillissement démographique. Ceci est dû essentiellement à une gestion plus active du gouvernement à travers la sélection d'immigrants qualifiés. Cependant, le nombre relativement élevé d'immigrants reçus annuellement, environ 235 000 nouveaux arrivants par année entre 1990 et 2016 (Canada, 2016) et près de 350 000 en 2019 (Gouvernement du Canada, 2020, p. 39), suscite de vives réactions et des appels grandissants à explorer des sources alternatives de main-d'œuvre.

1.5. Source de main-d'œuvre alternative à l'immigration

Face au statu quo des débats sur l'augmentation de l'âge normal de la retraite et des quotas d'immigration, plusieurs suggèrent l'exploration de sources alternatives de main-d'œuvre. Au Canada, la loi sur l'équité en matière d'emploi vise à accroitre le niveau d'emploi des groupes désignés qui inclut les femmes, les peuples autochtones, les personnes handicapées et les minorités visibles. Ces groupes, pour des raisons autres que leurs qualifications et disponibilités, subissent des niveaux disproportionnés de sous-emploi.

Le sous-emploi fait référence à une situation où une personne manifeste la disponibilité et la volonté de travailler plus d'heures ou dans un emploi mieux adapté à ses qualifications (ILO, 2013). Dans le premier cas, on parle de sous-emploi visible (ou simplement sous-emploi) et dans le second, il s'agit du sous-emploi invisible (emploi inadéquat). Le sous-emploi constitue donc une sous-utilisation de la capacité productive de la population active et les personnes sous-employées pourraient constituer une source de main-d'œuvre alternative ou complémentaire à l'immigration. Il est donc d'une importance capitale d'identifier ces personnes et accroitre leur contribution à l'offre de travail en réduisant ou éliminant, le plus possible, les barrières qui occasionnent leur sous-emploi.

Si le sous-emploi est très peu discuté au Canada, il serait selon plusieurs le défi réel du marché de l'emploi canadien (Congress, 2014; Li et al., 2006). En effet, les signes du sous-emploi dans le pays sont palpables, par exemple, dans le nombre croissant de personnes travaillant à temps partiel, c'est-à-dire travaillant moins de 30 heures par semaine, parce qu'elles n'ont pas trouvé de poste à temps plein. De 12% dans les années 1970, la prévalence de l'emploi à temps partiel est passée à 19% dans les années 2010, tandis que la part des travailleurs à temps partiel involontaire a toujours été d'environ 25% de tous les emplois à temps partiel (OECD, 2020).

Le sous-emploi se reflète également dans l'augmentation du taux de chômage des personnes âgées de 55 ans et plus, suite à leur participation accrue au marché du travail. Par exemple, le taux d'activité des personnes âgées de 65 à 69 ans est passé de 15,6% en 1976 à 26,5% en 2018 alors que pendant la même période, leur taux de chômage a doublé, passant de 2,2% à 4,7% (Statistique Canada, tableau 14-10-0018-01). Ceci suggère que l'augmentation de l'offre de travail n'a pas été entièrement absorbée par l'économie.

Malgré ce constat, les statistiques officielles ne font état que de la prévalence de l'emploi à temps partiel involontaire sous le terme sous-emploi, excluant ainsi les chômeurs et les travailleurs à temps plein qui voudraient travailler plus d'heures. Il en résulte un décalage entre les chiffres officiels et les niveaux réels de sous-utilisation de la main-d'œuvre. Par

exemple, le taux de sous-utilisation de la main-d'œuvre le plus complet (R8) publié par Statistique Canada (Tableau 14-10-0077-01) fait état d'une moyenne de 10,5% entre 1997 et 2013 alors que Congress (2014) fait état d'environ 16% de sous-emploi sur la même période. Des chiffres similaires s'observent aussi dans d'autres pays, par exemple aux États-Unis où le Bureau of Labour Statistics (BLS) fait état d'un taux de sous-emploi de la main-d'œuvre d'environ 6,6% en février 2012, tandis que les sondages de Gallup indiquent que 18% à 25% des travailleurs américains se perçoivent comme sous-employés (Thompson et al., 2013).

Que ce soit au Canada ou ailleurs, le sous-emploi est non seulement sous-déclaré dans les statistiques officielles, mais aussi il reçoit relativement peu d'attention dans les recherches empiriques. Par conséquent, les études sur le sous-emploi sont presque inexistantes et les personnes sous-employées sont très peu connues. Le vieillissement de la population faisant craindre une pénurie de main-d'œuvre, il apparait primordial que l'offre additionnelle de travail que représentent les personnes sous-employées soit mesurée. Il est difficile sinon d'avoir une idée claire du niveau d'utilisation de l'offre de travail et donc du niveau réel de pénurie. Ce vide dans la littérature, et d'autres liés au rôle du vieillissement démographique dans une éventuelle pénurie de main-d'œuvre, contribue à engendrer des inquiétudes et discordes dans les débats sociaux, académiques et politiques. Cette thèse a été initiée entre autres pour combler ces lacunes.

D'abord, les études actuelles sont limitées quant à la quantification des effets du vieillissement démographique sur la main-d'œuvre. En fait, on sait peu de choses de ces effets, autres que la proportion de personnes diminue dans certains groupes d'âge au profit d'autres groupes. Mais il n'existe pas à notre connaissance une mesure suffisamment précise du niveau et de l'évolution de l'offre de travail capable d'éclairer sans ambiguïté les politiques publiques dans le contexte du vieillissement démographique.

Ensuite, bien que plusieurs auteurs aient souligné l'importance des changements de comportements individuels et l'existence de potentiel de main-d'œuvre non utilisé, les niveaux de ces facteurs et leurs effets sur la main-d'œuvre demeurent quasi inconnus.

Enfin, si les avis sont partagés quant à l'utilisation de l'immigration pour faire face aux conséquences du vieillissement démographique, c'est aussi, en partie, parce qu'il n'y a pas de consensus sur le coût fiscal de l'immigration. Ce dernier est basé sur des études du passé qui ne tiennent pas compte des changements récents dans la structure par âge de la population et dans les politiques d'immigration. L'objectif de cette thèse est, entre autres, d'actualiser l'analyse des coûts et contributions des immigrants comparés aux natifs vis-à-vis des transferts publics au Canada, en utilisant une nouvelle approche.

1.6. Objectifs de la thèse

Si le vieillissement démographique soulève des inquiétudes de pénuries de main-d'œuvre, alors il urge de quantifier l'ampleur de ses effets sur l'offre de travail. L'immigration étant le moyen le plus souvent mis de l'avant pour pallier les conséquences du vieillissement, il serait utile de mesurer sa contribution sur l'offre de travail, mais aussi son impact sur les finances publiques, pour juger de sa pertinence, et ainsi réduire certaines des contradictions dans le débat sur l'immigration. Aussi, les immigrants étant souvent victimes du sous-emploi, il serait utile dans un contexte de vieillissement des populations d'explorer l'ampleur du phénomène ainsi que la perte de main-d'œuvre qu'il occasionne.

Cette thèse propose donc de quantifier l'effet du vieillissement démographique sur la main-d'œuvre, d'évaluer le coût fiscal de l'immigration comme moyen de pallier une pénurie, et d'explorer le potentiel des personnes sous employées comme source de main-d'œuvre alternative ou complémentaire à l'immigration. Ainsi, cette thèse entend contribuer aux connaissances nécessaires pour alimenter les discussions de politiques publiques face au vieillissement de la population canadienne.

Dans un premier temps, cette thèse tentera d'isoler l'effet des facteurs perturbateurs (que sont les comportements individuels et l'immigration) pour mieux comprendre celui du vieillissement démographique sur la croissance de la main-d'œuvre. Les effets du vieillissement sur la main-d'œuvre seront évalués à deux niveaux. Pour l'individu, le vieillissement se traduit par l'augmentation de l'espérance de vie et nombreux sont ceux qui proposent l'augmentation de l'âge d'éligibilité à certains programmes sociaux, suivant l'argument que les cohortes récentes travaillent moins longtemps pour financer une retraite plus longue. Dans un premier article, cette hypothèse sera examinée en analysant l'évolution de la durée de vie au travail, l'évolution de cette durée par rapport à celle de l'espérance de vie sous l'effet de la mortalité, de la participation au marché du travail et des heures travaillées. Les résultats devraient favoriser une discussion plus éclairée sur la hausse de l'âge normal de la retraite dans le but de pallier un ralentissement ou une stagnation de la croissance de la main-d'œuvre au Canada au cours des prochaines décennies.

Au niveau agrégé le vieillissement se traduit par un changement de la distribution par âge de l'offre agrégée de travail. Le deuxième chapitre mesurera l'offre agrégée de travail au Canada pour les immigrants et les natifs, en fonction de la structure par âge de la population, des taux de participation au marché du travail et des heures travaillées. La décomposition de l'accroissement de l'offre agrégée de travail observé de 1981 à 2016 entre ces trois facteurs permettra d'isoler l'effet du vieillissement démographique au cours de cette période. Ce chapitre apporte deux contributions à la littérature. D'abord il quantifie la contribution du vieillissement à l'offre agrégée de travail au Canada. Une mesure qui est jusqu'à maintenant limitée à l'augmentation des personnes âgées dans la population. Le chapitre apporte également plus de détails sur le rôle de l'immigration dans la constitution de la main-d'œuvre au Canada, et ceci au-delà des quotas d'immigration ou de l'effectif de la population immigrante. Ces contributions sont rendues possibles, d'une part par la prise en compte simultanée des composants démographiques et comportementaux, et d'autre part par

l'application du modèle du changement continu qui a permis de distribuer le changement dans l'offre de travail entre ces différents facteurs.

Si l'immigration contribue significativement à la croissance de l'offre de travail au Canada, son rôle dans l'économie en général et sur les finances publiques en particulier est souvent controversé. Afin d'apporter plus de lumière sur le rôle de l'immigration sur les finances publiques, un deuxième article mesurera la contribution nette des immigrants aux finances publiques par rapport aux natifs. Toutefois, il est primordial que les discussions autour de l'immigration ou de l'âge de la retraite dans le but de pallier une pénurie de main-d'œuvre prennent en compte le potentiel considérable des personnes sous-employées.

L'analyse du sous-emploi relève de deux motivations principales. La première motivation découle des controverses liées à l'immigration comme le remède le plus souvent utilisé pour faire face aux conséquences du vieillissement démographique. En effet, le nombre relativement élevé d'immigrants reçus annuellement suscite parfois de vives réactions et des appels grandissants à explorer des sources alternatives de main-d'œuvre. Le manque à gagner du sous-emploi apparait donc comme une source potentielle alternative ou complémentaire à l'immigration qui mérite d'être examinée. La deuxième motivation relève des différences immigrants-natifs sur le marché du travail. En effet, si le rôle des immigrants pour faire face aux conséquences du vieillissement démographique est controversé, c'est aussi parce que ceux-ci sont souvent victimes de sous-emploi, un phénomène qui touche toute la population canadienne, tant immigrante que native. Au vu de ces raisons, l'analyse du sous-emploi apparait primordiale non seulement pour évaluer son potentiel à pallier une pénurie éventuelle de main-d'œuvre, mais aussi pour réduire les inégalités sur le marché du travail.

Cette étude utilise plusieurs méthodes, notamment une adaptation de la méthode de Sullivan (Sullivan, 1971) pour estimer la durée de vie au travail et le modèle de changement continu (Horiuchi et al., 2008) pour décomposer les changements dans l'offre de travail entre 1981 et 2016, ainsi que la différence de coût fiscal entre les immigrants et les natifs. Elle s'est

également appuyée sur l'optimal matching et l'analyse des clusters pour concevoir un cadre conceptuel d'analyse du sous-emploi. Ces méthodes sont appliquées à des données provenant de diverses sources. Les sources de données comprennent les recensements, les estimations de populations, les enquêtes sur la main-d'œuvre, la santé, et la consommation, et couvrent le Canada et les États-Unis.

Pour terminer, nous discuterons dans un dernier chapitre les résultats précédents, leurs contributions aux débats tant sur l'immigration que sur le vieillissement démographique, ainsi que certaines de leurs implications pour les politiques publiques. Les différents chapitres et articles de cette thèse abordent ces débats sous plusieurs angles indépendants. Mais ensemble, ils constituent un cadre conceptuel d'analyse qui renseigne les politiques publiques dans un contexte de vieillissement des populations au Canada et ailleurs. Ce cadre évalue les effets du vieillissement démographique sur l'offre de travail, analyse l'opportunité des solutions les plus débattues et propose une alternative ; chacune de ces étapes comblant un vide ou une lacune dans la littérature existante. Le tableau suivant résume ce schéma sous forme de littérature-lacune-apport.

Tableau 1
Pallier aux effets du vieillissement démographique sur l'offre de travail: Cadre conceptuel d'analyse

Littérature	Lacune	Apport
Étape 1: Évaluer la réalité du vieillissement de la population		
Les changements démographiques sont à l'origine des craintes de pénurie de main-d'œuvre et de pression sur les finances publiques.	Mais face au changement aussi important dans les comportements individuels de même que l'apport continuel de l'immigration, l'effet isolé du vieillissement des populations n'est pas toujours clarifié et il se pourrait qu'il y ait plus de peur que du mal.	Quantifier les effets du vieillissement sur la main-d'œuvre et les finances publiques apparait donc primordial à toute discussion des solutions potentielles.
Étape 2: Analyser l'opportunité des solutions proposées		
En tête de liste des solutions proposées pour pallier les effets du vieillissement arrive l'augmentation des quotas d'immigration et de l'âge normal de la retraite.	Mais l'opportunité de ces solutions est vivement contestée. L'immigration par exemple aurait un effet négatif sur les finances publiques et ne serait donc pas adaptée comme moyen privilégié de pallier les pénuries de main-d'œuvre.	Les études mettant en lien l'immigration et les finances publiques dans un contexte plus récent étant limitées au Canada, il est nécessaire d'actualiser la littérature sur la base des données plus récentes.
Étape 3: Identifier des solutions alternatives		
Moins discuté dans le contexte du vieillissement démographique est l'apport potentiel des personnes sous-employées.	Mais le sous-emploi serait selon plusieurs le défi réel du marché de l'emploi au Canada et sa réduction pourrait rivaliser avec l'immigration pour pallier les pénuries éventuelles de main-d'œuvre.	Il est donc nécessaire d'estimer l'étendue du sous-emploi ainsi que l'offre de travail additionnelle que cela représente.

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Chapitre 2

Brève présentation des méthodes et sources de données utilisées

Dans ce chapitre, nous présentons brièvement les méthodes et données utilisées tout au long de la thèse, laissant le détail aux articles et chapitres individuels. Le premier article introduit le concept de durée de vie au travail qui représente l'offre individuelle de travail sur un cycle de vie hypothétique. Cette mesure est comparable à l'espérance de vie, mais à la différence que les taux de participation au marché du travail(taux d'activité) et les heures travaillées sont pris en compte. D'une part, la durée de vie au travail est estimée sur la base de la méthode Sullivan (Sullivan, 1971) pour chacune des années entre 1981 et 2016, afin d'analyser son évolution dans le temps. D'autre part, le changement total de la durée de vie au travail entre 1981 et 2016 est décomposé en effet de structure et de comportement, selon le modèle de changement continu de Horiuchi et al. (2008).

2.1. La méthode Sullivan

La méthode originellement proposée par Sullivan (1971) avait pour but d'estimer un indicateur unique de mortalité et de morbidité. Elle représente une adaptation de la table de mortalité classique qui au lieu d'utiliser seulement les nombres d'années vécues entre deux âges La dans la détermination de l'espérance de vie à l'âge a, les combine par simple

multiplication aux probabilités par âge de vivre dans un état de morbidité d'intérêt. Appliquant le même concept, on obtient les nombres d'heures vécues au travail par âge (wLa), en multipliant les nombres d'années vécues entre deux âges (La), par les taux d'activité (wpa) et les nombres d'heures travaillées(wha) correspondantes. Ainsi, la durée de vie au travail à un âge a est donnée par:

$$WLDa = \frac{wTa}{Sa} = \frac{\sum_{i=a}^{70+} wLi}{Sa} = \frac{\sum_{i=a}^{70+} (Li \times wpi \times whi)}{Sa} \tag{2.1.1}$$

Avec Ta le nombre d'années restant à vivre à l'âge a, Sa le nombre de survivants entre les âges a et $a+1$. Tout comme l'espérance de vie, la durée de vie au travail est exprimée en année, en faisant l'hypothèse qu'une année de travail correspond à 2000 heures de travail, c'est-à-dire, 40 heures par semaine sur une période de 50 semaines.

2.2. Le modèle de changement continue

Le modèle de changement continu (MCC) développé par Horiuchi et al. (2008) permet de décomposer la différence entre deux mesures récapitulatives issues du même processus en un certain nombre de composantes, chacune représentant la contribution des facteurs sous-jacents au processus. Le processus est une fonction f, prenant comme arguments les valeurs des facteurs (covariables ou variables indépendantes) et retournant une mesure récapitulative (la variable dépendante ou variable d'intérêt). Horiuchi et al. (2008) démontre qu'à mesure que les facteurs passent des valeurs $x_i(t_1)$ à $x_i(t_2)$ entre deux temps t_1 et t_2, la mesure récapitulative change de $f(x_i(t_1))$ à $f(x_i(t_2))$ et la différence entre ces deux mesures peut être décomposée en composantes additives c_i représentant la contribution des changements au sein de chaque facteur à cette différence. Ceci est traduit par l'équation (2.2.1).

$$f(x_i(t_2)) - f(x_i(t_1)) = \sum_i c_i \tag{2.2.1}$$

Avec $i = 1, 2, ..., n$ les facteurs en jeux. La décomposition est basée sur l'hypothèse que le changement de la covariable x_i se produit de manière continue ou graduelle selon une dimension temporelle réelle ou hypothétique $t_1 \rightarrow t_2$. Il fournit donc une justification raisonnable de l'additivité des effets des facteurs et de l'élimination des termes d'interactions même si le processus en question est une fonction non additive des covariables (Horiuchi et al., 2008, p. 786).

En d'autres termes, le modèle MCC introduit une fonction de décomposition g qui à l'aide d'une fonction de processus f transforme deux séries de covariables, les vecteurs $X(t_1)$ et $X(t_2)$ représentant les valeurs des covariables $X = (x_1,...,x_i...,x_n)$ aux temps t_1 et t_2 en une série de contributions ou d'effets, le vecteur $C = (c_1,...,c_i...,c_n)$. On peut donc écrire:

$$C = g(X,f) \tag{2.2.2}$$

Les séries X et C ayant les mêmes longueurs il en résulte une correspondance parfaite entre les facteurs et les effets, ces derniers pouvant faire l'objet de différents regroupements pour des fins d'analyse. De plus, l'idée de continuité implique que chaque élément c_i de la série C est obtenu par intégration selon l'équation:

$$c_i = \int_{x_i(t_1)}^{x_i(t_2)} \frac{\partial f(t)}{\partial x_i(t)} dx_i(t) \tag{2.2.3}$$

Dans la pratique, (2.2.3) est estimé par une intégration numérique où $\int_{x_i(t_1)}^{x_i(t_2)} d(t)$ est approximé par $\sum_{x_i(t_1)}^{x_i(t_2)} \delta(t)$, avec $x_{it} = x_i(t)$ la valeur d'un facteur i à un moment t.

Le modèle MCC constitue une meilleure alternative pour la méthode de standardisation souvent utilisée en démographie pour tenir compte des différences de structure de population dans la comparaison de mesures démographiques. En effet, le fait que la standardisation

nécessite une population tierce pour servir de standard la rend quelque peu moins robuste, car différents standards peuvent aboutir à différents résultats. Le modèle MCC résout ce problème et permet une décomposition directe et sans termes d'interactions entre les différents facteurs. Ceci ne veut pas dire que le modèle ignore les interactions entre les facteurs. Au contraire, les interactions (ou résidus dans le cadre de la régression) représentent une séparation incomplète des contributions de différents facteurs au changement total, et n'existent pas sous l'hypothèse de changement continue.

Le modèle MCC est utilisé à plusieurs endroits à travers cette thèse, notamment, pour évaluer l'impact de l'augmentation de l'espérance de vie sur la durée de vie au travail, pour isoler l'effet du vieillissement sur l'offre agrégée de travail, et pour éliminer l'effet perturbateur de la structure par âge de la population dans la comparaison des transferts publics entre immigrants et natifs. Dans chacun des cas, les contributions $C = c_1,...,c_n$ des facteurs sont obtenues en adaptant l'équation (2.2.2) aux particularités des entrées.

Dans le premier article, la mesure récapitulative est la durée de vie au travail $WLD = WLD_{a=0}$ et les covariables sont les valeurs par âge des taux de mortalité et de participation, ainsi que les heures travaillées. Quant à la fonction f, il s'agit de la table de mortalité adaptée par la méthode Sullivan qui transforme les facteurs en espérance de vie au travail (équation (2.1.1)). La décomposition de la différence entre les durées de vie au travail en 1981 et 2016 $WLD(2016) - WLD(1981)$ permet donc de trouver les contributions, $C = c_1,...,c_n$ de chaque facteur à cette différence.

Sur le plan agrégé, la mesure récapitulative étant l'offre agrégée de travail, le modèle MCC a permis d'isoler l'effet du changement de la structure par âge de la population (covariable d'intérêt) de celui de l'immigration et des comportements individuels de participation et d'heures travaillées (covariable perturbatrice ou de contrôles). Pour une année donnée, l'offre agrégée de travail L est estimée par la somme pondérée des heures travaillées annuellement par âge a et par statut de résidence r (wh_{ar}), par les taux d'activité (wp_{ar}), l'effectif total de la

population par âge (pop_r) et la proportion de la population (str_a) avec $r = (immigrant, natif)$. La fonction f peut donc être écrite comme suit:

$$L = \sum_r \sum_a (pop_r \times s_{ar} \times wp_{ar} \times wh_{ar}) = f(pop_r, str_{ar}, wp_{ar}, wh_{ar}) \tag{2.2.4}$$

Si le modèle et ses hypothèses semblent évidents pour les phénomènes temporels, comme dans les deux premiers cas, où la durée de vie au travail et l'offre agrégée de travail changent entre 1981 et 2016, il s'applique aussi également lorsque les changements se produisent dans une dimension purement hypothétique comme dans le troisième cas, où les covariables et les valeurs récapitulatives changent dans une dimension de natif à immigrant. Dans ce cas, le surplus d'immigrants $f(X_{ac}^{IMM}) - f(X_{ac}^{NAT})$ est décomposé sur la base de la fonction f permettant, le calcul du transfert par personne au niveau agrégé (la mesure récapitulative). Pour un compte de transfert c et un statut de résidence $r = (immigrant, natif)$, la valeur du transfert t par habitant, soit t_r^c, est donnée par la formule suivante:

$$t_r^c = \frac{\sum_a t_{ar}^c}{pop \times \sum_a str_{ar}} = f(str_{ar}, t_{ar}^c) \tag{2.2.5}$$

Où a représente l'âge et pop la population totale, str_{ar} les proportions de population et t_{ar}^c les transferts estimés par la méthode des comptes nationaux de transfert (NTA), décrite dans la section suivante.

L'utilisation du Model MCC pour décomposer le surplus de transfert public entre immigrant et natif a permis l'élimination des différences démographiques qui biaisent la contribution des différents comptes de transferts à ce surplus. Ce qui ne serait pas possible juste par l'analyse des transferts par personne. En effet, les transferts publics étant intergénérationnels, c'est-à-dire que les ressources sont collectées auprès de la population en âge de travailler (les transferts sortants) et réaffectées à la population dépendante, principalement les jeunes et les personnes âgées (les transferts entrants), ils sont sensibles à la structure par âge de la

population. Or la moyenne par habitant tient compte seulement de la taille de la population, mais pas de sa structure par âge, alors la comparaison basée sur les valeurs par personne est biaisée dans la mesure où les deux populations ont des structures d'âge différentes. Toutes choses égales par ailleurs, les valeurs par personne permettent de comparer un immigrant et un natif sans distinction d'âge alors que les valeurs ajustées comparent un immigrant à un natif de même âge.

2.3. L'approche des Comptes Nationaux de Transfer (NTA)

Le deuxième article utilise la méthode des NTA pour estimer l'impact fiscal total de l'immigration et sa répartition par âge du cycle de vie pour les immigrants et les natifs. La méthode NTA introduit l'âge dans le Système de comptabilité nationale (SCN) en ventilant le revenu national, la consommation et l'épargne par âge, afin de tenir compte des transferts intergénérationnels effectués par l'État ou la famille. Les NTA partent du principe qu'à chaque âge a du cycle de vie, la consommation C_a est financée par les revenus disponibles $[YL_a + YA_a] - S_a$ (revenu de travail plus revenu des actifs moins l'épargne), les transferts privés provenant de la famille $[TFI_a - TFO_a]$ et les transferts publics provenant des administrations publiques $[TGI_a - TGO_a]$. D'où l'équation:

$$C_a = [YL_a + YA_a] - S_a + [TFI_a - TFO_a] + [TGI_a - TGO_a] \tag{2.3.1}$$

Cette identité crée le lien entre les agrégats publics du Système de Comptabilité Nationale (SCN) et le cercle familial des ménages, où s'effectuent la plupart des transferts intergénérationnels. Le cadre conceptuel actuel des NTA, tel que présenté dans le manuel "National Transfer Accounts Manual: Measuring and Analysing the Generational Economy" (Nations, 2013), permet entre autres de mesurer les comptes (et sous comptes) du solde fiscal $[TGI_a - TGO_a]$ par habitant sur le cycle de vie. Au Canada, les comptes NTA y compris les comptes du solde fiscal sont estimés par Mérette and Navaux (2019) pour chacune des années entre 1997 et 2015. Cet article ira plus loin en départageant les comptes du solde fiscal par

statut de résidence. Pour un compte de transfert c et un statut de résidence r donnés, le transfert total T_c^r (ajusté) à l'âge a est donné par:

$$T_{ac}^r = \hat{T}_{ac}^r \times \frac{T_{ac}}{\sum_r \hat{T}_{ac}^r \times S_a^r} \tag{2.3.2}$$

Ainsi, le transfert total des immigrants T_{ac}^{IMM} à l'âge a est donné par:

$$T_{ac}^{IMM} = \hat{T}_{ac}^{IMM} \times \frac{T_{ac}}{\hat{T}_{ac}^{IMM} \times S_a^{IMM} + \hat{T}_{ac}^{NAT} \times S_a^{NAT}} \tag{2.3.3}$$

Les $\hat{T}_{ac}^r$, ($\hat{T}_a^{IMM}$ et $\hat{T}_a^{NAT}$) représentent les séries des profiles par âge de transfert non ajusté, et T_{ac} est le transfert total à l'âge a. Le transfert total des natifs T_{ac}^{NAT} peut donc être obtenu en soustrayant le transfert des immigrants du transfert total.

$$T_{ac}^{NAT} = T_{ac} - T_{ac}^{IMM} \tag{2.3.4}$$

Ce sont ces séries de transferts T_{ac}^r qui seront comparées entre immigrants et natifs pour évaluer l'impact fiscal de l'immigration. Plusieurs indicateurs seront utilisés à cet effet. Notamment, les différences immigrant-natif, ainsi que le solde, de transferts reçus et versés. La prise en compte des différences dans la structure par âge des sous-populations immigrante et native permettra aussi d'isoler l'effet des différences démographiques de cette comparaison.

2.4. Le Cadre Dynamique d'Utilisation du Travail

L'Organisation internationale du Travail (OIT), défini les personnes sous-employées comme celles qui durant une courte période de référence ont le désir et la disponibilité de travailler un nombre additionnel d'heures, et dont les nombres d'heures travaillées est en dessous d'une limite donnée. Mais, alors que l'OIT fixe les normes conceptuelles, les aspects pratiques de l'analyse du sous-emploi sont encore peu, voire jamais, mis en œuvre (Sugiyarto, 2008), et ceci

parce que plusieurs lacunes du cadre d'utilisation du travail existant limitent leur application. Au nombre des ces limites se trouvent l'utilisation de la semaine comme période de référence; la recherche des sous-employés uniquement parmi les travailleurs à temps partiel; et l'absence d'une approche systématique de détermination du seuil de sous-emploi. Le DLUF remédie ces limites en adoptant l'année comme période de référence, la durée du chômage et de l'emploi à temps partiel involontaire comme degré de volonté et de disponibilité de travailler, et l'analyse des clusters pour individualiser les seuils de sous-emploi.

D'abord, l'utilisation de l'année comme période de référence fournit une mesure plus complète de la participation individuelle au marché du travail en combinant la charge de travail hebdomadaire avec le nombre de semaines travaillées, ce qui élimine la nécessité d'accorder une attention particulière aux emplois partiels, temporaires, saisonniers et permanents. Ensuite, Le DLUF classe chaque personne active comme *potentiellement sous-employée* (PUE) et *probablement pleinement-employée* (PFE) en fonction de leurs comportements sur le marché du travail, soit la durée de leur période de chômage et d'emploi , et si l'emploi était à temps plein, à temps partiel volontaire ou à temps partiel involontaire. Enfin, un seuil de sous-emploi est attribué à chaque personne PUE, en sélectionnant par analyse des clusters les personnes PFE qui lui ressemblent le plus sur la base des caractéristiques sociodémographiques. Puis utilisant la moyenne des heures travaillées au sein du cluster comme seuil, la personne PUE est classée comme *sous-employée* (UE) ou *pleinement employée* (FU) selon que sa charge de travail annuelle est inférieure à ce seuil ou non. L'article 3 présente la méthode plus en détail suivie d'une application avec les données des États-Unis, et l'article 4 utilisera cette méthode pour analyser le sous-emploi et déterminer l'apport potentiel des personnes sous-employées comme source de main-d'œuvre au Canada.

2.5. Les Indicateurs de sous-emploi

Sur la base du Cadre Dynamique d'Utilisation du Travaill, plusieurs indicateurs de sous-emplois seront utilisés pour analyser le sous-emploi aux États-Unis et au Canada. Deux

indicateurs principaux seront utilisés dans ces analyses. D'une part, le taux de sous-emploi (TSE) utilise le nombre de personnes travaillant en dessous de leur seuil. D'autre part, le taux de sous-utilisation de la main-d'œuvre (TSU) utilise les heures supplémentaires requises pour le plein emploi.

Le TSE mesure la prévalence exprimée en pourcentage du sous-emploi, calculé de manière analogue au taux de chômage, en divisant le nombre de personnes sous-employées par la population active. Étant calculé à partir du nombre de personnes sous-employées, le TSE exprime le degré de propagation du phénomène, mais dit peu sur l'offre de travail correspondante. Le taux de sous-utilisation de la main-d'œuvre (TSU) comble cette lacune. Ce taux est calculé à partir des heures au lieu du nombre de personnes et par conséquent renseigne sur l'intensité du sous-emploi. Le TSU divise l'offre additionnelle de travail des personnes sous-employées par l'offre totale que travailleraient tous les participants au marché du travail en plein emploi au cours de l'année de référence. Il faut noter que l'offre de travail additionnel des personnes sous-employées (article quatre) est mesurée au Canada, relative à l'offre actuelle de travail (sous et pleins employés) alors que le TSU présenté ci-dessus et mesuré aux États-Unis (article trois) est relative à l'offre potentielle de travail (plein employé). Toutes choses égales par ailleurs, la première mesure est légèrement supérieure à la dernière, mais les deux sont essentiellement équivalentes.

Le TSE et TSU nécessitent, tous deux, des variables relatives aux écarts d'heure et au statut de sous-emploi. L' écart d'heure est la différence entre le seuil et les heures travaillées annuellement. Il représente donc le nombre d'heures supplémentaires nécessaires à une personne sous-employée pour atteindre son plein emploi. Le statut de sous-emploi est dérivé d' écart d'heures et codé avec 1 (Oui, pour sous-emploi) si l' écart d'heure est positif et 0 (Non, pour plein emploi) sinon. Ces variables proviennent, ou sont construites à partir, de plusieurs enquêtes.

2.6. Les sources de données

Les données utilisées pour la réalisation du cette recherche incluent les tables de mortalité, les taux d'activité, les heures annuellement travaillées, les recensements et estimations de population, de même que les transferts publics pour immigrants et natifs. La durée de vie au travail estimée dans le premier article fait usage des tables de mortalité provenant du HMD (2020) en les combinant avec les taux d'activité et les heures annuellement travaillées.

Dans ce article, les taux d'activité proviennent principalement du tableau 14-10-0327-01 (Caractéristiques de la population active selon le sexe et le groupe d'âge détaillé, données annuelles) de Statistique Canada. Cependant, étant estimée à partir de l'Enquête sur la population active, cette source ne fait pas de différence entre immigrants et natifs nécessaire pour estimer le nombre de nouveaux immigrants qui fournirait la même offre de travail agrégée que les personnes sous-employées dans l'article 4. Pour ce faire, les taux d'activité par statut de résidence sur la période de 2006 à 2016 sont extraits du tableau : 14-10-0083-01 (anciennement CANSIM 282-0102) de Statistique Canada, et l'estimation du nombre d'immigrants est restreinte à cette période.

Pour mesurer l'effet du vieillissement sur l'offre agrégée de travail dans le chapitre 3, il a été nécessaire de distinguer les taux d'activité par groupe d'âge et par statut de résidence, pour toutes les années entre 1981 et 2016. Pour ce faire, nous avons utilisé les variables sur le statut d'emplois issus des recensements de la population entre 1981 et 2016 pour estimer les taux d'activité par groupe d'âges de 5 ans et par statut de résidence. Ensuite, nous avons procédé à une régression linéaire à l'intérieur de chaque groupe d'âge et statut de résidence pour calculer les valeurs pour les années entre deux recensements.

Au Canada, les heures annuellement travaillées proviennent des enquêtes supplémentaires à l'enquête sur la population active (EPA) de Statistique Canada. Il s'agit de l'enquête sur les finances des consommateurs (EFC) de 1981 à 1998, l'enquête sur la dynamique du travail et du revenu (EDTR) de 1996 à 2011, et l'enquête canadienne sur le revenu (ECR) de 2012 à 2016.

Alors que l'EPA est réalisée mensuellement, ces enquêtes sont réalisées annuellement et les variables sont conçues pour rendre compte des caractéristiques de la population active au cours de l'année civile antérieure. À quelques différences près, dans la méthode d'échantillonnage, ces enquêtes abordent le même thème et les variables centrales sont comparables dans le temps. L'EFC, l'EDTR et l'ECR se sont succédé dans le temps, chacune améliorant et remplaçant l'enquête précédente et, par conséquent, prise ensemble, elles offrent une perspective de long terme et approfondie du marché du travail canadien tout au long de son processus de vieillissement. Elles constituent les sources principales de données pour les heures travaillées et autres variables sociodémographiques, sauf pour l'article 3 où elles sont complétées par les données provenant des enquêtes ASEC (Annual Social and Economic Supplement) et CPS (Current Population Survey) fournies par IPUMS-CPS (2020). Les ASEC sont des enquêtes annuelles supplémentaires aux CPS aux États-Unis tout comme l'EFC, l'EDTR et l'ECR le sont pour l'EPA au Canada.

Mis à part les heures annuellement travaillées, l'EFC, l'EDTR et l'ECR sont aussi les sources de données des transferts en espèce reçus par les individus et les ménages, des contributions à l'assurance sociale, et des impôts sur le revenu (des personnes et entreprises) pour les immigrants et les natifs. À ces données s'ajoutent celles des taxes à la consommation d'une part et les dépenses d'éducation et de santé d'autre part, pour estimer les profils de transferts publics non ajustés pour immigrants et natifs ($\hat{T}^r_{ac}$) respectivement. Les taxes à la consommation incluent les taxes sur les produits et services issues de l'enquête sur les dépenses des ménages (EDM) de 2010. Les profils d'éducation sont estimés sur la base des personnes inscrites aux études par âge et statut de résidence issue des recensements de la population. Quant aux profils de santé, ils sont estimés sur la base du nombre de visites médicales (toutes causes confondues) issues de la composante annuelle de l'enquête sur la santé dans les collectivités canadiennes (ESCC).

L'ajustement des transferts publics $\hat{T}^r_{ac}$ en T^r_{ac} est réalisé à l'aide des équations (2.3.2) et (2.3.3) en utilisant les séries de transferts ajustées au niveau national estimées par Navaux and

Mérette (2020) d'une part, et les estimations de population d'autre part. Les estimations annuelles de population sur l'ensemble de la période étudiée ont fait l'objet d'une commande spéciale auprès de Statistique Canada dans le cadre de ce projet. Elles nous renseignent sur les effectifs de population par année, âge et statut de résidence. Les estimations de population sont également utilisées dans le chapitre 3 pour estimer l'offre de main-d'œuvre agrégée.

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Premier article.

Population Aging and Worklife Duration in Canada

par

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ABSTRACT. Population ageing has brought concerns that the added years of life are predominantly being spent in retirement, contributing to a labour shortage and pressure on public finances. These concerns, however, usually omit an appropriate account of the changes in labour force participation and hours worked (behavioural components), factors that could be playing toward or against the tides of populating ageing (structural components) throughout the lifecycle.

This paper estimates worklife duration, an expected labour supply that incorporates mortality, labour participation and workload (hours worked) at each age, and analyzes the Worklife ratio, the share of life expectancy devoted to working. It also decomposes the changes in worklife duration into demographic and behavioural components, thus isolating the contribution of population ageing to the change between 1981 and 2016.

"Results suggest that worklife duration has not declined as the population has aged. Instead, we found that between 1981 and 2016, worklife duration increased by 4,96 years while its ratio to life expectancy increased by 3,55 percentage points. Labour force participation has been the main driver of these changes contributing, 3,57 years against 0,73 and 0,65 years for workload and mortality, respectively.

These results bring counterarguments into the ongoing debate in Canada to increase the retirement age in the name of shrinking working life duration to finance increasing life expectancy.
Keywords: Worklife Duration, Population Aging, Individual behaviour

1. Introduction

Population ageing raises concerns about labour shortages and the sustainability of public finances in most OECD countries. To many, a *one stone two birds* policy would be to increase the age at which individuals collect a full public pension (hereafter referred to as normal retirement age). On the one hand, such a policy would induce workers to stay longer in the labour market and, on the other hand, enhance public finance sustainability by delaying or reducing pension payments. Over the last two decades, many countries have used this reasoning for passing legislation to increase the normal retirement age or the number of contribution years to collect a full pension. In Canada, however, while most scholars and politicians agree on measures to promote the labour involvement of older adults, increasing

the age requirement for a full public pension benefit, on the other hand, is often a source of heated debates and discords.

1.1. The debates on increasing the retirement age

In Canada, while there has been no policy to increase the normal retirement age since the inception of the CPP/QPP (Chawla & Wannell, 2004), recent studies have been contradictory in their results and policy recommendations. On the one hand, studies analyzing some variants of dependency ratio tend to recommend an increase of the normal retirement age as the share of the dependent population increases (D'Amours et al., 2013; Hering & Klassen, 2010; Institut Canadien des Actuaires, 2019). For example, Hering and Klassen (2010) suggest that increasing the normal retirement age would significantly improve the fiscal sustainability of the CPP (Canada Pension Plan) and essentially solve the financing problems of the QPP (Quebec Pension Plan). On the other hand, studies focussing on the number of years spent in retirement see no reason for such policy, given that individuals are already delaying their retirement (Carrière & Galarneau, 2011; Carrière et al., 2015; Gomez & Gunderson, 2009; Lefebvre et al., 2012). For example, Carrière et al. (2020) demonstrated that working life expectancy at age 50 is increasing much faster than life expectancy and, therefore, saw no evidence of significant intergenerational inequity that increasing the normal retirement age would solve.

While these studies may diverge in their recommendation on increasing the normal retirement age, they have in common the little to no inclusion of changes in individual behaviour towards the labour market over the entire life cycle. This study contributes to the debates on policy responses to population ageing by accounting for labour participation and workload (hours worked) in estimating worklife duration, that is, the expected labour supply at age 15, from the individual perspective.

The paper brings three primary contributions to the debates. First, it estimates worklife duration as an expected labour supply that incorporates mortality, labour participation and

worked hours at each age; Second, it analyze the changes in worklife duration and worklife ratio (the share of life expectancy devoted to working) between 1981 and 2016. Finally, it decomposes the changes in worklife duration into demographic and behavioural components, thus isolating the contribution of population ageing to the change between 1981 and 2016. These contributions not only recognize the importance of the changes in individual behaviour over the last few decades but also provide a more precise estimate of the individual labour supply, a gap in the literature that contributes to discords in debates on policy responses to population ageing.

1.2. The changes in individual behaviours

Individual behaviours in the labour market have been changing along with the population age structure. Therefore, they could aggravate or mitigate the effect of population ageing on the labour supply. Fürnkranz-Prskawetz et al. (2005) illustrates the influence of behavioural components using data on five selected OECD countries from 1983 through 2000. The paper found that a change in age-specific labour force participation rather than a shift in age structure dominated the crude labour force rate changes. Individual behaviours in the labour market cover entry patterns at a young age, exit schedules at old age, and prime-age participation for men and women. Over the last few decades, these behaviours have changed significantly, especially among women, and so have their impacts on the lifecycle labour supply.

Today young Canadians are staying longer in school and thus postponing their entry into the labour market later than their parents did (Clark, 2007; Fleury, 2009). For instance, Clark (2007) found that in 1971, three-quarters of young adults had left school by age 22, whereas only half had left by that age in 2001. During roughly the same period, full-time employment among young men and women aged 17 to 24 and not in school full-year has changed from 76% for men and 58% for women to 59% and 49% respectively (Statistics Canada, Table: 14-10-0018-01).

At the other end of the lifecycle, life expectancy and health improvement have enabled delaying retirement to a greater extent than predicted (Carrière & Galarneau, 2011; Gomez & Gunderson, 2009; Lefebvre et al., 2012; Leinonen et al., 2015). For instance, the expected retirement age for all Canadian workers aged 45 and over increased from 59.2 years in 1994 to 62.9 years in 2002 (Gomez & Gunderson, 2009). That is a four-year[1] increase in 8 years, leading to a decline in the proportion of years in retirement (to life expectancy), from 55% to 48%.

The last four decades have also seen significant changes in labour participation among prime-age[2] adults (Black et al., 2017; Ketcheson et al., 2017; Moyser, 2017; Ruggles, 2015; Wilson & Jones, 2018). In Canada, labour participation among men aged 25 to 54 began decreasing in the 1950s (from 97.1% in 1950), a trend that continued steadily till the 2010s (to 90.9% in 2015). In contrast, participation among women increased by 60.4 percentage points (pp) during the same period, from 21.6% to 82.0%, narrowing the gender gap from 60 points in 1950 to 9pp in 2015 (Moyser, 2017).

While many studies have highlighted the changes in individual behaviours in the context of population ageing, they primarily have focused on labour force participation and rarely included worked hours over the lifecycle. However, the changes in workload could be as significant to policy response to population ageing as changes in labour participation. In the early 1900s, the workweek lasted 60 hours over six days before declining to 37-40 hours over five days in the 1960s (Sunter & Morissette, 1994). The decline continued through the 1980s, partially resulting from the increase in part-time employment (Dolton, 2017). Nowadays, part-time is the preferred work arrangement among students (Galarneau et al., 2013), workers aged 50 and over (Carrière & Galarneau, 2011), and a way for many women to reconcile work and family. In Canada, weekly hours changed from 42.3 hours for full-timers and 16.0 hours

[1]Perhaps due to difference in methodology or period of study, Lefebvre et al. (2012) found only an increase of only two years from 1994 to 2007.
[2]Prime-age adults refer to those well-passed schooling ages but still far from retirement. Some studies equate this group with those aged 35 to 54 while others use the ages from 25 to 54

for part-timers in 1976 to 40.8 and 18.3, respectively, in 2018 (Statistics Canada: Table 14-10-0043-01).

Following the changes in individual behaviour over the last four decades, defining *working age* is no longer as simple as delimiting age groups (Carrière et al., 2020; Carrière & Galarneau, 2011). Therefore, estimating the effect of population ageing on the labour supply must include as much of the lifecycle as possible. This paper aims to contribute to this task for Canada. It measures worklife duration (WLD) as the labour supply from the individual perspective and isolates the contributions of mortality, participation, and workload to the changes in WLD between 1981 and 2016.

1.3. Worklife duration in the literature

Several terms are used in the literature to refer to WLD. Among others are labour force expectancy, worklife expectancy, labour market life expectancy, duration of working life, the average length of working life, active life expectancy, etc. (Loichinger & Weber, 2016).

Some studies have focussed on worklife duration at older ages, attempting to answer policy concerns by analyzing the share of life expectancy at older ages (often 50 years old) spent working rather than retired (Carrière & Galarneau, 2011; Denton et al., 2009; Loichinger & Weber, 2016). For example, Denton et al. (2009) published cohort working life tables for Canadian men and women aged 50 and older, considering variation in mortality and participation by age. Loichinger and Weber (2016) accounted for variation of mortality and participation by age and education level in analyzing the ratio of working life expectancy at age 50 to life expectancy and healthy life expectancy for European countries.

While these studies provide insights into the time allocation at older ages, they are limited in guiding policy response to population ageing, as they leave aside essential parts of the lifecycle. In contrast, Eurostat has developed the *duration of working life* indicator covering most of the lifecycle to monitor the EU 2020 strategy on employment. The *duration of working*

life as used by Eurostat refers to the number of years a person aged 15 would expect to be in the labour market (i.e. employed or unemployed) throughout his or her life (Eurostat, 2019).

Another branch of the literature, perhaps the most common, provides Worklife tables as the basis for life insurers in tort compensation after an injury (Gilbert, 2018; Skoog et al., 2011). These tables integrate non-market labour in estimating worklife duration, which nearly equalizes men's and women's estimated lifetime total working years (Krueger & Slesnick, 2014). Like the Eurostat indicator, the measures of worklife duration from these tables account for most of the lifecycle. However, they are both limited to including labour participation, leaving aside workload.

In summary, estimations of worklife duration in the literature have accounted for behavioural components to some extent. However, they are primarily limited to including labour participation leaving aside workload. In other words, they merely measure *the spread* of labour attachment, leaving out *the depth* of the attachment, a dimension that would be accounted for by including workload. This research attempts to improve our understanding of the changes in working lifespan and the role of population ageing and individual behaviours over the last four decades. The paper uses an adaptation of Sullivan's method (Sullivan, 1971) to estimate worklife duration and the Model of continuous change (Horiuchi et al., 2008) to decompose its changes between 1981 and 2016. The following section describes these methods in detail.

2. Methods and data sources

Worklife duration measures the number of years a person can expect to devote to paid labour while accounting for mortality (life expectancy), labour participation, and workload (hours worked). Worklife Ratio (WLR) is the share of life expectancy that an individual will devote to paid work. By relating WLD to life expectancy over time, the trend in WLR provides valuable insights into the trend in the dependency ratio at the individual level. In these definitions, life expectancy reflects the mortality schedule derived from the traditional

lifetable. Participation refers to the individual probability of participation in the labour market, which is the ratio of those employed and unemployed over the population aged 15 and over, and workload refers to the average workload annually.

Building on period life tables, WLD and WLR for a given year describe working patterns of a synthetic or hypothetical cohort with the same mortality, participation, and workload as those observed in that year. In other words, a WLD of 25 years at age 20 for the year 2000 means that an individual could expect to work an additional 25 years if patterns of mortality, participation, and workload by age over the remaining life cycle follow the same distribution observed in the year 2000.

Including workload brings an additional precision level in estimating the labour supply. This paper uses the term WLD to account for this additional precision. Worklife duration is life expectancy (at work) that accounts for participation and workload on top of survival rates. Like Eurostat's indicator, it looks at the entire life cycle of active persons, rather than specific states or periods in the life cycle, such as youth unemployment or early withdrawal from the labour force (Eurostat, 2019). However, it goes beyond the lifecycle by integrating the depth of participation captured by the average workload at each age. Thus, it provides a better approximation for the labour supply at the individual level and a better basis for policies that involve individual work lives, such as increasing the retirement age.

2.1. Life and Worklife Tables

In the literature, two methods are commonly used to measure WLD. The simplest method has been to assume some reference age at which individuals exit from the labour market. For example, assuming workers qualify for a full public pension at age 65, WLD at 25 would be 40 (65-25) years. This approach has been common in the '70s, even though it vastly overestimates WLD. Since then, more sophisticated methods like the Markov Process Worklife Expectancy tables (MPWE) have appeared. These approaches account for mortality and participation, which in the case of MPWE tables, allows individuals to transit through various states (active

to non-active and vice versa) from one age to the next. A particular type of MPWE table is the LPE table which estimates WLD in terms of probabilities of being alive (L), participating in the labour market (P), and being employed (E) as opposed to unemployed (Ireland, 2010). LPE tables are built following Sullivan's method (Sullivan, 1971) for accounting for health status and mortality in estimating Healthy Life expectancy(HLE). The same method is used in this study to include labour participation rates and workload on top of mortality rates in estimating WLD.

WLD at age a is estimated by dividing the remaining hours to work (wTa) from age a, by the number of persons surviving at age a (Sa).

$$WLDa = \frac{wTa}{Sa} = \frac{\sum_{i=a}^{70+} wLi}{Sa} \tag{2.1}$$

where wLa is the number of person-hours worked between age a and age $a + 1$. Following Sullivan's approach, wLa is computed by multiplying the number of persons that lived (La) by the participation rate (wpa) and the workload (wha). Equation (2.1) is therefore re-written as:

$$WLD_0 = \frac{\sum_{a=0}^{70+} (La \times wpa \times wha)}{Sa} \tag{2.2}$$

2.2. Data sources and series

The La series are readily available in the Life tables data from the Human Mortality Database (HMD, 2020), and the wpa are extracted from Table: 14-10-0327-01 (Annual labour force characteristics by sex and detailed age group) of Statistics Canada. The wha series are the averages of the annual workload by age group during a given year. Annual workloads come from three series of annual surveys complementary to the Labour Force Surveys (LFS) of Statistics Canada. The surveys include the Survey of Consumer Finances (SCF) from 1981 to

1997, The Survey of Labour and Income Dynamics (SLID) from 1996 to 2011, and The Canadian Income Survey (CIS) from 2011 to 2016.

Over the years, these surveys have improved in various ways. However, they remain consistent in their central theme, thus providing a long and deep view of the Canadian labour market throughout its ageing process. The annual workload variable is unavailable for some years. In that case, the estimation multiplies the number of weeks worked and the number of hours usually worked per week for that year. The questions used in the three surveys to capture the number of weeks worked come in a few variants. A common one would be: *During 2013, how many weeks did you work at a job or business? Include vacation, maternity or parental leave, illness, strikes, and lock-outs.*. As for the number of hours usually worked per week, the question is some variant of *During those weeks, how many hours did you usually work per week at all jobs?*

The input data and resulting series have undergone several other processing, including synchronizing the age groups and converting WLD into work-year. For instance, *wpa* are available by age group of 5 years from age 15 to 69 and as a single group for those aged 70+. Therefore, the age groups for *La* and *wha* are combined accordingly. Also, since workload *wha* is the total number of hours worked annually, WLD is ultimately measured in hours. Therefore, to allow convenient conversion in years, a full-year at work is assumed to be equivalent to 2000[3] hours, at 40 hours per week for 50 weeks.

The three series of survey data cover only persons aged 15 and above. Therefore, individuals are assumed to have no participation or workload in the labour market before age 15. However, although not crucial in magnitude, WLD at later ages is still affected by mortality before age 15. It may be worth noting that the study uses Public Use Micro Files (PUMFs) hosted in the Odesi Scholar Portal (ODESI, 2020). While confidential files hosted by

[3]Although reasonable, converting one year into 2000 hours is arbitrary, and a different choice would result in a different WLD. Nevertheless, this does not affect the trends and relative changes in WLD as well as derived policy and social implication

Research Data Centers (RDCs) would have provided more granular data, we do not expect the results to change much.

2.3. Decomposition of change

The model of continuous change (Horiuchi et al., 2008) is used to decompose the difference in WLD at age 15 between 1981 and 2016 (the dependant summary measure) into additive effects resulting from the changes in the demographic and behavioural components (the covariates). The model assumes that changes in the covariates happen continuously or gradually, along an actual or hypothetical dimension rather than discretely. This assumption makes sense, particularly for demographic phenomena where change occurs naturally over time. It, therefore, provides a reasonable justification for the additivity of covariate effects and the elimination of interaction terms, even if the measure in question is a non-additive function of the covariates (Horiuchi et al., 2008, p. 786)

In equation (2.2), the La represents the demographic component of WLD and results from two factors. On the one hand, the vector qa contains the probabilities of dying between ages a and $a+1$. On the other hand, the vector ma contains the average number of years lived by those who died between ages a and $a+1$. Starting the worklife table at $So = 100\,000$ individuals, the Sa series are generated with the formula $Sa+1 = Si(1-qa)$ and since the ages a do not vary from one year to another, equation (2.2) can be written as:

$$WLD_0(t) = f(qa,ma,wpa,wha)(t) \tag{2.3}$$

or in more generalized form as:

$$WLD(t) = f(W(t)) \tag{2.4}$$

where W is the matrix of P components (qa,ma,wpa,wha) over L ages and f represents the worklife table function that transform W into WLD.

Based on Horiuchi et al. (2008, p. 792) the contribution to life expectancy at birth $e_0(t)$ for example, of death rate change in the i-th age group from the period t_1 to the next period t_2 can be calculated as:

$$c_i = \int_{M_i(t_1)}^{M_i(t_2)} \frac{\partial e_0(t)}{\partial M_i(t)} dM_i(t) \tag{2.5}$$

where $M_i(t)$ is the death rate for the i-th age group at time t. Extending this formula to include the additional behavioural components included in equation (2.4), we can write:

$$c_i = \int_{W_i(t_1)}^{W_i(t_2)} \frac{\partial e_0(t)}{\partial W_i(t)} dW_i(t) \tag{2.6}$$

where $W_i(t)$ represents the age-specific components for the i-th age group at time t. To conveniently integrate with the preceding, W from (2.4) need to be reshaped into a single vector of length N (N=PxL), with WLD_i ($i = 1, 2,..., N$) representing the age-specific components. The partial derivative in equation (2.6) is therefore obtained numerically from:

$$WLD(t) = f(W_i(t)) = g(W_1(t),W_2(t)...W_N(t)) \tag{2.7}$$

where g represents the worklife table function that transforms the covariates values, the vector $W_i(t)$ of length N=PxL into the vector $WLD(t)$ of length L, the summary values at a given time t. The function g is different from f only in the formats of its inputs but equivalent in its output series.

Computationally, the right side of equation (2.6) is estimated by numeric integration, that is approximating $\int_{W_i(t_1)}^{W_i(t_2)} d(t)$ with $\sum_{W_i(t_1)}^{W_i(t_2)} \delta(t)$, and assuming that covariate changes incrementally in T interval between t_1 and t_2 and proportionally to one another. Setting T to 12 to denote monthly changes from one year to another has been sufficient to reduce the overall approximation error to practically (6 decimal points) equal to zero.

The method is applied to each pair of consecutive years between 1981 and 2017, resulting in a total of 27 648 lifetables (for 12 intervals, 16 age groups, four components, and 36 pairs of years). Each worklife table provides a new WLD series resulting from the change from one month to another of a single component while holding all other covariates at their previous levels. Incremental decomposition between 1981 and 2016 provides the contribution of each age-specific component to the total change. It also enables to follow the trends in contributions over the entire period giving a glimpse of the next few years or decades.

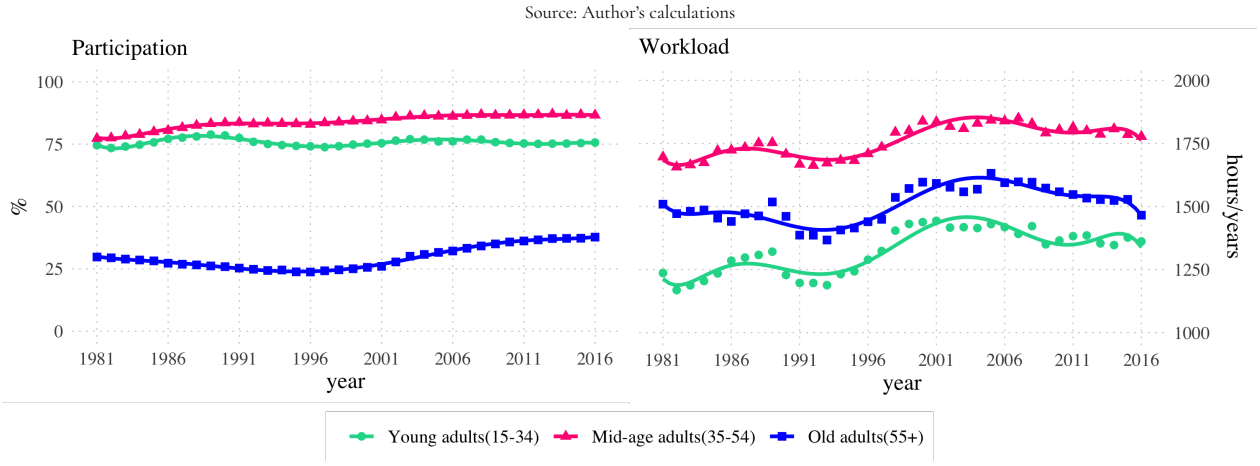
3. Changes in individual behaviours

As we aim to integrate personal behaviours into estimating WLD, it may be helpful to review the changes in personal behaviours that make their inclusion necessary. Figure 1 and Figure 2 show how participation and workload have changed over the past four decades.

3.1. Trends in Participation and Workload

In 1981, participation among the younger age group was very close to adults'. However, the two trends diverged as participation increased for mid-age adults but stagnated for the young. For instance, the labour participation rate has increased by about 9 percentage points (pp) between 1981 (77,3%) and 2016 (86,6%) for mid-age adults while the change was only 1 pp for young adults (from 74,6% to 75,7%). For those aged 55 and over, participation decreased slightly till the mid-1990s but increased consistently since then to reach 37,7% in 2016, an 8 pp increased compared to 1981 (29,8%).

Fig. 1
Labour participation rate and average workload by age group for both sexes combined, Canada 1981-2016



The decrease in labour participation experienced during the 1990s could be the result of the recession that affected most of the western world at that time. Despite this economic downturn, trends in participation have been quite linear over the years, while the trends in workload have followed a more agitated pattern, showing three distinct periods for all age groups. Between 1981 and 1990 workload has been relatively stable for mid-age adults while increasing slightly for young and older adults. During this period, workload averaged 1 235 hours for young adults, 1 699 hours for mid-age adults and 1 454 hours for old adults. However, when the recession hit in, it decreased remarkably for all age groups, with young and older adults being the most affected. After the recession, workloads increased rapidly, and by early 2000, the annual workload was about 1 423 hours for young adults, 1 829 hours for mid-age adults and 1 587 hours for old adults. Since then, workloads have dropped noticeably for young and old adults while stagnating for mid-age adults. In 2016 workload was about 1 361,5 hours for young adults, 1 777,5 hours for mid-age adults and 1 465,6 hours for old adults.

As we can see from these results, individual behaviours have changed so much that not accounting for these changes in estimating individual or aggregate supply would lead to

significant bias. Among others, three highlights arise from the changes in individual behaviours over the last four decades. First, although their labour participation has remained about the same between 1981 and 2016, young adults have had the most significant increase in workload during that period with 125 additional hours compared to 81 for mid-age adults and a decrease of 44 for old adults. Second, the labour participation of young adults was closer to that of the mid-age adults than the old adults. However, the opposite is true for their workload, which was closer to that of the old adults than the mid-age adults. These trends suggest that although schooling has remained their main activity, increased availability of part-time jobs has improved employability for the young. Finally, while the labour participation rate increased among old adults by about the same percentage point as for mid-age adults, more and more old adults are opting for part-time jobs in retirement or pre-retirement years, leading to a decrease in average workload. Nevertheless, as Carrière and Galarneau (2011) point out, the decrease in average workload was insufficient to offset the more significant effect of labour participation, leading to an increase in aggregated labour supply.

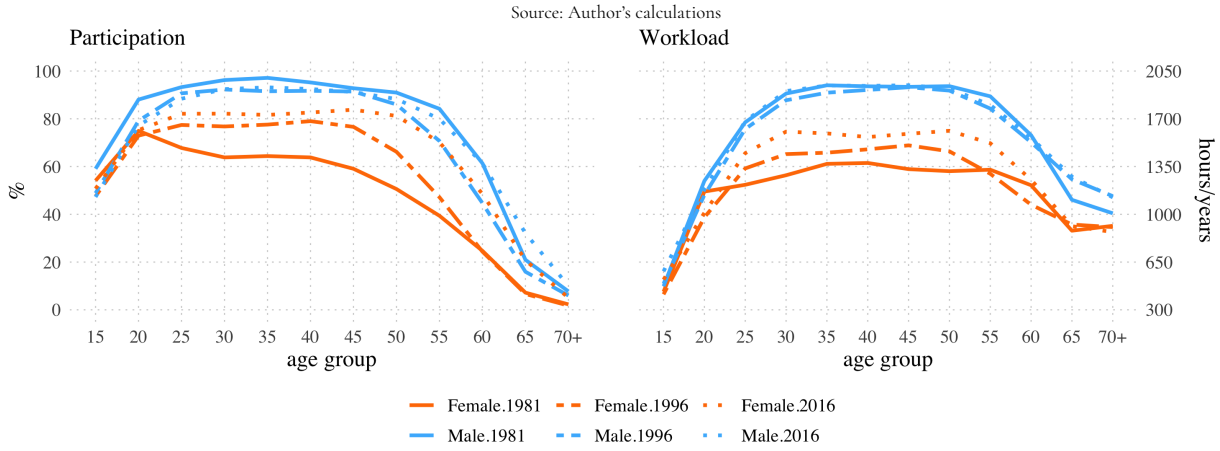
As one could have expected, given the transformation of the labour market over the 1970s, both labour participation and workload have increased visibly only among mid-age adults, mainly due to a higher involvement of women in the labour market. Therefore, these trends may be hiding significant differences between sexes and by age, as we shall see in the next section.

3.2. Participation and workload by age and gender

Previous studies have, quite well, described the tremendous change in women's involvement in the labour market over the last half-century. However, the lifecycle profile of these changes is less common in the literature. Figure 2 shows the labour participation rate and workload by age for a synthetic cohort in 1981, 1996, and 2016 for men and women. The year 1996 is included here as it marked the end of the recession in the early 1990s, a period where

unemployment and early retirement were exceptionally high in Canada (Amirault & Lafleur, 2000; Patrick, 2001). Comparing the profiles, we can see that the age profile of participation and workload has changed quite differently for men and women.

Fig. 2
Labour participation rate and average workload by age for men and women, Canada 1981-2016



For women aged 15 to 24, labour participation in 2016 was about the same as in 1981. From age 25, however, participation in 2016 vastly surpassed the levels in 1981, with the most significant gap (32.1 pp) observed for the 55-59 age group. For instance, while 71.0% of women aged 55-59 were in the labour market in 2016, only 38.9% were doing the same in 1981. In 2016, the maximum participation rate was observed among those aged 45-49 (83.6%), while in 1981, it was among those aged 20-24 (74.9%). It is also worth noting that before 1996, labour participation increased significantly among women under 45. From 1996 however, the bulk of the increase happened after age 45-49. This is probably due to a cohort effect rather than an age effect. As a large cohort of women enters the labour market, it increases the participation rate of the following age groups as it ages. Therefore lower age groups that do not receive a similar inflow of new entrants will see a decrease in the participation rate.

While the increase in participation among women was roughly linear through the studied period, the stagnation observed among men was less straightforward, as decreases in some

periods and age groups absorbed increases from other periods and age groups. For instance, while labour participation among men decreased between 1981 and 2016, Figure 2 suggests that the decrease happened mainly before age 60. For instance, labour force participation in 2016 is lower than in 1981 for men at all ages under 60, the sharpest drop (12 pp) occurring at age 15-19, from 59.2% in 1981 to 47.3% in 2016. However, from ages 60 and over, the trend reversed, and labour participation in 2016 has increased significantly, reaching 31.9% from 19.1% for those aged 65-69. If compared with the profile in 1996, the increase in participation at older ages is much more significant and started much sooner. In fact, labour participation decreased for men of all ages between 1981 and 1996, and much of the decrease happened among those aged 45-49 and over. From 1996 however, labour participation began to increase from age 50, surpassing its levels in 1996 and 1981 from age 55 and 65, respectively.

Interestingly, compared to 1981, the participation rate in 2016 decreased for those aged 15-19 by about the same amount that it increased for those aged 65-69, suggesting that the increased schooling among young adults is being compensated by delaying retirement among old adults. While such compensation may not have happened within actual cohorts, it is nevertheless relevant from an intergenerational perspective of time allocation. Also, the maximum labour force participation rate was reached in 2016 in the age group 40-44 (92.9%). In 1981 however, it was reached in the 30-34 age group (96.1%).

Not only has the age profile of participation among women changed between 1981 and 2016, but their age profile in workload also has increased steadily and significantly. Women's workload in 2016 vastly surpassed its level in 1981 for those aged 25 to 59, with the highest increase (365 hours per year) occurring within the age group 50-54. However, a drop (146 hours) occurred for those aged 20-24, while the workload stagnated after age 60. The profile in 1996 shows a drop from age 55, which has been regained at age 60 in 2016, resulting in stagnation. The stagnation of workload is even more prolonged for men, resulting in about the same age profile in 1981, 1996 and 2016. However, the drop mainly occurred around age 55, while those aged 60 and over experienced an increase. These trends suggest that

pre-retirement marked by a reduction in workload is happening earlier than before. At the same time, they confirm the pattern of delaying retirement suggested by their higher labour participation. This pattern could also be observed in the workload profile of 1996, suggesting that no noticeable change in workload has happened since then.

3.3. Changes in the gender gap

Overall, participation and workload followed different patterns for men and women between 1981 and 2016. In general, trends were increasing for women while decreasing or stagnating for men. Nevertheless, men have had greater participation and workload than women at any given age and period, even though the gap has narrowed considerably. For example, in 1981, the gap in participation rate between adult (aged 35-54) men and women was 34 pp (94% and 60%). By 2016 it reduced to only 9 pp (91% and 82%). Although less dramatic, the change in the workload gap was also significant. From 588 hours in 1981 (1 936 and 1 348 hours), the gap in workload among men and women aged 35-54 decreased to 349 hours by 2016 (1 945 and 1 596 hours).

These trends suggest that including workload on top of labour participation would add significant precision and thus is valuable for estimating labour supply and its changes over time. In the next section, we will look at the trend in WLD, a measure of individual labour supply over the life cycle, resulting from the interaction between mortality, participation, and workload.

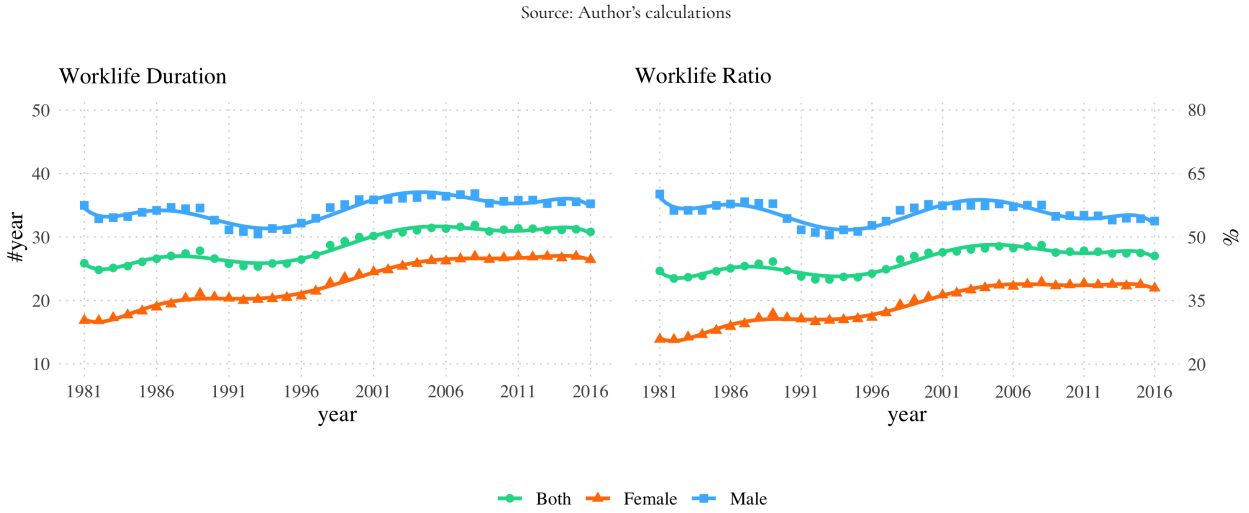
4. Worklife duration and ratio

4.1. Trends in Worklife Duration and Ratio

WLD results from the interaction between mortality, participation, and workload (hours worked). Because participation and workload by age have been changing in parallel with

mortality, the result of their interaction in the labour market is less obvious. Figure 3 presents trends in WLD and WLR between 1981 and 2016

Fig. 3
Trend in Worklife Duration and Ratio at age 15 for men, women and both sexes, Canada 1981-2016



Over the past four decades, WLD increased for women by 9,6 years, from 16,8 years in 1981 to 26,4 years in 2016. For men, WLD in 2016 just recovered about the same level in 1981, with only 0,25 year increase. As a result, WLD for both sexes combined increased by 4,96 years from 25,9 years in 1981 to 30,8 years in 2016. However, the changes were not monotone throughout the period, and the trends highlight four sub-periods. First, the period between 1981 and 1988 has seen a rapid change in WLD for women, from 16,8 to about 20,3 years, while it fluctuated slightly around 33,9 years for men. For the eight years that followed, WLD stagnated for women but decreased remarkably for men to about 31,2 years, the lowest throughout the entire period. During the decade 1996-2006, WLD increased for both sexes to reach 36,4 years for men and 26,2 years for women in 2006. Since then, WLD has stabilized for both sexes.

Although total WLD has increased over the last four decades, life expectancy has also increased. Therefore, how changes in WLD compare with life expectancy has been a source of much debate.

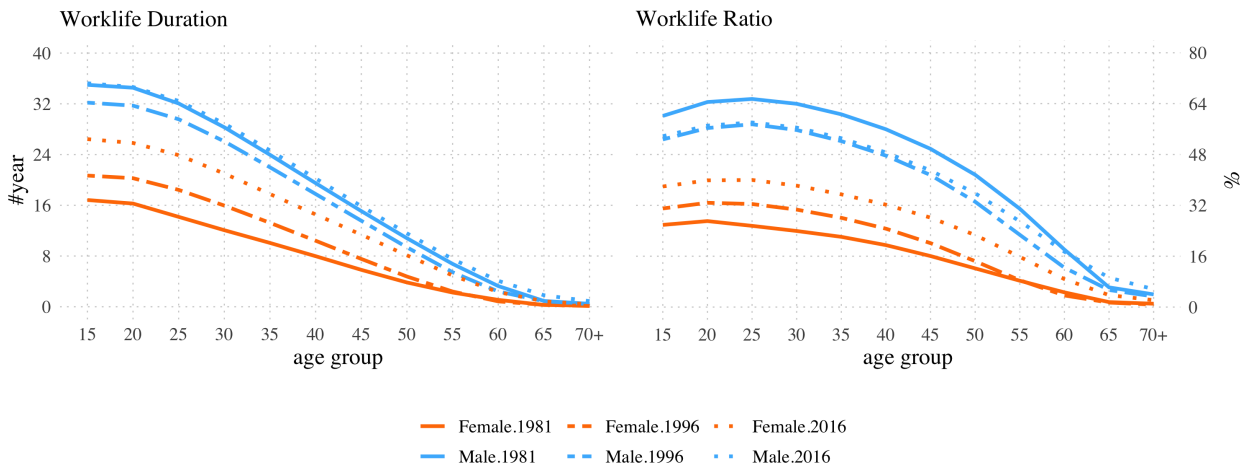
In 1981, men aged 15 would expect to devote about 60,1% of their lives to paid work. By 2016 that proportion fell to about 53,8%, a decrease of −6,38% points. Women on the other hand, have increased their WLR by 12,08 points, from 25,9% in 1981 to 37,9% in 2016. This increase, although very much related to the higher participation and workload, is partially due to a lesser gain in mortality for women. For instance, between 1981 and 2016, life expectancy at age 15 increased by 7.29 years for men (from 58.19 years to 65.48 years) but only 3.83 years for women (from 65.85 years to 69.68 years) (HMD, 2020). Therefore, despite a decreasing WLR among men, increasing trend among women resulted in an increased total WLR of 3,55 points from 42% to 45,5%. However, this overall improvement hides significant variations across ages, as shown in the next section.

4.2. Worklife duration and ratio by age and sex

Figure 4 compares WLD and WLR of a synthetic cohort in 1981 and 1996 to one in 2016 by age for men and women. While WLD by age among men in 2016 was about the same as in 1981, it has remarkably increased compared to 1996. For women at all ages of the lifecycle, WLD increased steadily between 1981 and 2016. The only exception is for women aged 50 and over, for whom an increase is apparent only after 1996. Throughout the studied period, the highest increase (10 years) happened at 25-29, from 14 years in 1981 to 24 years in 2016. These patterns are also reflected in their WLR, as the changes in the labour market dominated that of life expectancy for both sexes.

Fig. 4
worklife duration (WLD) and Ratio (WLR) by age for men and women, Canada 1981-2016

Source: Author's calculations



Comparing WLR profiles for men in 1981 and 2016, it appears that the decrease happened mainly before age 60. From age 60, however, WLR in 2016 surpassed that of 1981. For example, men aged 65-69 in 2016 could expect to work three percentage points (pp) more of their remaining lives than they would in 1981, as their WLR increased from 6% in 1981 to 9% in 2016. The trend suggests that the increase in WLD at age 65 between the two years was more significant than life expectancy. Also, this pattern appeared much sooner (at age 45-49) in the lifecycle if we compare WLR in 2016 and 1996. For women, the increase in WLR at age 15 resulted from an upward trend at all ages. However, the highest increase of 14pp is observed among those aged 25-29, going from 28% in 1981 to 42% in 2016.

In summary, the decrease or stagnation among men was primarily due to young and mid-age adults. In contrast, there was a noticeable increase among older men and women at all ages of the lifecycle. As a result, between 1981 and 2016 total WLD has increased by 4,96 years while WLR has increase by 3,55 pp. These results suggest that increased engagement in the labour market among women and old adults has compensated for the decrease among men and young adults. On the other hand, these changes have also compensated for improved mortality, contrary to what is often believed.

Furthermore, while women have historically had a higher life expectancy, men, on the contrary, have had a higher WLD and ratio than women due to their higher labour participation and workload. However, as trends in WLD and WLR increased for women but stagnated or decreased for men, the gap between men and women decreased considerably over the last four decades. The gap in WLD at age 15 in favor of men went from 18,17 years in 1981 to 8,81 years in 2016, while the gap in WLR decreased from 34,28 pp in 1981 to only 15,82 pp in 2016.

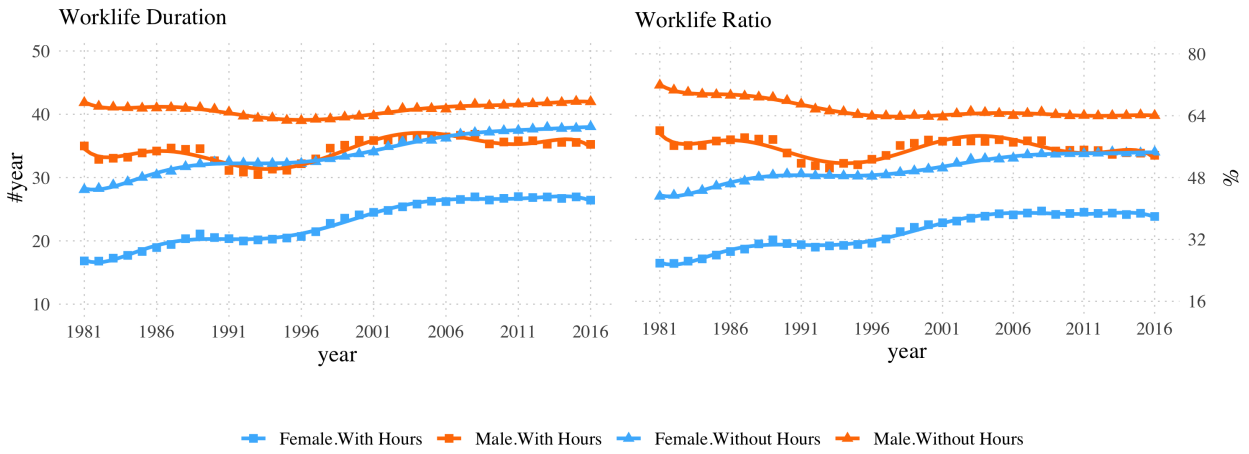
4.3. Importance of including hours worked

In previous sections, we emphasized the need to include working hours in estimating the labour supply. Although this inclusion is reasonable in principle, we have yet to compare empirical results with and without workload. Figure 5 describes the trends in WLD and the associated WLR with and without the workload.

Looking at the trend in WLD with and without workload, three observations stand out. First, not including workload results in higher estimates in WLD and WLR. For example, WLD in 2016 would be 42 (instead of 35,2) for men and 38 (instead of 26,4) for women. Although slightly higher, these results are comparable with other countries that rely on similar methods. For instance, recent reports from Eurostat (2019) show that the expected duration of working life in the European Union (EU) in 2016 was 35.7 years (40 in Canada) for both sexes. In 2018, the expected average duration among the EU Member States ranged from 31.8 years in Italy to 41.9 years in Sweden.

Fig. 5
Trends in worklife duration with and without workload, Canada 1981-2016

Source: Author's calculations



Second, by assuming that men and women work about the same number of hours, the gap between men and women is reduced considerably. For instance, the gap in WLD for 2016 is reduced to less than half, with 3,9 years, hours excluded, instead of 8,81 years, hours included. In Europe, excluding working hours results in a 5 years gap (EuroStat, 2020) for the same year, with men at 38.1 years (42 in Canada), and women at 33.1 years (38 in Canada).

Third, including workload affects not only the values of WLD and WLR but also their trends. For instance, with and without workload trends were similar in the 1980s. Slowly, however, they diverge from each other, especially since 2004 for men, leading to significantly different levels of WLD as workload variability increases.

Although workload in Canada has increased over the past four decades, the trends suggest that workload is likely to decrease in the following decades or stagnate at best due to an increasing proportion of part-time workers. A decreasing workload is mainly expected from young adults still in school and old adults in or near retirement. However, it could also come from prime-age workers for whom reducing working hours is becoming a lifestyle. As the proportion of part-timers increases, so will the bias of WLD solely based on participation.

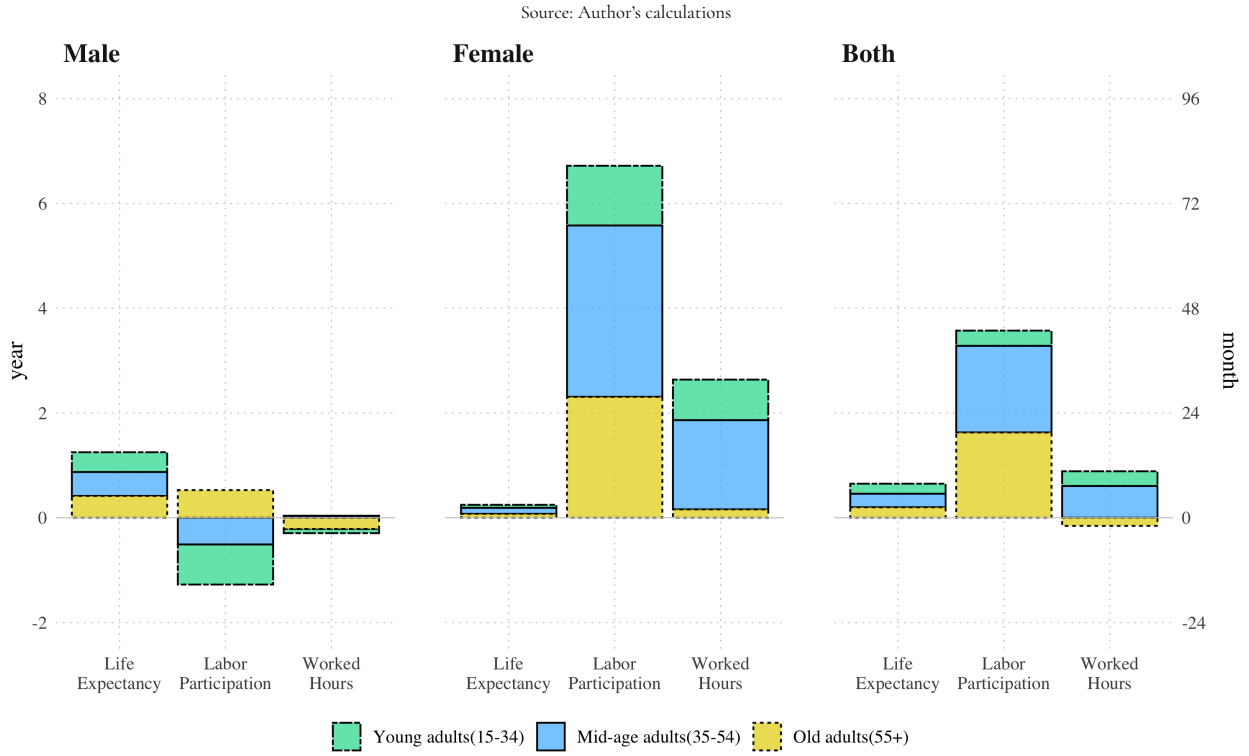
Therefore, not accounting for working hours will increase bias in labour supply estimates and gender and intergenerational differences. At least, workloads have had a mitigating effect on the labour supply, as we shall see in greater detail in the next section, where we analyze the contributions of mortality, participation, and workload to the changes in WLD over the past four decades.

4.4. Components of Increased Worklife Duration

Figure 6 shows the results of decomposing the total change in WLD into contributions made by each age-specific component of life expectancy (mortality), labour participation (participation), and workload (hours worked). Overall, between 1981 and 2016, WLD increased by 4,96 years while its ratio to life expectancy increased by 3,55 percentage points. Participation has been the main driver of these changes, contributing 3,57 years against 0,73 and 0,65 years for workload and mortality, respectively. From an age perspective, contributions (all components and both sexes combined) come mainly from adults aged 35-54 followed by adults aged 55 and over (2,51 years and 1,68 years respectively, with only 0,77 year from those aged 15-34).

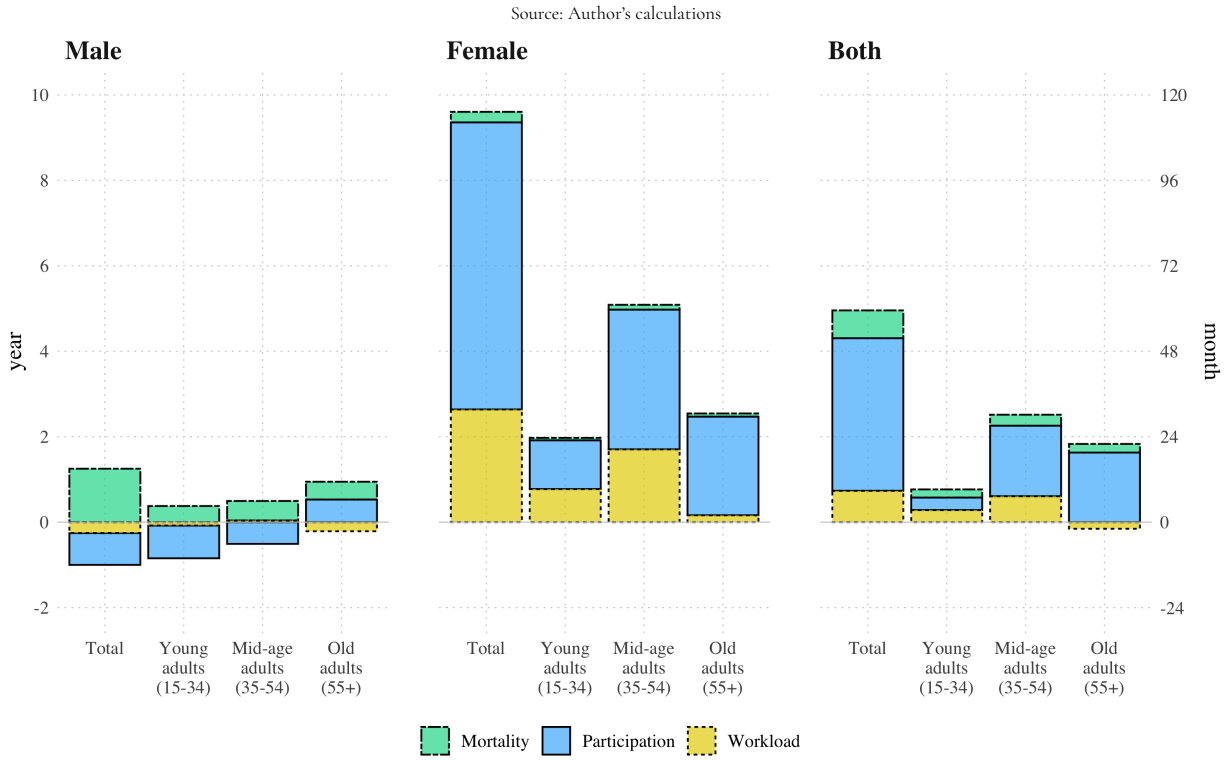
Looking at contributions to WLD by each component for men and women, it appears that mortality improvements have benefited men at all ages, contributing 1,25 year to their additional WLD. This positive contribution, however, was just enough to compensate for the downward effect of their participation (−0,75 year) and workload (−0,25 year). As a result, WLD among men increased only by 0,25 year in four decades. Compared to men, women have benefited much less from mortality improvement. For this reason, mortality contributed almost nothing to the 9,6 years of change in their WLD, whereas participation has been by far the most significant contributor, with 6,72 years against 2,64 year for workload.

Fig. 6
Number of years contributed by components to changes in worklife duration by sex, Canada 1981-2016



A different perspective to present Figure 6 would be to switch the placement of components and the age groups. In Figure 7, the bars are re-arranged so that each of them reports the total contribution for a given age group split by components. A new bar (titled Total) is added to report the total contribution for all age groups split by components. While the information presented remains the same, some results may stand out more clearly. For example, it may be more straightforward to see that, contributions from all components almost cancelled each other out for men, participation made the major contribution for women and both sex, and mortality contributed almost nothing for women.

Fig. 7
Number of years contributed by components to changes in worklife duration by sex, Canada 1981-2016



As we discussed earlier, the change in WLD did not happen steadily or incrementally but rather through successive sub-periods of increases and decreases. Table 1 and Table 2 split the total change between 1981 and 2016 into sub-periods of 5 years. Looking at the sub-periods, it appears that during the first two periods, WLD decreased for men by about the same amount that it increased for women resulting in stagnation in WLD for both sexes. In other words, WLD stagnated between 1981 and 1990, as improvements in mortality and participation were entirely offset by degradation in workload. For men, about half of the decrease happened among young adults. The other half is split equally among mid-age adults and old adults. For women, the increase mainly happened among the adult population. These results suggest a structural change in the labour supply: Young adults (mainly men) withdrew

from the labour market to pursue higher educational attainment, while a more significant engagement among adult women compensated for the hole created.

Building on the increases in human capital investment and women's participation over the decade 1981-1990, the following three periods (1991 to 2005) will see a significant increase in WLD for both sexes. On the one hand, the increase more than overwrote the decrease in the previous decade for men. On the other hand, about two-thirds of their total increase in WLD happened during those 15 years for women. Interestingly, the three age groups contributed about the same toward the increase, suggesting that the 15-year period has seen a society-wide change or a macroeconomic transformation that affects all generations and sexes equally. In particular, the period 1996-2000 appears as a turning point, where WLD increased the most and about the same amount for both sexes. The increase during these five years accounts for about 3.7 years, most of which comes from workload (about 2.8 years) out of the 4,96 years increase for the entire studied period.

Table 1
Increase in Worklife Duration by age group and period for men, women and both sex, Canada 1981-2016

Source: Author's calculations

	Young(15-34)			Adult(35-54)			Older(55+)			Total		
Period	B	F	M	B	F	M	B	F	M	B	F	M
1981-1985	0.3	0.8	−0.3	0.8	1.4	0.1	−0.4	−0.1	−0.7	0.7	2.1	−0.9
1986-1990	−0.8	−0.1	−1.6	0.1	1.3	−1.0	−0.1	0.2	−0.5	−0.8	1.4	−3.1
1991-1995	0.5	0.0	0.9	0.2	0.4	0.1	0.0	0.0	0.0	0.7	0.4	1.0
1996-2000	1.7	1.6	1.7	1.4	1.5	1.3	0.6	0.7	0.6	3.7	3.8	3.6
2001-2005	0.0	0.1	−0.1	0.3	0.7	−0.1	0.8	0.8	0.8	1.1	1.6	0.6
2006-2010	−0.5	−0.2	−0.7	−0.1	0.2	−0.3	0.6	0.8	0.5	0.0	0.8	−0.5
2011-2016	−0.4	−0.4	−0.4	−0.3	−0.4	−0.2	0.1	0.2	0.1	−0.6	−0.6	−0.5
Total	0.8	1.8	−0.5	2.4	5.1	−0.1	1.6	2.6	0.8	4.8	9.5	0.2

M= Male, F=Female, B=Both sexes

Contributions are in year

Table 2
Increase in Worklife Duration component and period for men, women and both sex, Canada 1981-2016

Source: Author's calculations

	Mortality			Participation			Workload			Total		
Period	B	F	M	B	F	M	B	F	M	B	F	M
1981-1985	0.2	0.1	0.3	0.5	1.5	−0.9	0.1	0.5	−0.2	0.8	2.1	−0.8
1986-1990	0.1	0.0	0.2	0.5	1.4	−0.7	−1.4	−0.1	−2.5	−0.8	1.3	−3.0
1991-1995	0.1	0.0	0.2	−0.4	0.0	−1.0	1.0	0.3	1.9	0.7	0.3	1.1
1996-2000	0.1	0.0	0.3	0.8	1.2	0.3	2.8	2.6	3.1	3.7	3.8	3.7
2001-2005	0.1	0.0	0.2	1.1	1.4	0.7	−0.1	0.3	−0.3	1.1	1.7	0.6
2006-2010	0.1	0.0	0.2	0.6	0.8	0.4	−0.7	−0.1	−1.2	0.0	0.7	−0.6
2011-2016	0.0	0.0	0.0	0.4	0.4	0.3	−0.9	−0.9	−0.9	−0.5	−0.5	−0.6
Total	0.7	0.1	1.4	3.5	6.7	−0.9	0.8	2.6	−0.1	5.0	9.4	0.4

M= Male, F=Female, B=Both sexes

Contributions are in year

These results illustrate pretty well the booming economy of the late 1990s as opposed to its beginning. Compared to 1992, the GDP increased by 20% in 1998, while the population only increased by 6.6%. Furthermore, the unemployment rate, which had reached 11% in 1992, fell to less than 7% in 2000, its lowest level in over 25 years (Amirault & Lafleur, 2000). This decrease is partially due to incentives for early retirement put in place by employers, both public and private, in the 1990s(Maxime et al., 2009). Such incentives have increased the proportion of retirement before age 60 to 48% of all retirements during 1997-2000 from 28% during 1987-1990 (Patrick, 2001).

During 2006-2010, WLD stagnated, as the increase for women absorbed a reverse effect among men. Also, WLD increased for the older population, just enough to overwrite the decrease among young adults and mid-age adults. In contrast, negative contributions from workloads cancel out positive ones from mortality and participation altogether. The decrease

continued through the last five years for both sexes, as a slight increase among the older population could not offset the decrease among young adults and adults.

Overall, not only are Canadians working longer than before but also, they are spending a higher proportion of their increased longevity in the labour market. Moreover, while increased longevity has had a lower effect on WLD than behavioural factors, this effect is positive. Therefore, increasing life expectancy, a driver of population ageing, has contributed to expanding the working lifespan in Canada. Of course, population ageing goes beyond increasing life expectancy at the collective level. However, the distinctive effect at the individual level brings essential nuances to the ongoing debate on increasing the retirement age in Canada. The following section discusses the findings and some of their implications for public policy in Canada.

5. Discussion

As population ageing progresses, so do concerns about financial pressure on public healthcare and pension systems. These concerns arise partly from assuming that added years of life are predominantly spent in retirement, collecting a pension but not contributing to government revenues. This study analyzes the levels of WLD and the contributions from changes in life expectancy and individual behaviours during the last four decades in Canada. The results show that not only has WLD increased, but its ratio to life expectancy also increased between 1981 and 2016. Between 1981 and 2016, worklife duration increased by 4,96 years while its ratio to life expectancy increased by 3,55 percentage points. In other words, adjustments in individual behaviours have balanced time allocation between men and women, resulting in an overall positive effect on WLD. However, how these results predict future trends and fit in the ongoing debate to increase the retirement age in Canada remains a question.

Trends over the last four decades suggest that men and women have reached a stable balance in time allocation that only a major social or economic shock could break. Therefore, WLD

for the next few decades will be driven by trends in mortality[4], especially at older ages, where close to 100% of the improvement will be happening (Eggleston & Fuchs, 2012).

This by no means implies that individual behaviours would play no role in future development. It does mean that increased longevity will provide a natural and default room for participation and workload to expand at older ages. Of course, individual behaviours respond to various factors that are hardly predictable. For example, financial readiness affects the decision to either retire or, for those already retired, to return to work (Bélanger et al., 2016). Nevertheless, patterns over the last four decades, especially for older men for whom the improvement in WLD is shared evenly (Figure 7) between behavioural and demographic components, suggest that individual behaviours adjusted proportionately to the increase in life expectancy. While past performance may not continue, we see no reason to suggest that these automatic adjustments would stop.

Alternatively, WLD could increase following an economic boom that induces greater engagement in the labour market. Labour shortage, to some extent, could be a trigger in two ways. First, it would allow salaries to rise (if only temporarily), motivating more people to enter the labour market while providing better prospects for recent immigrants. Second, and most importantly, it would induce companies to use their current workforce more effectively while reducing underemployment. It is also possible for WLD to decrease in the next few decades due to increased automation. This scenario is, however, the least probable as automation usually creates at least as many jobs that it eliminates (Dixon et al., 2021; Nikitas et al., 2021).

This study provides a novel estimate of worklife duration for which population ageing has made a positive contribution over the last few decades in Canada. Nevertheless, it has left some questions unanswered. First, there is no definite answer to how far in time will automatic adjustment of personal behaviours be enough to maintain a stable WLD to life

[4]United Nations projects annual increase in life expectancy of about 0.18% till 2030 and 0.13% afterward. Details at https://www.macrotrends.net/countries/CAN/canada/life-expectancy.

expectancy ratio, as has been the case over the last four decades. Second, while population ageing is reduced to increasing life expectancy at the individual level, it encompasses the interactions between fertility, mortality, and immigration at the aggregated level. Therefore, it is essential for policy debates related to population ageing to understand how aggregated labour supply responds simultaneously to demographic and behavioural factors.

Future research will also need to compensate for some of the limitations of the work presented in this paper. First, the study only accounted for age and sex differences in mortality, participation, and workload. However, differences in demographic and behavioural components go beyond these factors. They include, for example, education, marital status, job type and migration, variables that could have provided more insights into worklife differentials. Second, the study relies on cross-sectional data and thus suffers from the same shortcomings as studies that estimate period lifetables. This implies that no actual cohort has experienced the series of mortality, labour participation and workload that went into estimating worklife duration. As a result, the worklife durations estimated in this study pertain to synthetic cohorts rather than actual ones.

Another limitation relates to the cyclical nature of labour market data, especially workloads, which is reflected in the estimates of worklife duration and could lead to bias when comparing two years. For example, many indicators, including worklife duration for men, appear to have stagnated between 1981 and 2016, but they have (in fact) increased from relatively low levels during the recession of the 1990s. Still, just as period lifetables provide valuable insights on mortality trends, WLD estimated in this paper provides essential elements for consideration when debating policy options in a context of longer life and population ageing.

6. Conclusion

This article contributes to the ongoing debate on the effect of population ageing on the labour supply by accounting for age-sex-specific mortality, participation, and working hours

in estimating worklife duration and its ratio to life expectancy. Results show that not only has WLD increased by 4,96 years but also its ratio to life expectancy increased by 3,55 percentage points. Labour participation has been the main driver of these changes contributing, 3,57 years against 0,73 and 0,65 years for worked hours and mortality, respectively. Most of the changes comes from women who contributed 9,6 years compared to 0,25 for men. However, longer life expectancy has had a positive effect on WLD among men contributing 1,25 years to their additional WLD compared to only 0,25 years for women.

In summary, Canadians have worked long enough to cover their increased longevity, and this trend will likely persist for the next few decades. Therefore, a policy to increase the normal retirement age based on shrinking worklife duration appears neither necessary nor urgent. Furthermore, such a policy could be unfair for two reasons. On the one hand, life expectancy did not increase equally for all income groups. On the other hand, added years of life are not entirely healthy years during which individuals can work. What would be needed are policies that promote, support, and enhance existing trends in living and working longer. Also, the narrative behind these policies should focus less on the change in the relative size of age groups. Instead, monitoring the changes in measures of worklife duration similar to the one proposed in this paper would provide a better base for policy discussion on population ageing. Thus, raising the retirement age may still be an option, provided its potential benefits are widely discussed and accepted.

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Chapitre 3

Effet du vieillissement démographique sur l'offre agrégée de travail

Le vieillissement démographique suscite des inquiétudes quant à ses effets sur la croissance de l'offre agrégée de travail. Si au Canada, les politiques pour y faire face sont vivement débattues, la quantification de ces effets se limite très souvent à l'augmentation des personnes âgées de 65 ans et plus en défaveur des autres groupes d'âge. Ce chapitre propose une mesure plus précise des effets du vieillissement démographique sur l'offre agrégée de travail au Canada entre 1981 et 2016, tenant compte non seulement des facteurs démographiques, mais aussi des changements de comportements individuels sur le marché du travail. Selon les résultats, le changement dans la structure par âge de la population au Canada entre 1981 et 2016 a réduit la croissance de l'offre agrégée de travail de 11,7%, alors que les changements dans les taux d'activité et les nombres d'heures travaillées comptent, respectivement, pour une augmentation de 19,3% et 5,8%.

Mots Clés: Offre agrégée de travail, Comportement individuel, Vieillissement démographique.

3.1. Introduction

Le vieillissement démographique est le résultat d'une interaction entre la fécondité, la mortalité et l'immigration. Il implique, le plus souvent, l'augmentation de l'espérance de vie et donc, peut avoir un effet positif sur l'offre de travail. Au Canada, l'augmentation de l'espérance de vie à contribué 0,65 année à l'accroissement de la durée de vie au travail (offre individuelle de travail) entre 1981 et 2016 (Montcho et al., 2021). Mais si le vieillissement a eu un effet positif sur l'offre individuelle de travail, comment affecte-t-il l'offre agrégée de travail?

Au Canada, bien qu'on assiste de plus en plus à un report de la retraite au niveau des personnes âgées de 60 et plus (Carrière & Galarneau, 2011), le rôle du vieillissement démographique ou de l'allongement de l'espérance de vie dans ces changements n'est pas clairement établi. Alors que le report de la retraite augmente l'offre agrégée de travail au niveau des personnes âgées, le retrait massif des baby-boomers du marché atténue ces effets positifs. En conséquence, l'effet net du vieillissement démographique sur l'offre agrégée de travail, demeure théorique et supposé négatif, étant basé sur l'hypothèse qu'une diminution relative de la population active cause une diminution correspondante de l'offre agrégée de travail.

Cependant, le changement de la structure par âge de la population ne se traduit ni automatiquement ni intégralement sur l'offre agrégée de travail, car cette dernière est également et parallèlement affectée par d'autres facteurs dont les comportements individuels[1] et l'immigration. Il est donc primordial que l'estimation de l'effet du vieillissement démographique sur l'offre agrégée de travail tienne compte de ces facteurs afin de fournir des résultats plus précis pour alimenter les discussions et l'adoption de politiques publiques appropriées.

[1]À noter que ces facteurs expliquent aussi en partie le vieillissement, par exemple une réduction de la fécondité des femmes qui participent au marché du travail par rapport à celles qui sont inactives

Malheureusement, il n'existe pas à notre connaissance, une telle étude qui quantifie avec précision l'effet isolé du vieillissement sur l'offre agrégée de travail au Canada. Pour combler ce vide, ce chapitre propose d'estimer l'offre agrégée de travail comme fonction de l'effectif de la population, des taux de participation au marché du travail, et des heures travaillées. Par la suite, nous proposons une analyse des changements dans l'offre agrégée de travail entre 1981 et 2016, en dissociant la contribution du vieillissement démographique à ces changements, de celles des autres facteurs.

3.2. Mesure de l'offre agrégée de travail

L'objectif principal de ce chapitre est de mesurer l'effet du vieillissement démographique sur l'offre agrégée de travail tout en tenant compte de l'évolution des taux de participation, du nombre d'heures travaillées, de la taille de la population et de l'immigration.

$$L = \sum_{r} \sum_{a} (pop_r \times str_{ar} \times wpx_{ar} \times whx_{ar}) = f(pop_r, str_{ar}, wpx_{ar}, whx_{ar}) \qquad (3.2.1)$$

Pour une année donnée, l'offre agrégée de travail L peut être estimée par la somme pondérée des heures travaillées au cours de l'année par âge a et par statut de résidence r (whx_{ar}), avec $r = (immigrant, natif)$. Le facteur de pondération est le produit de l'effectif total de la population (pop_r, de la structure de la population ($str_a r$) et des taux de participation au travail (wpx_{ar}) par âge et par statut de résidence. Il faut noter que l'équation (3.2.1) est en réalité une approximation de l'offre agrégée de travail. Le total des heures travaillées dans l'économie est une évaluation de l'emploi total résultant de l'équilibre sur le marché du travail entre la demande de travail des entreprises et l'offre de travail des ménages.

En exprimant l'offre agrégée de travail total en heures, la formule (3.2.1) donne une mesure plus précise que celle utilisant l'effectif de la population active. Pour mesurer l'effet isolé du vieillissement démographique sur l'offre agrégée de travail, le modèle de changement continu

(Horiuchi et al., 2008) a été utilisé. Cette méthode permet de décomposer la variation totale d'une mesure entre deux années en composantes correspondant aux contributions des facteurs qui sous-tendent le changement observé. L'adaptation du modèle de changement continu à la mesure à l'équation (3.2.1) a permis de distribuer la variation totale de l'offre agrégée de travail entre 1981 et 2016, non seulement entre ces trois composantes, mais aussi entre immigrants et natifs.

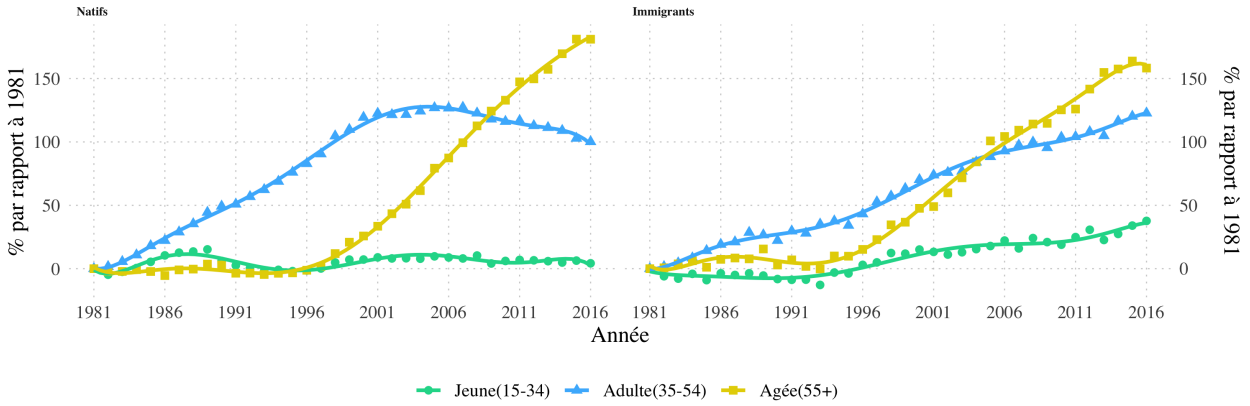
3.3. Croissance de l'offre agrégée de travail

L'offre agrégée de travail est mesurée pour chacune des années entre 1981 et 2016 utilisant les sources de données décrites au chapitre 2. La Figure 1 montre l'évolution de la croissance de l'offre agrégée de travail sur la durée de l'étude. Sur cette période, l'offre de travail agrégée s'est accrue de 69,3% alors que sur la même période, la population totale augmentait de 54,3%. Ce résultat témoigne de l'importance des facteurs structurels et appelle à une analyse plus approfondie de leur rôle sur l'évolution de l'offre agrégée de travail. Une analyse de l'évolution de l'offre de travail par grand groupe d'âge donne quelques indications sur la source de cette croissance.

Chez les natifs, l'offre agrégée de travail des personnes âgées de 15-34 ans est restée constante par rapport à son niveau de 1981 sur toute la période et pourrait diminuer (croissance négative) au cours des prochaines années. En revanche, l'offre de main-d'œuvre chez les immigrants du même groupe d'âge s'est accrue de 50% entre 1990 et 2016 après une stagnation dans les années 1980. Ceci est lié, en bonne partie, aux changements dans les politiques d'immigration qui ont eu pour effet d'augmenter significativement le nombre de nouveaux arrivants qualifiés et donc l'offre agrégée de travail de la population immigrante. Cependant, étant focalisées sur la population adulte, ces politiques semblent limiter dans leur effet sur l'offre de travail des personnes âgées de 55 ans et plus, dont la croissance est autant importante chez les natifs que les immigrants.

En effet, c'est parmi les personnes âgées de 55 ans et plus que la croissance de l'offre agrégée de travail aura été la plus importante, ayant triplé en deux décennies (entre 1996 et 2016) après avoir stagné jusqu'en 1996. Si cet accroissement reflète pleinement les tendances récentes de report de la retraite, c'est surtout le changement démographique, plus précisément le vieillissement de la population, qui en est le moteur comme nous le verrons dans la section suivante.

Fig. 1
Évolution de l'offre agrégée de travail selon le groupe d'âge, Canada 1981-2016



Chez les personnes âgées de 35 à 54 ans, l'offre agrégée de travail des immigrants s'est accrue à un rythme constant entre 1981 et 2016, atteignant en fin de période 150% de son niveau initial. En revanche, l'offre de travail chez les natifs s'est accrue jusqu'aux années 2000, mais à un rythme substantiellement (environ 1,5 fois) supérieur à celui des immigrants. Néanmoins, cette croissance ralentit par la suite pour éventuellement décroitre et revenir à son niveau de 1999 en fin de période. Cette différence dans l'évolution de l'offre agrégée de travail entre natifs et immigrants âgés de 35 à 54 ans s'explique en bonne partie par le rajeunissement de population immigrante avec l'arrivée continuelle de nouveaux immigrants. C'est ce renouvellement soutenu de la population immigrante qui a permis de compenser pour son vieillissement, alors que la population native, n'ayant pas une fécondité suffisante pour maintenir sa croissance, a subi pleinement les effets du vieillissement.

Si ces résultats illustrent les changements dans l'offre agrégée de travail au cours des dernières décennies, ils ne reflètent pas exactement les changements démographiques ayant lieu au cours de la même période. La figure Figure 2 montre, en 1986 et 2016, le poids relatif de grands groupes d'âge parmi l'ensemble de la population âgée de 15 ans et plus d'une part, et, d'autre part, leur poids relatif dans l'offre agrégée de travail. Elle montre aussi la variation en pourcentage de leur poids entre ces deux années.

Fig. 2
Poids relatif de grands groupes d'âge dans la population âgée de 15 ans et plus et dans l'offre agrégée de travail, et variation en point de pourcentage (pp), Canada 1981-2016

On sait que le vieillissement démographique a considérablement modifié la structure par âge de la population canadienne entre 1981 et 2016. Cependant, comme nous l'avons mentionné plus tôt, ces changements ne se reflètent pas systématiquement sur la structure par âge de l'offre agrégée de travail. Par exemple, à l'augmentation de 4,2 points de pourcentage (pp) de la population des adultes de 35-54 ans, correspond une augmentation de 9pp dans l'offre agrégée de travail. Au même moment, la population des 55 ans et plus a augmenté de 13,1pp

alors que l'offre agrégée de travail n'a augmenté que de 7,5pp. En conséquence, alors qu'en 1981 les jeunes de 15-34 ans comptaient pour 46,9% de l'offre agrégée de travail contre 40,9% et 12,2% pour les adultes de 35-54 ans et de 55 ans et plus respectivement, ces contributions étaient de 30,4%, 49,9% et 19,7% en 2016.

Ces résultats suggèrent des rendements d'échelle[2] constants, croissants et décroissants pour les jeunes, adultes et personnes âgées respectivement entre les contributions à la population d'une part, et à l'offre agrégée de travail d'autre part. Autrement dit, alors que l'offre agrégée de travail a augmenté plus rapidement que la population parmi les adultes, elle a augmenté moins rapidement parmi les personnes âgées de 55 ans et plus. En revanche, une diminution de la population des jeunes âgés de 15 à 34 s'est traduite en une diminution correspondante de l'offre agrégée de travail.

Cependant, ces reculs sont encore plus révélateurs de l'importance des comportements individuels dans la détermination de l'offre agrégée de travail, et de ce fait, décourage l'utilisation des seuls changements de la structure par âge de la population pour expliquer l'évolution de cette offre. En effet, se référant à la formule (3.2.1), il découle que la différence dans les changements de structure de la population et de l'offre agrégée de travail provient essentiellement des changements de comportements individuels quant à la participation au marché du travail et les heures travaillées. En d'autres termes, si une croissance de la population en âge de travailler peut avoir un impact sur l'offre agrégée de travail, c'est aussi le cas si un changement dans les comportements individuels face au marché du travail favorise une plus grande participation ou un nombre plus élevé d'heures travaillées. Montcho et al. (2021) résume les changements des comportements individuels au cours des dernières décennies en trois points saillants.

Premièrement, bien que leur taux d'activité soit resté à peu près constant entre 1981 et 2016, les jeunes ont connu la plus forte augmentation de leur charge de travail au cours de cette

[2]Voir https://fr.wikipedia.org/w/index.php?oldid=180732598 pour plus d'information sur les rendements d'échelle

période avec une moyenne de 125 heures contre 81 pour les adultes et une diminution moyenne de 44 heures pour les plus âgés. Comparé à leurs niveaux en 1981, ces changements représentent une augmentation de 10,1% contre 4,8% pour les adultes et une diminution moyenne de 2,9% pour les plus âgés.

Deuxièmement, la diminution de la charge moyenne de travail des personnes âgées de 55 et plus est due au fait qu'un nombre de plus en plus important optent pour des emplois à temps partiel pendant la retraite ou la préretraite. Cependant, ceci ne cache pas le fait qu'au cours de la période étudiée, le taux d'activité des plus âgées a augmenté d'environ le même nombre de point de pourcentage que chez les adultes, passant de 29,8% en 1981 (contre 77,3%) à 37,7% (contre 86,6%) en 2016. Ainsi, comme le souligne Carrière and Galarneau (2011), la diminution de la charge de travail moyenne a été insuffisante pour compenser l'effet plus important de la participation au marché du travail, ce qui a conduit à une augmentation de l'offre de travail agrégée.

Enfin, on peut noter que si les taux d'activité des jeunes sont restés plus proches de celui des adultes sur toute la période, leur charge de travail, au contraire, est restée beaucoup plus proche de celle des personnes âgées. Ces tendances suggèrent que, bien que la scolarité soit restée leur principale activité, la disponibilité accrue d'emplois à temps partiel a amélioré l'employabilité des jeunes.

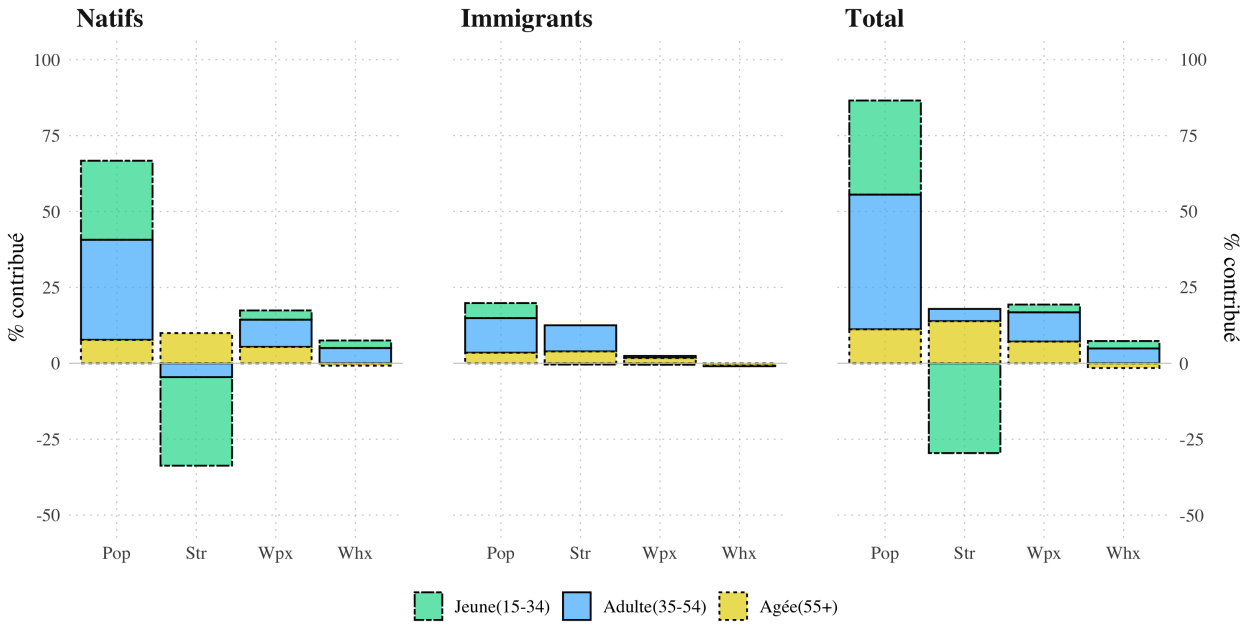
En somme, au cours des dernières décennies, les comportements individuels vis-à-vis la participation et le nombre d'heures travaillées ont connu des changements importants et leurs effets sur l'offre agrégée de travail se confondent avec ceux du vieillissement démographique. Il est donc nécessaire que l'effet de ce dernier soit isolé des autres facteurs confondants. Pour ce faire, le modèle de changement continu de Horiuchi et al. (2008) est utilisé pour décomposer la variation totale de l'offre de travail entre 1981 et 2016 en composantes attribuables aux changements dans la structure par âge de la population, la

participation au travail, et les heures travaillées. Dans la section suivante, les contributions de ces facteurs et celui de vieillissement démographique sont analysés.

3.4. Les contributions des composantes de l'offre agrégée de travail

La Figure 3 résume les contributions des facteurs démographiques et comportementaux à la croissance de l'offre agrégée au Canada entre 1981 et 2017.

Fig. 3
Contributions des facteurs démographiques et comportementaux exprimées en pourcentage de la variation totale de l'offre agrégée de travail, Canada 1981-2016



En observant la contribution de chacun des facteurs, il ne fait aucun doute que l'augmentation de la taille de la population a été la principale source d'offre additionnelle de travail au Canada au cours des dernières décennies, avec une contribution de 86,6%. Le changement de la structure par âge de la population a été, quant à lui, la source d'une

diminution de 11,7% de l'offre additionnelle de travail entre 1981 et 2016, alors que sur la même période, les changements dans la participation et les heures travaillées comptent pour une augmentation de 19,3% et de 5,8% respectivement. Ainsi, même si le vieillissement démographique a un effet négatif sur l'offre agrégée de travail, cet effet est compensé par le changement dans les comportements individuels qui au total ont accru l'offre agrégée de travail de 25,1% contre une diminution de 11,7% pour le vieillissement.

Comme on pourrait s'y attendre, l'évolution de chacun des grands groupes d'âge a eu un effet différent sur l'offre agrégée de travail. En effet, l'effet négatif du vieillissement démographique provient essentiellement des plus jeunes travailleurs (15-34) avec une diminution de 29,6% de l'offre additionnelle entre 1981 et 2016. En revanche, on observe une contribution positive de 13,9% et de 4% chez les personnes âgées (55ans et plus) et les adultes (35-54 ans) respectivement. En d'autres termes, les effets positifs du vieillissement par le haut ont compensé environ de moitié l'effet négatif du vieillissement par le bas, et ceci, en surplus de l'effet positif des comportements individuels.

Par ailleurs, si l'effet total du vieillissement démographique sur l'offre agrégée de travail accrue entre 1981 et 2016 est négatif, il ne l'est que pour la population née au Canada, dont le changement de structure par âge a réduit cette offre de travail de 23,8%. Quant à la population immigrante, sa structure par âge a permis un gain de 12,1% sur la période considérée. Ainsi, la jeunesse relative des immigrants a compensé de moitié les effets négatifs du vieillissement de la population native.

Tous composants confondus, l'immigration, à elle seule, compte pour 32,9% de l'accroissement de l'offre agrégé de travail entre 1981 et 2016, alors que sur la même période les immigrants ne comptent en moyenne que pour 18,7% de la population canadienne (Statistiques Canada, Catalogue no. 98-404-X2016001). Que ce soit pour les immigrants ou les natifs, le changement dans les comportements individuels au cours de la période étudiée a contribué positivement à l'offre additionnelle de travail, à l'exception des heures travaillées

dont la contribution est positive pour les natifs (6,7%), mais négative pour les immigrants (−0,9%). Quant à la participation au marché du travail, la contribution est de 17,4% pour les natifs contre 1,9% pour les immigrants.

3.5. Conclusion

Alors que l'allongement de l'espérance de vie a contribué à l'accroissement de la durée de vie au travail (Montcho et al., 2021), l'impact du vieillissement démographique sur l'offre agrégée de travail est lui négatif. Cependant, les résultats de ce chapitre montrent que si, entre 1981 et 2016, le vieillissement démographique à réduit la croissance de l'offre agrégée de travail de 11,7%, les changements de comportements individuels l'ont accru de 25,1%. En d'autres termes, les effets positifs des changements dans les comportements individuels ont plus que compensé les effets négatifs du vieillissement démographique, et ceci, sans qu'aucune politique de report de la retraite soit mise en place.

À l'instar de Marois et al. (2019), ces résultats montrent que si le vieillissement démographique est inévitable, ces effets sur l'offre agrégée de travail ne le sont pas, du moins jusqu'à un certain point. Au Canada, ces effets sont amoindris dans une large mesure par l'immigration et les changements de comportements sur le marché du travail. En effet, si l'impact du vieillissement sur la croissance de l'offre agrégée de travail est négatif, elle ne l'est que pour la population native, avec une réduction de 23,8%, alors que le renouvellement continuel de la population immigrante compte pour 12,1% de cette croissance.

Tous facteurs combinés, 32,9% de l'offre additionnelle entre 1981 et 2016 est attribuable à l'immigration, alors que le poids des immigrants ne compte que pour 18,7% de la population totale en moyenne sur la même période. Mais si cet apport de l'immigration est essentiel à la croissance de la main-d'œuvre, son impact sur les finances publiques est-il tout aussi important pour justifier un accroissement des quotas annuels? Il s'agit d'une considération importante dans une politique d'immigration. Le prochain article tente de répondre à cette question en utilisant la méthode des comptes nationaux de transferts (National Tranfers

Account) pour comparer les contributions fiscales des immigrants et des natifs aux finances publiques.

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Deuxième article.

Comparing Public Transfers to Immigrants and Natives in Canada: A National Transfer Accounts Approach

par

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ABSTRACT. In Canada, immigration constitutes the primary response to population ageing. While extensive research has covered the impact of immigration on various aspects of the labour supply, the financial aspect has received less attention. In this study, we apply the National Transfer Account (NTA) method and demographic decomposition to estimate the net fiscal cost of immigration in Canada between 1997 and 2015. Results show that, on average, immigrants received about $1 710 more in Net transfer per capita than natives between 1997 and 2015. However, this cost is mainly the result of labour market imbalances which, after removing the effect of demographic differences, account for 85% of the surplus.
Keywords: Immigration, Public Finances, National Transfer Account

1. Introduction

Migration has always been a hot topic and one of the most controversial in industrialized countries (Marois et al., 2020). More often than not, and especially during the second half of the 20th century, studies on immigration have focused on its effect on the labour market outcome of native workers (Castles, 2012; Fusaro & López-Bazo, 2018; Piché, 2013). Although these considerations have continued till the current decade, they have somehow faded into the background of a new threat: population ageing, the increasing share of older persons in a population due to declining fertility rates and rising life expectancy.

Population ageing has become a dominant policy concern in advanced economies for its far-reaching effects on the labour market and public finances. It directly reduces the growth of the labour supply and increases the risk of a labour shortage. In Canada, between 2007 to 2016, the population aged 15 and older increased by 3.1 million people, but the number of labour market participants increased only by 1.6 million (Fields et al., 2017). As the relative (to the population size) number of labour market participants decreases, government expenditures (relative to public revenue) increase, all else remaining equal.

These prospects put heavy pressure on public finances and call for complex policies (Clavet et al., 2013; Godbout et al., 2012; Kudrna et al., 2015; Lee & Ryan, 2001; St-Maurice et al.,

2018; Zokalj, 2016). For instance, St-Maurice et al. (2018) estimate that the province of Quebec would see its budgetary balance decrease from 0.2% of GDP in 2022 to -2.8% in 2058. This would mainly result from an increase in health expenditure, from 39.5% of government revenues in 2022 to 62.9% in 2058. For the United States, Lee and Ryan (2001) calculated that population ageing would raise the tax costs of the current benefits package by about 50%, even with no changes in the per-recipient costs of programs. Budgetary projections in Europe anticipate an increase of public health care expenditures in all countries by an average of 24.07% in 2060, compared to the level in 2013 (Zokalj, 2016). Kudrna et al. (2015) suggested that to finance the significant increase in old-age related government expenditure programs, the Australian government would have to cut non-age related expenditures by 32% or increase the consumption tax rate by 28% for balancing the government budget by 2050.

As the pressure brought by population ageing on various aspects of the economy builds up, immigration increasingly appears as a source of additional labour supply and a possible solution to alleviate the pressure on public finances. For this reason, recent decades have seen a subtle but significant change within the immigration debate from policies that harden *undesirable* immigration to policies that welcome *selected* immigrants. Indeed, population ageing has given new vitality to the immigration debate. However, while selected immigrants are tailored to and absorbed by the labour market, their costs to taxpayers have been less documented (Dustmann & Preston, 2007).

Public opinion on immigration has traditionally been negative. Most people believe that immigrants do not pay their fair share to the tax system or receive more than they contribute to public finances. A 2008 European Social Survey reveals that 44% of European citizens responded that immigrants receive more than they contribute, with only 15% believing that they receive less (Dustmann & Frattini, 2014). Much empirical research also supports the idea that immigration is costly for receiving countries. This message is at the core of Borjas's latest book, Immigration Economics, the 30 years summary of the author's work in the field of immigration (Card & Peri, 2016). In Canada, Grubel and Grady (2012) found that in the

fiscal year 2005/2006, the average immigrant costed $6,051, while Javdani and Pendakur (2013) reported about $500. Outside Canada, Chojnicki (2011) found that even though the long-term effect of immigration on the French public finances is slightly positive, the life cycle net contribution is negative for 2005. Fehr et al. (2003) stated that even doubling the number of immigrants, an extreme measure by most policy standards, will do little to mitigate the upcoming financial pressure in developed countries.

As the immigration debate continues, so does immigrant intake in most developed countries (Card & Peri, 2016). In Canada, for example, the number of landed immigrants has remained relatively high since the early 1990s, with an average of approximately 235,000 new immigrants per year (Canada, 2016). In 2017, the country welcomed more than 286,000 permanent residents. Still, the government adopted a historical multi-year plan to grow its annual immigration levels to 340,000 by 2020 (2018 Annual Report to Parliament on Immigration). These policies suggest that, contrary to Borjas (2014) and others, skilled migrants significantly contribute to public finances. Even unskilled migrants may be net contributors if they eventually depart or make few claims on government expenditures while in the country (Rowthorn, 2008). Akbari (1989) found a positive net fiscal transfer of $500 using data from the Canadian census in 1981, while results from İleri (2019) and Dungan et al. (2013) also suggest that immigration is likely to positively impact the Canadian economy, including lowering wages inequality and improving overall welfare.

In the US, Storesletten (2000) found that selective immigration policies involving an increased inflow of working-age high and medium-skilled immigrants can remove the need for future fiscal reform. For instance, an annual intake of 1.6 million immigrants (an increase from 0.44% to 0.62% of the population) would be equivalent to an alternate policy to increase tax revenue by 4.4 percentage points in the US. Akin (2012) for Germany and Dustmann and Frattini (2014) for the United Kingdom also provide strong evidence that immigrants, especially recent ones, have made substantial contributions to public finances.

Despite being intensely debated as a policy response to population ageing, immigration has yet to receive enough fiscal analysis to support current policies. The reasons are twofold. First, different studies make different assumptions about the consumption of public goods (Grubel & Grady, 2012) and most studies only account for costs and contributions that are directly related to the individual, while those from and through the family are left out (d'Albis et al., 2019). Second, the scope of the immigrant population is not consistent across studies, and results vary for different cohorts (Grubel & Grady, 2012), subgroups and methodology (Chojnicki, 2011). As an illustration, Lee and Miller (1998) found that the overall fiscal impact (taxes paid minus costs generated) is, on average, $1,400 for first-generation immigrants, -$400 for first and second generations, and $600 if extended to all descendants of living immigrants.

Not only have Lee and Miller (1998) distinguished the fiscal impact of immigration by the generation of immigrants, but also they have included many costs and benefits, including public goods. Such a comprehensive approach is infrequent and almost nonexistent for Canada. This study fills the gap by using the National Transfer Account (NTA) method to measure the costs and contributions of immigration between 1997 and 2015. The NTA method takes an intergenerational perspective that accounts for costs and contributions involving the family and the state (Mason & Lee, 2011; Nations, 2013). This article builds on Mérette and Navaux (2019), splits inflow and outflow transfers between immigrants and natives, measures the differences between the two populations, and attempts to uncover the sources of these differences using demographic decomposition.

2. Methods, data and measures

This study compares immigrants and natives regarding their cost and contribution to the public finances. Doing so allows assessing the extent to which immigration has contributed to public finances and supports its policies in Canada. This article defines an immigrant as a person born outside Canada but residing as a citizen or permanent resident. The 2016 Census

enumerated about 7.5 million immigrants in Canada, accounting for about 22% of the total population. About 61% of immigrants in Canada live in the three metropolitan areas of Toronto, Montreal, and Vancouver. Recent immigrants who arrived between 2011 and 2016 are mainly from Asia and belong to the economic class, those selected for their ability to contribute to Canada's economy through their employment, entrepreneurship or investment.

Per-capita costs and contributions for immigrants and natives are estimated using the National Transfer Accounts (NTA) method. The NTA terminology refers to costs and contributions as inflow transfers and outflow transfers, respectively, or transfers to denote both. Age-adjusted transfers are estimated using the model of continuous change. This section presents an overview of the two methods and the indicators of comparison.

2.1. The National Transfer Account Method

National Transfer Accounts (NTA) constitute an age-based national accounts methodology that originates from the works of Lee (1980) and Mason (1988). The NTA method introduced age into the System of National Accounts (SNA) by disaggregating national income, consumption, and savings by age and therefore takes into account inter-generational transfers made through the state or the family. This article goes further by splitting transfers to and from the state between immigrants and natives.

Calculating net public transfers for the entire population

NTA measures how individuals produce, consume, save, and share resources at each age through the family and the state. NTA reconciles age profiles calculated from surveys and administrative data with macro-aggregates from national accounts (Nations, 2013). As illustrated in d'Albis et al. (2019), the NTA equation (2.1) decomposes the sources through which individuals fund their consumption C_a:

$$C_a = Y_a^L + [YA_a - S_a] + [T_a^{FI} - T_a^{FO}] + [T_a^{GI} - T_a^{GO}] \tag{2.1}$$

At each age a consumption is funded by labour income Y_a^L, asset income minus saving $[YA_a - S_a]$, private inflow transfers minus private outflow transfers $[T_a^{FI} - T_a^{FO}]$, and public inflow transfers minus public outflow transfers $[T_a^{GI} - T_a^{GO}]$. Public inflow transfers T_a^{GI} includes public consumption (health, education, other consumption) and public cash transfers (mainly public pensions - Canada Pension Plan, Quebec Pension Plan, Old Age Security pension, and Guaranteed Income Supplement -, family allowances, and unemployment benefits). Public outflow transfers T_a^{GO} include all taxes from individuals (mainly employee contributions, direct taxes from persons, and consumption taxes) and corporations (mainly employer contributions and direct taxes from private and public corporations).

Allocating public transfers to immigrants and natives

Mérette and Navaux (2019) calculated the NTA profiles for the Canadian population. This paper allocates the components of public inflow transfers T_a^{GI} and public outflow transfers T_a^{GO} between immigrants (IMM) and natives (NAT). Equation (2.2) calculates how much of the aggregate value of a given transfer T accounts for immigrants.

$$T_a^{IMM} = \hat{T}_a^{IMM} \times \frac{T_a}{\hat{T}_a^{IMM} \times S_a^{IMM} + \hat{T}_a^{NAT} \times S_a^{NAT}} \tag{2.2}$$

where S_a^{IMM} and S_a^{NAT} account respectively for the share of immigrants and the share of natives in the population of age a. $\hat{T}_a^{IMM}$ and $\hat{T}_a^{NAT}$ represents crude value of transfers for immigrants and for natives at age a, before readjustment on aggregate T_a. As evidenced by equation (2.3), crude readjusted public transfer for natives denoted T_a^{NAT} is calculated by subtracting the crude readjusted public transfer for immigrants T_a^{IMM} from the crude readjusted public transfer for the population T_a of age a.

$$T_a^{NAT} = T_a - T_a^{IMM} \tag{2.3}$$

Data sources for public transfers

NTA age profiles for the population at large T_a from 1997 to 2015 are obtained from Mérette and Navaux (2019). Statistics Canada has provided annual population estimates by age and immigration status used to calculate the share of immigrants (S_a^{IMM} and natives S_a^{NAT}) at age a.

Non-readjusted variables ($\hat{T}_a^{IMM}$ and $\hat{T}_a^{NAT}$) come from the following sources. The calculation of Inflows requires four variables: education, health, cash transfers, and other inflow transfers. Public transfer outflows are composed of five variables: contributions to social insurance plans, direct taxes from persons, direct taxes from corporations and government business enterprises, taxes on products and imports - mainly consumption taxes - and other taxes. Per-capita age profiles for other inflows and outflows are considered equals for immigrants and natives. These include expenses on public goods such as national defence, public security, and national debt.

We use two surveys to calculate non-readjusted age profiles for cash transfer, contributions to social insurance plans, direct taxes from persons, and direct taxes from corporations and government business enterprises: the Survey of Labour and Income Dynamics (SLID, from 1997 to 2011) and the Canadian Income Survey (CIS, for 2012 and 2015). SLID and CIS include both a status variable that identifies immigrants and natives. Taxes on products are calculated from a single wave of the Survey of Household Spending (SHS), as only the 2010 survey indicates an immigration status for the head of the household. No additional information is available for other household members. Therefore, we assumed the same status for all members of the household. Education profile is estimated from student enrollments by immigration status and 5-year age groups from census samples published by Statistics Canada in Public Use Micro-data Files. The school attendance variable is available only for persons aged 15 and over; therefore, we assumed that the education profile is the same for immigrants and natives aged 14 years or less. For constructing the unadjusted age profile of health care

cost, we use the number of total medical consultations (TMC) in the Canadian Community Health Survey (CCHS) annual component.

Using the TMC as a proxy for individual health care costs may seem inappropriate to some extent. However, there is no better proxy for public health care expenditure that is easily accessible to our knowledge. Studies on health status analysis usually rely on the Health Utility Index (HUI) to measure individual health status. However, the HUI did not win our favour mainly for two reasons. First, HUI is more subjective than TMC since the first is a cognitive evaluation of health status while the second represents actual usage of health care services. Therefore TMC is more likely than HUI to result in health care expenditure. Furthermore, Piérard (2016) found that self-rated health statuses, including HUI, are not strongly associated with health care expenditure. The author concludes that these measures are such noisy health status assessments that the magnitude of their relationship with health care expenditure is difficult to estimate.

Second, our investigations show that average TMC and HUI time series are highly correlated (about 93% for natives and 85% for immigrants). The relationship is not that intense at the micro-level (about 33% for natives and 34% for immigrants), perhaps due to the noisy phenomena mentioned by Piérard (2016). To sum up, TMC appears to be a manifestation of genuine health concerns that are more likely to result in health care usage and, thus, is a better proxy for health care expenses than the HUI. Nevertheless, TMC does not reflect all expenses and may still bias the analysis.

2.2. Measures and analytical strategy

The analytical process includes three phases corresponding to the analysis of age-specific transfers, crude transfers, and age-adjusted differences in transfers between immigrants and natives.

The analysis starts by looking at the age profile of public transfer, the age-specific transfers, in light of the life cycle hypothesis of consumption (Ando & Modigliani, 1963; Deaton, 2005). For each account and sub-account, equations (2.2) and (2.3) provide the basis for computing the age-specific transfer time series (T_a^r) for immigrants (T_a^{IMM}) and natives (T_a^{NAT}). These profiles are described at the individual and aggregate level for the year 2015 in section section 3.

The second step of the analysis (section 4) looks at crude transfers from three perspectives: the Transfer-to-Population ratios, the Net Transfers, and the Immigrant Surpluses. Using the age-specific time series of transfers, crude transfers (T_c^r) is calculated as the per-capita transfer for each account c and residency status r by dividing aggregated transfer by the total population.

$$CrudeTransfer = T_c^r = \frac{\sum\limits_a T_{ac}^r}{pop \times \sum\limits_a S_a^r} = f(S_a^r, T_{ac}^r) \tag{2.4}$$

In equation (2.4) and the ones that followed, *pop* is the total population and S_a^r is the proportion of the population at age a for a residency status r.

The Transfer-to-Population ratio compares the proportion of transfer allocated to immigrants with their share in the population for each account. Net Transfer, Immigrant Surplus and Net Surplus are defined and calculated as follows. For a given year, Net Transfer (NT^r) is the sum of all transfers (inflows minus outflows) across all ages, all sub-accounts c included and for each residence status (immigrants or natives) denoted by r. Immigrant surplus (IS_c) is the difference in transfer between immigrants and natives for a given account or sub-account c of inflows and outflows.

Finally, Net Surplus (NS) is the sum of all Immigrant Surplus across all accounts or sub-accounts; or the sum of all Net Transfers (immigrants minus natives). Net surplus is positive when immigrants, more than natives, receive more from public finances than they

contribute to it and negative otherwise. Therefore although a null Net Surplus is the sign of equilibrium in transfer between immigrants and natives, a negative Net Surplus is desirable as a justification for ongoing or increasing immigrant intake on a fiscal basis.

$$NetTransfer = NT^r = \sum_c T_c^r \tag{2.5}$$

$$ImmigrantSurplus = IS_c = \sum_r T_c^r = T_c^{IMM} - T_c^{NAT} \tag{2.6}$$

$$NetSurplus = NS = \sum_c IS_c = \sum_r NT^r \tag{2.7}$$

In the third and final step (section 5), the model of continuous change (Horiuchi et al., 2008) is used to decompose the crude surpluses (Immigrant and Net) and to account for the differences in the age structure of the two populations. In the literature, accounting for such differences usually relies on age-standardized values. Calculating the age-standardized values required adjusting either one population to have the same age structure as the other or both populations to have the same age structure as a third population, called the standard population (Statistics Canada, 2017). Standardization removes the biased caused by an eventual difference in the age structure of two populations by giving the same age distribution to the two populations and thus provides a much more accurate representation of the difference in the feature in comparison. However, a disadvantage of this approach is that it requires choosing an arbitrary standard which usually loads to different results for different standards. Therefore, Fürnkranz-Prskawetz et al. (2005) proposed decomposing the crude measure change into a direct change in the characteristic of interest and the change attributable to a change in the structure or composition of the population.

This study applies the model of continuous change (Horiuchi et al., 2008) to decompose the differences in transfer between immigrants and natives into demographic and fiscal components.

2.3. The model of continuous changes

The model of continuous change (MCC) allows extracting age-adjusted transfers from the surpluses for each transfer account. The age-adjusted transfer represents the fiscal components, while the difference between the crude and the age-adjusted transfer is the demographic component. Considering the analogy with concepts used in epidemiology, age-specific and age-adjusted transfers relate to the crude transfer in the same way that age-specific and age-adjusted mortality rates relate to crude mortality rates. The age-adjusted transfers are analyzed side by side with crude transfer and the demographic component for all sub-accounts in section 5.

MCC allows decomposing the difference between two summary measures resulting from the same process into components, each representing the contribution of the process's factors. The process is a function that takes values of the factors (the covariates) and returns a summary measure (the dependent variable). Horiuchi et al. (2008) demonstrate that, as covariates changes from states X_1 to X_2, so does the summary measure change from Y_1 to Y_2 and the difference between Y_2 and Y_1 can be decomposed into additive components representing the contribution of the change within each co-variate toward the difference $Y_2 - Y_1$.

$$f(X2_r) - f(X1_r) = \sum_r Y_r \tag{2.8}$$

The decomposition assumes that changes in the covariables happen continuously, or gradually, along a dimension rather than discretely. This assumption makes sense for phenomena where change occurs naturally over time, but it equally applies when the changes occur over a hypothetical underlying dimension (Horiuchi et al., 2008, p. 790). In this study,

summary values change over a hypothetical immigrant-to-native dimension. Therefore equation (2.5) can be rewritten as

$$\begin{aligned} ImmigrantSurplus &= IS_c = f(S_a^{IMM}, T_{ac}^{IMM}) - f(S_a^{NAT}, T_{ac}^{NAT}) \\ &= f(X_{ac}^{IMM}) - f(X_{ac}^{NAT}) \end{aligned} \tag{2.9}$$

where X_{ac}^r is the matrix of $P = C \times A$ components of transfer T_{ac}^r and population structure $S_a^r = S_{ac}^r$ over A ages and C accounts for a given residency status i, and f represents the function in equation (2.4) that transform the covariates X_{ac}^r into T_c^r. The difference $f(X_{ac}^{IMM}) - f(X_{ac}^{NAT})$ is decomposed by creating a wrapper function g around the R (R Core Team, 2018) package DemoDecomp (Riffe, 2018).

$$\begin{aligned} Y_{ac} &= g(f, X_{ac}^{IMM}, X_{ac}^{NAT}) \\ &= (D_{ac}, F_{ac}) \end{aligned} \tag{2.10}$$

The results is a matrix $Y_{ac} = \{D_{ac}, F_{ac}\}$ representing the contributions of the change of each element of $X_{ac}^r = \{S_a^r, T_{ac}^r\}$, with D_{ac} the demographic components and F_{ac} the fiscal or adjusted components of transfers. Following the decomposition, the fiscal component of the immigrant surplus for a given account is obtained by summing the elements of F_{ac} accross ages, $F_c = \sum_a F_{ac}$. Similarly, the elements of D_{ac} would add up to the associated demographic components D_c. Therefore, immigrant surpluses for various accounts and the Net Surplus for all accounts are obtained with the following equations:

$$ImmigrantSurplus = IS_c = \sum_a Y_{ac} = \sum_a D_{ac} + \sum_a F_{ac} \tag{2.11}$$

$$NetSurplus = NS = \sum_{c} IS_c = \sum_{c} \sum_{a} D_{ac} + \sum_{c} \sum_{a} F_{ac} \tag{2.12}$$

3. Public transfer in Canada for 2015

3.1. Age profile of public transfer

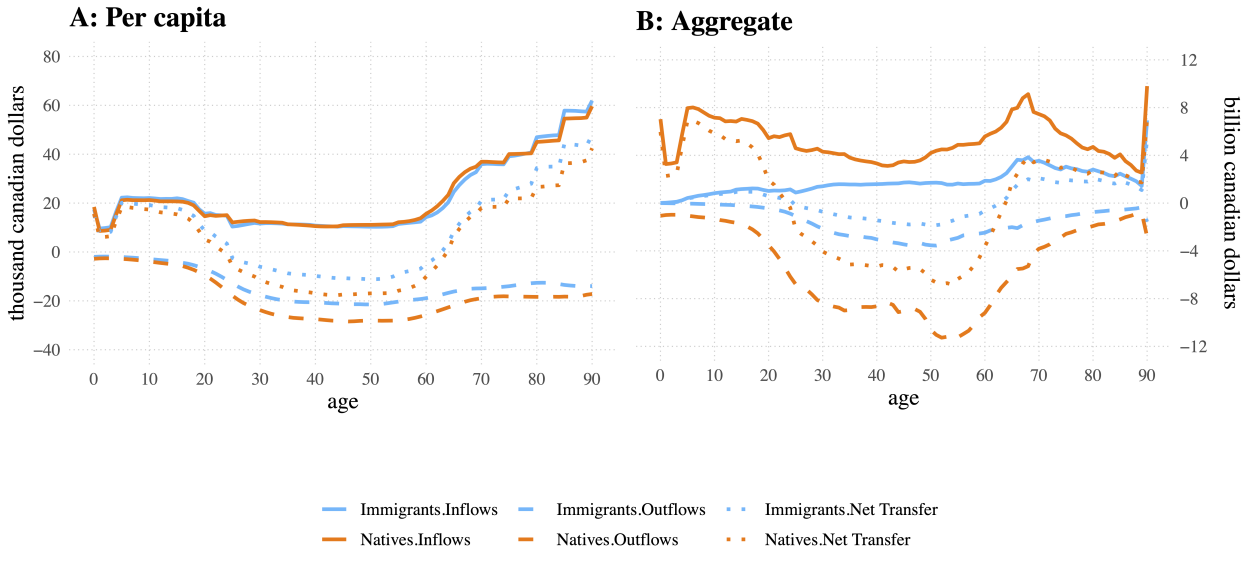
Like other advanced economies, public transfers in Canada are a significant component of inter-generational transfers, complementing transfers between family members. Through public transfers, individuals transfer wealth from their productive ages to finance consumption during the ages of dependency. In that sense, the NTA method represent a cross-sectional implementation of the life-cycle hypothesis (Ando & Modigliani, 1963; Deaton, 2005). According to that hypothesis, Net Transfer is positive at younger ages where the individual depends significantly on inflows for its consumption, and outflows are at their lowest levels. In adulthood, outflows surpass inflows, and Net Transfer becomes negative as the individual engages in income-producing activities. Finally, in retirement ages, the individuals turn back to the government to finance (partially) the remaining years of their life. The net transfer becomes positive again and increases to reach its maximal in the final years of life. Figure 4-A shows the age profile of public transfer in Canada for the year 2015 at the individual level.

Per-capita inflows are pretty similar for natives and immigrants and overlap at almost all ages. They average $18 830 between birth and age 19, decrease to about $11 810 between age 20 and 59 and increase by $1 380 for each birthday from age 60 to reach a maximum of $60 000 just before death. Despite this similarity, there are slight differences between immigrants and natives, first from age 60 to 70 in favour of immigrants (i.e. they cost less) and then from age 80 to 90 in favour of natives. While the reasons for the latter are less evident, the former is probably related to later retirement among immigrants as they tend to retire about two years later than natives (Statitics Canada, 2006, p 284).

Similar to inflows, the age profile of outflows overlaps for immigrants and natives before age 15, as individuals from both groups have almost no income-producing activity during that period. Beginning at age 15, however, outflows are much lower for immigrants than natives. From $4 100 for immigrants and $5 300 for natives at age 15, outflows increase rapidly and the trends diverge for the two groups. Between age 35 and 59, contributions stabilized around $20 930 for immigrants and $27 820 for natives. However, the gap slightly reduces while outflows decrease steadily between ages 55 and 69. Thereafter till the end of life, contributions stabilized around $13 640 for immigrants and $18 220 for natives.

While the per-capita profiles are different but pretty close for immigrants and natives in 2015, the aggregate profile illustrated in Figure 4-B shows different patterns for the two populations, mainly due to the difference in their population size. For instance, natives are responsible for most public transfers at all ages, especially for the sub-population aged less than ten and between 60 and 70 years old. These are the ages where the size gap between the two populations is the largest.

Fig. 4
Age profile of public transfer for immigrants and natives, Canada 2015



Source:

Author's calculations

3.2. Public transfers in sub-accounts

Results from Figure 4 suggest that immigrants are responsible for a relatively small part of public transfers compared to natives. However, they account for a disproportionate share of transfer in various sub-accounts compared to their population share. Table 1 splits the Inflow and Outflow transfers for 2015 into their respective sub-accounts along with the population shares for immigrants and natives. It shows that immigrants represent about 24.2% of the Canadian population but contribute to 22.7% of outflows. Furthermore, while their share in inflow transfers (25.2%) is much closer to their share in the population, there is a significant gap between inflow sub-accounts. For instance, immigrants are only responsible for 14.5% of education costs but account for 29.5% of health expenses. For outflow accounts, the share ranges from 21.7% for sales taxes at one end and 25.4% for social insurance contributions at the other end. In dollar values, Net Transfer to public finances in 2015 is positive ($ 19 004 million or 0.96% of GDP) for immigrants but is slightly negative ($7 120 million or 0.36% of GDP) for natives. However, as the benefits of immigration become visible only in the medium and long term (Goldin et al., 2011), a more accurate analysis requires a comparison over many years.

Table 1
Population and aggregated public transfers, Canada 2015

Source: Author's calculations

Items	Absolute numbers			Percentage	
	Canada	Natives	Immigrants	Natives	Immigrants
Population	35,065	26,575	8,490	75.8	24.2
Inflow Transfers	638,972	478,204	160,768	74.8	25.2
Cash transfers (Cash)	228,722	165,925	62,797	72.5	27.5
Education Inflows (Education)	97,209	83,130	14,079	85.5	14.5
Health Expenses (Health)	154,292	108,837	45,455	70.5	29.5
Other Inflows (Others)	158,749	120,312	38,437	75.8	24.2
Outflow Transfers	627,472	485,325	142,147	77.3	22.7
Outflowss to social insurance plans (Insurance)	93,238	69,580	23,658	74.6	25.4
Taxes on Products and Imports (Sales)	235,613	184,420	51,193	78.3	21.7
Person Income Taxes (Income)	238,391	186,447	51,944	78.2	21.8
Corporate Taxes (Business)	68,197	51,040	17,157	74.8	25.2
Other Outflows (Others)	−7,968	−6,163	−1,805	77.3	22.7
Inflows minus Outflows (Net Transfer)	11,500	−7,120	18,620	−61.9	161.9

· Population are in thousand of persons

· Transfer values are in millions of CAD$

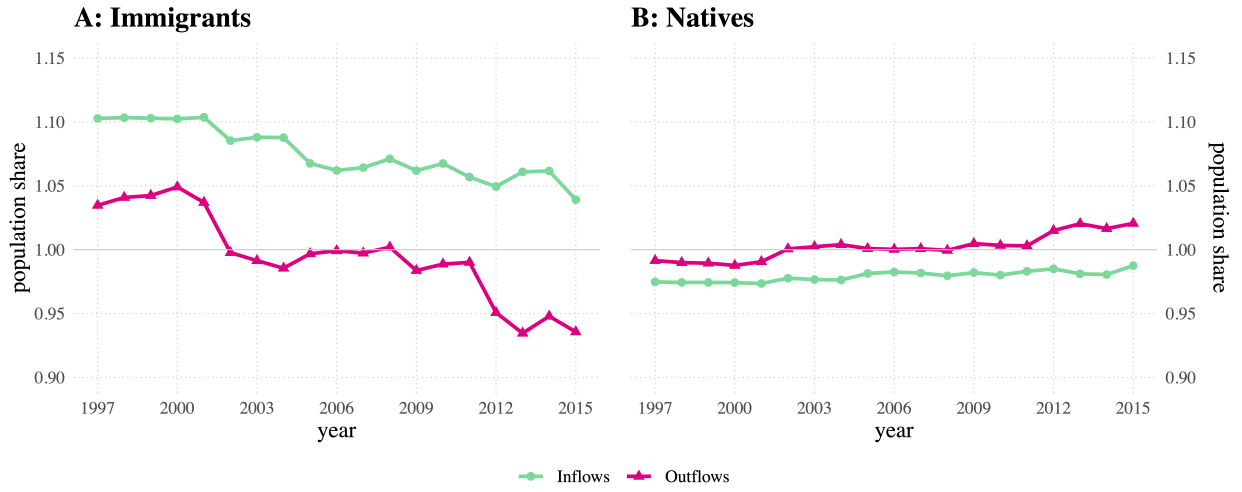
4. Trends in public transfers from 1997 to 2015

4.1. Transfer-to-Population ratio

While the aggregate Net Transfer is positive for immigrants and negative for natives for 2015, this trend is relatively recent as it became apparent only from 2012. Figure 5 shows that the opposite trend was prevailing until 2001, with immigrants contributing about 5% more than their population share.

Fig. 5

Transfer share as a ratio to Population share for immigrants and natives, Canada 1997-2015



Source: Author's calculations

Between 2002 and 2011, immigrants and natives contributed to public finances roughly in the same proportion as their population share. While the trend in outflows has reversed throughout the studied period for the two populations, the trend in inflows has been much more stable, especially for natives who received between one and two percent less public transfer than their population share. For immigrants, the cost was about 10% more until 2001 but decreased gradually to about 5% more than their share in the population.

Although aggregate measures provide exciting insights about the relative cost of immigration in Canada, crude per-capita values are better indicators for comparing immigrants and natives, as they remove the effect of the population size. Figure 6 shows the trends in crude per-capita values for Net Transfers (A) on one hand and Immigrant Surpluses (B) on the other hand between 1997 and 2015.

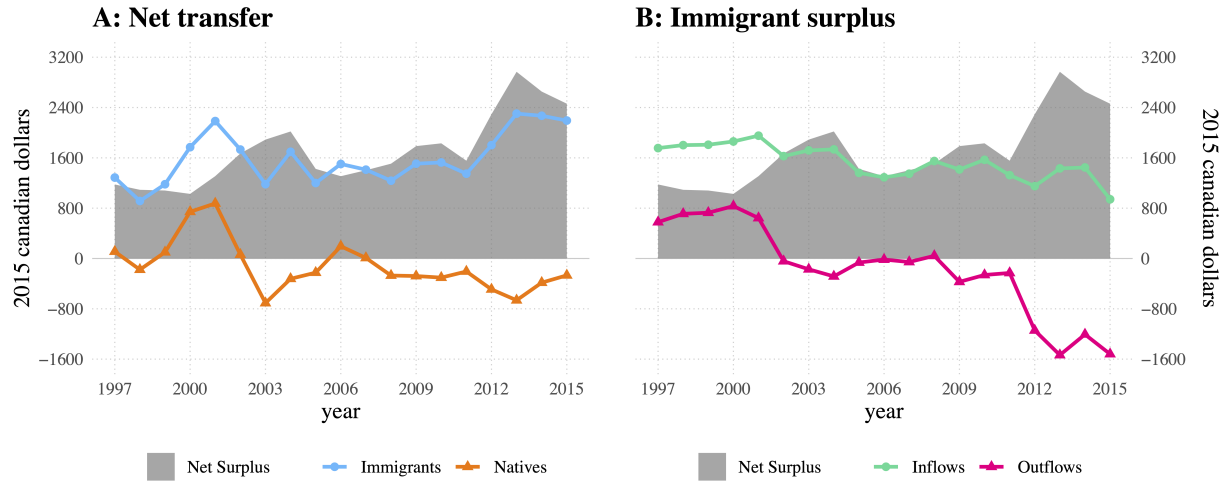
4.2. Net Transfer of immigrants and natives

Excluding the sudden increase from 2011, which increased it to $1 710, the average Net Surplus of transfer has fluctuated only slightly around $1 400 since 1997. A positive Net Surplus of transfer implies that the average immigrant has cost the state more than the

average native. However, this overall unfavourable cost says little about the origins of these costs, as it hides significant differences in trends within each group and transfer components.

Looking at the trend in Net Transfer (Figure 6-A) separately for immigrants and natives, it can be observed that immigrants have had a positive Net Transfer over the studied period. This positive Net Transfer implies that immigrants have consistently received more transfers from the state than contributing to its revenues. Between 1997 and 2011, the average Net Transfer for immigrants fluctuated around $1 400 per year. However, it rose rapidly between 2011 and 2013 to surpass $2 100. Although at a much lower level, natives have also seen a positive Net Transfer between 1997 and 2002. However, Net Transfer among natives has dropped and become negative since 2003. Between 2005 and 2015, Net Transfer among natives mostly has been negative with slight fluctuation around $280, a sign that they contribute more to the public purse than they received from it.

Fig. 6
Difference in Inflows and Outflows transfers for immigrants and natives, Canada 1997-2015



Source: Author's calculations

Together, these observations suggest that immigrants have consistently received more than they contributed. In contrast, natives have received slightly less than they contributed, leading to a consistently positive Net Surplus between 1997 and 2011. However, it is still

unclear how surpluses in inflows and outflows have trended during the studied period and which one contributed the most to the sudden increase in the Net Surplus from 2012. Figure 6-B analyze the trend in Immigrant Surplus for inflows and outflows, which may provide further clarification.

4.3. Immigrant Surplus for Inflows and Outflows

Over the studied period, the Immigrant Surplus for inflow has been positive, with immigrants receiving about $1 400 more than natives on average. However, the trend is downward, suggesting that transfers to immigrants have been decreasing compared to natives. For instance, the surplus has dropped by about $700 between 1997 and 2015 for inflows. Along with this trend, if the surplus for outflows maintained their early 2000s level, the Net Surplus between immigrants and natives would be close to null by 2015. Instead, while the surplus for inflow decreased slowly and steadily, the surplus for outflow increased drastically between 1997 and 2015. For instance, before 2002, the average immigrant contributes about $700 more than native in outflow transfer. From early 2000 however, the surplus in outflow dropped significantly. As a result, both immigrants and natives contribute about the same amount between 2002 and 2008. The situation reverses between 2009 and 2011, with immigrants contributing less than natives but only slightly. From 2012 however, the gap in outflow transfer deepened, with natives contributing about $1 400 more than immigrants.

Although Net Transfer and Immigrant Surplus result in the same Net Surplus, they illustrate different aspects of the transfer dynamic and reveal two crucial imbalances. First, the increase in Net Surplus between 2000 and 2004 is mainly due to outflows increasing for natives but stagnating among immigrants. Second, the increase in Net Surplus between 2011 and 2013 resulted from outflows decreasing for immigrants while stagnating for natives. As outflows are solely dependent on individual labour outcomes, these results suggest that the labour prospect of immigrants has degraded compared to natives during the studied period, especially during and after the 2008-2009 economic crisis. However, the crude values used to

generate these results do not account for the difference in the age structure of the two populations. Therefore, proper isolation of demographic effects is necessary for an unbiased comparison of transfer differences between immigrants and natives.

5. Decomposing the Immigrant Surplus

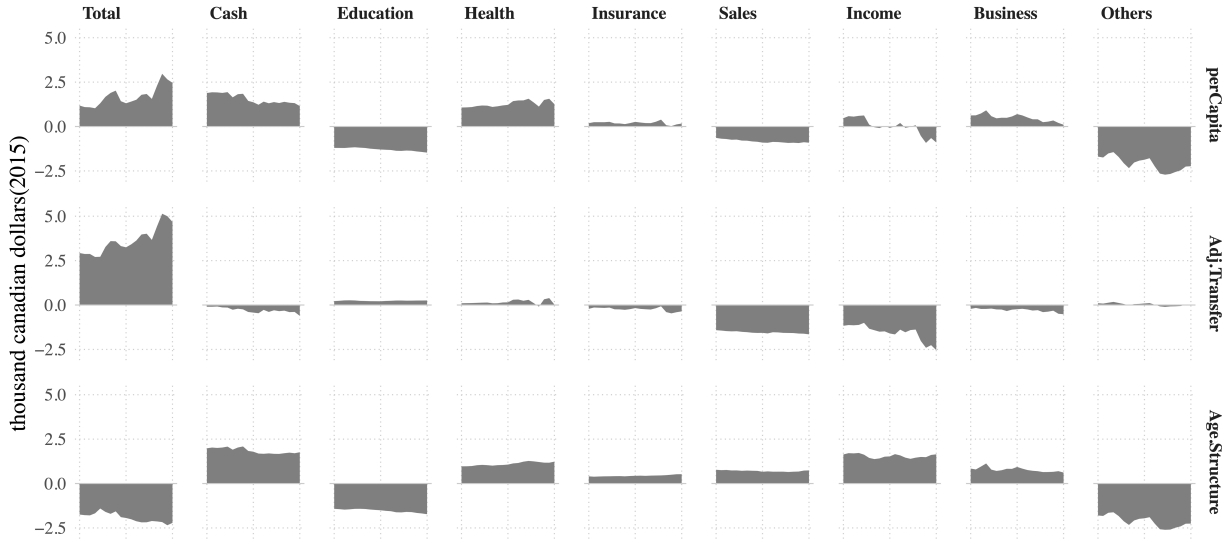
5.1. Age structure and public transfers

Public transfers are inter-generational; this involves collecting resources from the working-age population (the outflow transfers) and reallocating them to the dependent population, mostly the young and old (the inflows transfers). The immigrant and native populations are different not only in their size but also in their age structure. By dividing total (across all ages) transfer by the total population, per-capita comparison between immigrant and natives accounts for the difference in the population size but not for the difference in age structure. It follows that a comparison based on per-capita values is biased to the extent that the two populations have different age structures. To account for this biais, the decomposition discussed earlier is applied to the surpluses in each account and sub-account separately . The decomposition function takes the age-specific transfer and the population size as inputs for a given transfer account. It then applies the decomposition algorithm and returns the two components representing the respective contributions of the inputs to the per capita crude surplus. Doing so allows extracting the share of crude surplus accrued by a difference in age-specific transfer rather than a difference in the age structure of the two populations.

Age-adjusted surpluses are the components associated with age-specific transfers and represent the difference between an immigrant and a native of the same age. We will also refer to these as fiscal components On the other hand, demographic components are associated with the population size by age. However, they express only the portion of the surplus that results from a difference in the age structure between the two populations because the per-capita calculation cancels out the effect of the total population size. Also, as

Net Surplus is the sum of all Immigrant Surpluses across all accounts (inflows minus outflow), the age-adjusted Net Surplus is computed similarly, as the sum of all age-adjusted Immigrant Surpluses. Figure 7 presents the trend in the crude and age-adjusted surpluses as well as the demographic components for each sub-accounts throughout the studied period. Account names are simplified as per Table 1

Fig. 7
Trend in Immigrant Surpluses for crude transfer (perCapita) and its age-adjusted (Adj.Transfer) and demographic components(Age.Structure) by transfer accounts, Canada 1997-2015.



Source: Author's calculations

5.2. Age-adjusted Net Surplus

Results show that age-adjusted Net Surplus followed the same pattern as per-capita Net Surplus, but the levels are much higher in absolute values. Furthermore, the overall negative sign for demographic components of Net Surplus indicates that age structure is much more favourable to immigrants, as it reduced the difference between immigrants and natives from the adjusted value to the per-capita value. In other words, the per-capita difference would have been much higher than its current (crude) value if the immigrant and native populations had the same age structure. In dollar value, at equal age, the average immigrant has cost to the

state about $3 640 per year, more than the average native, between 1997 and 2016. However, a favourable population structure reduced this surplus by about $1 930, leading the $1 710 in per-capita Net Surplus. While the demographic effect has increased steadily during the studied period from $1 750 to $2 210, the trends in Adjusted Net Surplus were much abrupt with increases every few years (early 2000, late 2000, early 2010) from $2 930 in 1997 to $4 680 in 2015. The steady increase of the demographic components over the years reflects the faster ageing of the native population, as the immigrant population has been purposefully kept young through various economic immigration programs.

These results imply that the difference in age structure between immigrant and native populations accounts for much of their difference in crude surpluses. Therefore, not accounting for the demographic effect leads to conflicting results that confuse our understanding of the transfer differential between immigrants and natives, create unnecessary discord in the immigration debates, and lead to inappropriate public policy. The confusion goes even further when comparing the sub-account of inflow and outflow as we shall see in the following section.

5.3. Age-adjusted surpluses in sub-accounts

Looking at the adjusted surplus for the sub-accounts, it appears that income and sales taxes are the primary sources of the Net Surplus. This result makes sense because the other sub-accounts tied to public programs are less likely to increase social inequality to the size of the Immigrant Surplus. On the other hand, the sub-accounts of Income and Sales taxes directly relate to individual revenue, which is more subjected to labour market outcomes than public policy. However, this pattern is not observable from the crude values, and crude Net Surplus shows opposite results, with inflows appearing as the primary sources of disparities in Net Transfers. For example, most contributions to public finances represent a given proportion of the individual's income. Therefore, it is intuitive that the sub-account of income taxes reflects the difference between immigrants and natives to a large extent. On the

contrary, the crude Net Surplus for income taxes shows conflicting results, positive between 1997 and 2003, null till 2012, and negative afterward.

These results illustrate the mitigating effect of demographic components in the differences in transfer between immigrants and natives. Demographic differences are also the reasons for the high per-capita health care cost, which is close to zero in the age-adjusted surplus. In other words, the high difference in health care transfer between immigrants and natives implies that there are relatively more immigrants in the age groups with the highest health care costs. This implication may be unexpected since the average age of new immigrants entering Canada is lower than the average of the native population. But as shown by Malenfant et al. (2011, p 244), the immigrant population in Canada is older than the population as a whole because immigrants are over-represented above the age of 30 and under-represented below.

Not only have demographic differences affected the size of the Immigrant Surplus, but they have also changed its direction and trend. For example, looking at the per-capita surplus, immigrants seem to have paid on average more business taxes than natives. However, after adjusting for demographic effects, the situation reverses, with immigrants paying fewer business taxes than natives. Moreover, contrary to the per-capita measure, the trend in Immigrant Surplus is increasing. The low business taxes paid by immigrants suggest that they operate smaller businesses than natives. They also contributed toward social security and received cash transfers, slightly less than natives. The opposite applies to education and health care costs, where immigrants consume slightly more than natives.

The Other sub-account of transfer includes public goods, services, deficits and debts. The NTA method distributes these costs evenly, making no difference between immigrants and natives by design. As a result, the age-adjusted surplus for the other sub-accounts is close to zero and has the lowest absolute value among all sub-accounts. Therefore the significant negative effect (in favour of natives) seen in the per-capita surplus is mainly due to the difference in age structure between immigrants and natives. When adjusted for these

differences, the surpluses in these other sub-accounts compensated each other, revealing the sub-account of sales and income taxes as the two most important sources of disparities between immigrants and natives.

Immigrants receive similar benefits from public programs, but their low revenue does not contribute equally to public finances, leading to a positive Net Surplus. As a result, difference in sales and income taxes added up to an age-adjusted surplus of $3 090 which represent 85% of the $3 640 in total age-adjusted surplus. As these taxes come from income mainly earned from labour, the labour market stands out as a significant source of inequality between immigrants and natives. Furthermore, while both income and sales taxes are the main contributors to Net Surplus, income taxes alone drive its trends. These results stand against the expectations of a positive impact of immigration on public finances, especially for recent immigrants for whom economic factors have motivated admission. However, there are not revealed until demographic differences between immigrants and natives are accounted for. Therefore, how the labour market has become the source of so many imbalances, especially since 2011, is a crucial question to discuss and address should Canada intend to benefit from its immigrants. In particular, understanding how hiring and wage discrimination affect immigrants' contribution to society and government revenues will be essential.

6. Limitations and Conclusion

6.1. Improvements for future research

This study contributes new results to the immigration debates using new datasets and advanced methods. However, there is room for improvement in various areas, including the effects of a changing demographic structure, extended scope of the immigrant population, the age at arrival, and the healthy immigrant effect. As we have seen, omitting the demographic difference between immigrants and natives results in significant bias in analyzing the transfer differential between the two populations.

This study addressed the bias that would result from a difference in the age structure between immigrant and native populations. However, the changes in the age structure from one year to another may also introduce bias in the trend comparison. The bias may be slight for consecutive years but significant over many years as the population ages and immigration continues. The logic for such bias is the same that justifies accounting for inflation when comparing the price difference of two baskets of products over time.

Demographic effects may also arise from a different composition of the immigrant population. For instance, although this study has gathered data over many years, the cross-sectional nature of these data makes it applicable only to the first generation of immigrants. As pointed out by previous studies (Lee & Miller, 1998), defining the immigrant population is particularly challenging, and enlarging the immigrant population by including more generations may lead to different results. The first generation refers to people born outside Canada but now residing as citizens or permanent residents. Those born in Canada but have at least one parent born outside the country belong to the second generation, while those with both parents and themselves born in Canada belong to the third generation. With such variants in the immigrant population, their effect on the Immigrant Surplus would be worth investigating.

Even for the first generation of immigrants, the age at arrival could be a source of difference in transfers. For instance, there is a general assumption that immigrants arriving at working age represent a saving in childhood and education expenses which primarily occur in the country of origin. For example, Dustmann and Frattini (2014) found that between 1995 and 2011, European and non-European immigrants endowed the UK labour market with human capital that would have cost £14 and £35 billion respectively if produced through the British education system. Unfortunately, this study has not accounted for the age of arrival. However, the results suggest that immigrants have made a similar contribution in Canada, as they represent about 24.2% of the Canadian population but are responsible for only 14.5% of education costs in 2015.

If arriving later implies saving in education costs for the host country, departing earlier is also expected to reduce age-related expenses. Health care, for example, could see some savings if some immigrants return to their home country to spend the last and most cost-intensive part of their life (Bratsberg et al., 2014). This expectation does not seem to apply in Canada, as our research shows that immigrants accounted for 24.2% of the population but 29.5% of health care expenses in 2015. This result may be related to using total medical consultation as a proxy for health care expenses and, therefore, will require further investigation, especially given the other expectation that immigrants are healthier than natives (Ichou & Wallace, 2019; Vang et al., 2016). This foreign-born health advantage is known as the Healthy Immigrant Effect (HIE). It is mainly the result of immigration policies that put a relatively high weight on health status and disqualify applicants whose health conditions would cause excessive demand for health care or social services.

6.2. Conclusion

Overall, the average immigrant contributed for about $15 830 per year while receiving about $17 420 per year on average between 1997 and 2017. A native on the other hand has contributed $16 000 but received $15 890. In net, immigrants received about $1 710 more than natives on average and this surplus is increased to $3 640 when comparing immigrants and natives at the same age. Labour market imbalances are the primary sources of this difference, accounting for 85% of the Net Surplus.

These results lie somewhere between the results from Grubel and Grady (2012) and Javdani and Pendakur (2013) who reported $6 051 and $500 respectively for the fiscal year 2005/2006. Although reducing this divergence alone contributes to a healthier immigration debate, a more significant contribution from this study lies in using the NTA method, which is more englobing than previous methods regarding the type of transfers included. Moreover, the striping out of demographic disturbances through effect decomposition has brought to the light effects that would stay hidden otherwise. These methods clearly show the cost of

immigration to public finances and point to labour market imbalances as the primary source of this cost. Therefore, rather than debating whether or not immigrants' intake should be increased or reduced, it would be beneficial to debate how to enable immigrants to achieve their full potential in the labour market. The solution to such questions may involve adjusting the selection criteria. However, it also calls for more research and policies to address the labour market imbalances, especially the sudden degradation of the Immigrant Surplus since 2011.

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Troisième article.

Measuring Underemployment: A Dynamic Labour Utilization Framework

par

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ABSTRACT. This study demonstrates that the existing Labour Utilisation Framework does not appropriately measure the actual level of underemployment. Therefore, it proposes a Dynamic Labour Utilisation Framework (DLUF) that includes a systematic method for setting the underemployment threshold. Applying these methods using data from the United States suggests that the country has yet to attain full employment as the underemployment rate averaged 13,11% (±2,5) between 1999 and 2019. Furthermore, the threshold for underemployment varies widely across groups. For example, while adult men aged 25-54 would be willing to work for about 44,18 hours per week, same-age women, on the other hand, would only be available for about 38,17 hours per week, and young men and women aged 15-24 could work only for 26,81 hours.
Keywords: Labour Utilization Framework, Underemployment, Optimal matching, Cluster analysis

1. Introduction

The International Labour Organization (ILO) sets the general guides for collecting and analyzing labour statistics. However, the initial Labour Utilization Framework (LUF) was not specifically designed for measuring underemployment, i.e. the unused labour supply in the economy. Although an extended version of the Labour Utilization Framework (ELUF) recognized the need to account for labour underutilization beyond unemployment, it contains some limitations restricting its application in most countries, including major economies such as the United States. As a result, the share of involuntary part-time workers in total employment is the most widely available measure of underemployment estimated by statistical agencies worldwide (Bell & Blanchflower, 2019). The limitations of the ELUF are threefold: using the week as a period of reference, looking for the underemployed solely within part-time workers, and using an arbitrary threshold for underemployment. Together these limitations restrict the initial purpose of the ELUF to measure the levels of unused labour supply adequately.

This paper proposes a Dynamic Labour Utilization Framework (DLUF) designed to measure underemployment. Using the year as the reference period, the DLUF creates individualized thresholds for all labour market participants using optimal matching and cluster analysis.

Then it classifies each person as underemployed if their annual workload falls below the threshold and fully employed otherwise.

The DLUF allows measuring two dimensions of underemployment. On the one hand, the Underemployment Rate (UER) measures the spread or prevalence of underemployment as the percentage of labour market participants working under their threshold. On the other hand, the Labour Underutilization Rate (LUR) measures the depth or intensity of underemployment as the percentage of aggregated potential hours that remain unused. An advantage of the DLUF is that it allows accounting for the contextual labour market environment through key socio-demographic and labour force status variables. Thus, it applies to any country with existing survey data without relying on subjective responses from new questionnaires.

The contribution of this study is threefold. First, it describes the Extended Labour Utilization Framework and the limitations that lead to its low adoption. Then, it presents the improvements the Dynamic Labour Utilization Framework brings to the ELUF. Finally, the DLUF is used for measuring underemployment in the United States, using data from the Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS).

2. The Labour Utilization Framework

The Labour Utilization Framework (LUF) is the general guidelines set by The International Labour Organization (ILO) for measuring and analyzing labour utilization. Initially, the LUF describes the labour force statuses, where individuals are classified as employed, unemployed, or inactive, depending on how attached they are to the labour market. However, recent resolutions emphasized an extended version of the LUF (hereafter referred to as ELUF), recognizing the need to incorporate labour underutilization in the existing LUF.

2.1. Underemployment in the LUF

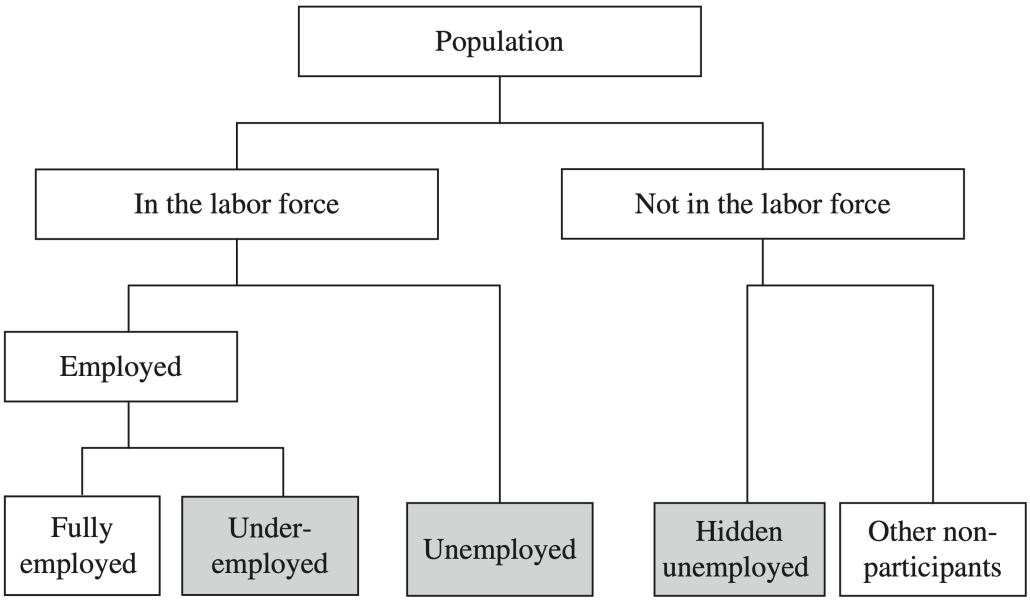
The concepts used to describe the labour underutilization situation have changed over time. The 13th International Conference of Labour Statisticians (ICLS) in October 1982 introduced the first formal definition of underemployment. It defines underemployment as a situation where a person's employment is inadequate compared with specified norms or alternative employment. Initially, the ELUF distinguished between two types of underemployment (ILO, 1982). The first is time-related and reflects an insufficient number of hours worked given a threshold. Time-related underemployment is also referred to as visible underemployment. The second is referred to as invisible underemployment and includes all other forms of underemployment. Invisible underemployment relates to an uneven allocation of labour resources or a fundamental imbalance between labour and other factors of production.

The current international standards resulted from the "Resolution Concerning Statistics of Work, Employment and Labour Underutilization" adopted at the 19th ICLS in October 2013. The 19th ICLS still distinguishes two types of labour underutilization. However, it defines underemployment solely as time-related labour underutilization. In contrast, the *other forms of labour underutilization* are called *inadequate employment*, as in the 16th ICLS. Since the adoption of the 19th ICLS, labour underutilization in the ELUF includes situations where there are mismatches between labour supply and demand, which translate into an unmet need for employment among the population (ILO, 2013). Three components of labour underutilization have been underlined and illustrated in Figure 8 from Wilkins and Wooden (2011):

- underemployment (time-related), when the working time of persons in employment is insufficient compared with alternative employment situations in which they are willing and available to engage;

- unemployment, reflecting an active job search by persons not in employment who are available for this form of work;
- Hidden unemployment (potential labour force), referring to persons not in employment who express an interest in this form of work but for whom existing conditions limit their active job search or their availability.

Fig. 8
Extended labour force underutilization framework



Source: Fig.2.1 An Extended labour force underutilization framework from Wilkins and Wooden (2011)

For the ILO, persons in underemployment (time-related) are *all persons in employment who, during a short reference period, wanted to work additional hours, whose working time in all jobs was less than a specified hours threshold, and who were available to work additional hours given an opportunity for more work…* (ILO, 2013, p. 9). The underemployed are separated from the unemployed and the hidden unemployed because they have worked and received payment for

some hours (Wilkins & Wooden, 2011). The hidden unemployed (potential labour force) are distinguished from the underemployed and unemployed because they are outside the labour force but would prefer to be in employment (Wilkins & Wooden, 2011). On the other hand, inadequate employment describes situations in the workplace that reduce the capacities and well-being of workers compared to an alternative employment situation. Therefore, employment under one's educational level or in a field that does not match one's best skills or training are considered inadequate employment rather than underemployment

While the ILO sets the conceptual standards, practical aspects for analyzing underemployment are still poorly, if ever, implemented (Sugiyarto, 2008). In most countries, it has never been implemented. This article aims to translate the ILO's ELUF into a practical framework applicable to any country. But first, we will look at the limits that make the ELUF impractical in most countries.

2.2. Limitations of the ELUF

The limitations that make the ELUF impractical are threefold: using the week as a period of reference; looking for the underemployed solely within part-time workers; and using an arbitrary threshold for underemployment. Together these limitations restrict the initial purpose of the ELUF to measure the levels of underemployment adequately.

First, the ILO recommends that the labour force statistics be collected and analyzed on a short period of reference, a week for instance. However, a short reference period is limited in capturing the overall participation. An individual may be working fewer weekly hours while totalling a higher monthly or annual workload than one with higher weekly hours because the former has a more significant number of participating weeks than the latter. A short period of reference may seem suitable to ensure that an individual will belong only to one employment status at a time. However, even during a reference period of a single week, an individual can navigate the three employment statuses. Furthermore, while hours *usually* and

actually worked are more likely to diverge on a short period of reference, there are more likely to converge to hours *finally* paid on a sufficiently long period of reference.

Second, country-specific reports and many studies confuse underemployment with part-time employment, or rather, look for the underemployed solely within the part-time workers. However, as argued by Bell and Blanchflower (2018), *There is a problem with simply measuring underemployment by looking at part-timers who say they would prefer a full-time job as there is the possibility – and reality that other groups of workers may be underemployed also.* (Bell & Blanchflower, 2018, p. 5). For instance, while most involuntary part-time workers will end up underemployed, it does not exclude that full-time workers may also satisfy the criterion of willingness and availability given some other threshold. Similarly, the underemployed should include the unemployed for having even higher levels of willingness and availability than the involuntary part-time workers. Therefore, as far as labour utilization is concerned, full-time, part-time, and unemployed workers are all candidates and different only to the extent (duration and level) of their availability and willingness.

Finally, unlike the other labour force measures such as participation rate and unemployment rate, no indicator of underemployment is measurable until the threshold that distinguishes a sufficient from a low workload is defined. The ILO recommendation is that each country sets this threshold based on local contexts, labour conditions, and particular occupations. In practice, defining this norm is a potentially tricky task (Wilkins, 2007) and rarely carried out. Instead, countries usually use arbitrary or the same threshold as part-time employment (Wikipedia contributors, 2020) which also varies across countries. For example, Canada uses 30 or more hours while Australia and the UK use 35 or more. In the United States, the Bureau of labour Statistics uses 35 hours or more, but the Affordable Care Act defines full-time as 30 or more hours. Even in the developed world, some countries require 40 hours or more to qualify for full-time. The reasonings for deciding such thresholds are not usually articulated but seem to draw on implicit social norms (Wilkins & Wooden, 2011). However, the criteria of willingness and availability imply that underemployment is first and foremost individual

and the threshold should vary accordingly. Therefore, a fixed threshold will inevitably underestimate underemployment for some individuals while overestimating it for others.

To sum up, the short weekly period of reference ignores the overall participation and thus does not offer a long enough timeframe for assigning employment prevalence and intensity. Looking for the underemployed solely within the part-time workers excludes workers that could have been underemployed based on an equivalent threshold or a more extended period of reference. Regardless of how it is selected, using a single threshold does not reflect the individual's willingness and availability, the preconditions of underemployment. With such limitations, the ELUF is impractical in most countries, and appropriate underemployment analysis would require a new or a wholly redesigned framework.

2.3. Attempts to improve the ELUF

To some extent, many (Bell & Blanchflower, 2019; Sugiyarto, 2008) recognize the limitations of the ELUF, and they have proposed alternative measures of labour underutilization to compensate for them. For example, reports from the US Bureau of Labour Statistics (BLS) usually include alternative measures of labour underutilization U-6 to complement the official unemployment rate (U-3). In addition to the unemployed, U-6 includes persons marginally attached to the labour force on the one hand and persons employed part-time for economic reasons on the other hand. According to the BLS, the marginally attached have looked for a job sometime in the last 12 months but not in the last four weeks preceding the survey (Bureau of labour Statistics, 2020). U-6, therefore, attempts to use the year as a reference period while recognizing the need to look for the underemployed beyond the involuntary part-time workers.

Taking this recognition a step further, Bell and Blanchflower (2019) propose the *Bell/Blanchflower Underemployment Index* (BUI hereafter) for all labour participants. However, the threshold is defined inconsistently for the unemployed and the employed. First, the employed thresholds rely on surveys responses on the desired number of hours. However,

most countries, including the United States and Canada, have not integrated such questions into their surveys. Therefore, the application of the BUI is limited to a few countries. Second, the index assigns to the unemployed a constant threshold calculated as the average among the employed and thus does not account for socio-demographic differences. Last but not least, the BUI combines under and over employment, two phenomena with different causes, consequences and policy implications. Therefore, the BUI may be a good summary of the state of the labour market, but its utility for public policy is limited.

Apart from their limits, the U-6 and BUI are worthwhile endeavours to compensate for the limitations of the ULUF. However, they both rely on a non-systematic approach for setting the underemployment threshold. Sugiyarto (2008) was one of the first to emphasize the importance of using a systematic approach for defining the underemployment threshold. In his paper "Measuring Underemployment: Does the Cut-off Point Really Matter?", the author proposed performing a K-Means cluster analysis on the monthly wages to create two significantly distinct groups of workers. Then, using the mean (of the means) of working hours for these two groups as the threshold for everyone. While such a method is systematic and consistent, low-salary individuals are likely to work fewer hours and thus be auto-selected in one of the clusters. Furthermore, it still does not account for socio-demographic differences.

While there have been some attempts to improve on the limitations of the existing ELUF, none of the measures we know of integrates all the solutions into a comprehensive framework. As a result, underemployment is rarely studied appropriately, and the underemployed receive relatively little attention. The Dynamic Labour Utilisation Framework (DLUF) achieves these two goals by providing a comprehensive framework that addresses the limitations that makes the ELUF impractical. In essence, the DLUF uses the year as the period of reference for measuring labour force variables, the record of unemployment or involuntary part-time employment to express willingness and availability, and a systematic approach for setting the full employment threshold.

3. The Dynamic Labour Utilization Framework

3.1. Adjusting the ELUF

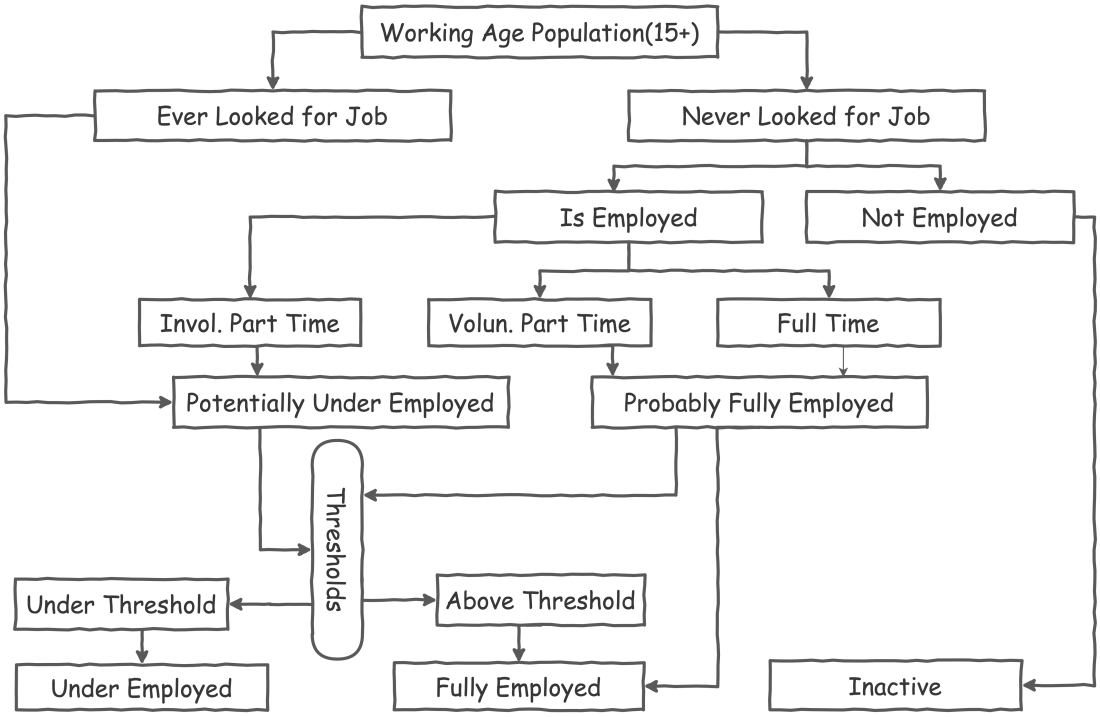
The year as reference period

As per ILO's recommendation, most countries collect Labour Force Status (LFS) variables using the week as a period of reference. While the week may be a good choice for analyzing unemployment, the year is a better time frame for measuring underemployment. It resolves many inconsistencies that make the ELUF inapplicable in most situations.

First, the traditional full-part time classification is based on a weekly workload and does not account for the overall participation. Using the year provides a consistent timeframe for measuring individual labour participation. It allows combining the weekly workload with the number of weeks worked, thus removing the need to pay special attention to temporary, seasonal, and permanent job positions.

Second, the year as a reference period integrates hours *usually* and *actually* worked. While the two measures are likely to diverge in a given week, they are more likely to converge to the number of hours paid annually, which is more consistent than either of the two. With the year set as the time of reference, the full-underemployment variable is created in a three-step process described below and summarized in Figure 9.

Fig. 9
The Adapted labour Utilization Framework for analyzing Underemployment



Source: @Gilbert MONTCHO

Willing and Available

In a first step, the DLUF uses the criteria of willingness and availability to map individuals into groups of *Potentially Under Employed* (PUE) and *Probably Fully-employed* (PFE). This classification relies on individual behaviour in the labour markets regarding the duration of their unemployment and employment and whether the employment was full-time, voluntary part-time, or involuntary part-time.

Expressly, the DLUF assumes that an individual that has ever been unemployed in the reference year is PUE to the extent of his unemployment duration. An individual who has never been unemployed in the reference year but has held an involuntary part-time job is also PUE to the extent of his employment duration. The PFE individuals are in the labour market

but do not satisfy any of the above conditions. This category includes persons that have only held full-time or voluntary part-time job positions, both of which express no willingness or availability for a new job or more hours. The inactive individuals, who have never been unemployed or employed in the reference year, retain their status, as in the ILO's framework.

Although the DLUF classification uses the current full-part-time status, it differs fundamentally from the ELUF framework, as it considers all labour participants for inclusion in the PUE group. In the DLUF classification, only those with a positive number of weeks in unemployment or involuntary part-time employment would be available for extra work hours. However, being PUE for a given number of weeks in the year does not inform on the number of hours an individual would be willing to work if the opportunity arrives at the prevailing wage. The next step comes in to fill that gap.

Individualized threshold

The second step in the DLUF methodology is to set the thresholds of underemployment for each PUE individual. It consists of first selecting PFE workers similar to each PUE individual to create their personalized cluster based on several socio-demographic variables. Then, it uses the average workload within the cluster as the cut-off point between full employment and underemployment. The assumption here is that if a PUE individual is to engage in an alternative employment situation, it would be at about the same workload as their most similar peers that are currently PFE. Thus, the threshold for underemployment can be reasonably generalized as the average workload of probably full-employed individuals after controlling for Socio-Demographic Status (SDS) variables.

The idea of using peer levels to set the threshold has been in the literature since Feldman (1996) for whom earning 20% less than in one's previous job or than one's peers is one of the five dimensions of underemployment (McKee-Ryan & Harvey, 2011). But Sugiyarto (2008) was one of the first to attempt a systematic approach for defining the underemployment threshold rather than a fixed value. He argues that the threshold should theoretically be

determined to significantly differentiate the two groups of under and full-employed regarding some essential characteristics relevant to both groups. We argue that it also is essential that the threshold satisfies two additional conditions.

First, the determination of the threshold should not rely on variables that could introduce auto-selection bias. For example, the method used by Sugiyarto (2008) was to perform a two clusters analysis (K-means) on the salary and to use the mean of the means of the weekly hours of these two clusters to serve as the threshold for all individuals. Doing so will lead to an auto-selection bias because low-salary individuals are likely to work fewer hours and thus be auto-selected in one of the clusters, leading to an auto-selecting bias. Second, it should differentiate the threshold for various socio-demographic groups. This condition is essential because different sub-populations have different levels of availability and willingness. For example, a full-year student or a 65-year-old person looking for a job is unlikely to have the same thresholds as a prime-age or non-student worker.

One way to ensure these two conditions is to individualize the thresholds to allow the threshold within any socio-demographic cross-group to reflect the particular behaviours of individuals of that group in terms of optimal working hours. This study proposes a dynamic method for setting thresholds using cluster analysis and optimal matching methods. The computational implementation for setting the threshold is described in section 3.3.

3.2. Labour force status in the DLUF

The third and last step is simply a classification of each PUE individual as underemployed (UE) or fully-employed (FU) based on whether their actual workload is lower than their personalized threshold or otherwise. This design ensures that the more time one spends in unemployment or involuntary part-time work, the greater the chance of being underemployed. However, not all persons that experience unemployment will end up in underemployment; neither is it automatic for one in an involuntary part-time job to be counted as underemployed, as would be the case in the Extended Labour Utilization

Framework (ELUF). These conditions only make one PUE. The underemployment judgment is made only after considering worked hours of one's most similar peers that are PFE. As the average working hours of the probably full-employed individuals reflects their personal preference, and by using this average as the underemployment threshold, it follows that PFE individuals are confirmed full-employed (FE).

In the Dynamic Labour Utilization Framework (DLUF), an underemployed is a person that experienced unemployment or involuntary part-time employment and whose worked hours are less than the average workload of similar individuals that did not experience any of the two phenomena during the reference year. The following example illustrates the differences between the ELUF and the proposed DLUF. Suppose an individual has been out of the labour force from January to November. In December, he entered the labour market and searched for a job for two weeks, found one, and worked for 50 hours in total between the 15th and 31st of December. The ELUF would classify the individual as inactive, unemployed or employed, depending on the survey's date during the year. In the DLUF, this person would be classified as underemployed if her most similar workers' average workload in the reference year is greater than 50 hours and FU otherwise. This method is dynamic as it allows the threshold to vary for different SDS and combinations of SDS; and systematic as it removes the guesswork that countries would find challenging and unsatisfying to perform. The following section presents the computation algorithm of the dynamic threshold.

3.3. Setting the thresholds

A single threshold of Underemployment

The simplest method to estimate the underemployment threshold as described above would be to view the potentially underemployed (PUE) and probably full-employed (PFE) groups as homogeneous internally, solely based on availability and willingness. Then we can estimate a single underemployment threshold for all PUE workers as the average workload of all PFE individuals. For the US, such a threshold would then be 40 ($\pm$14) hours per week (working 50

week/year) between 1999 and 2019. While this single threshold has the advantage of being systematic and not arbitrarily chosen as in the ELUF, it, however, does not allow for differentiation among different SDS groups. For example, it implies that a 70 years old retiree looking for a job will be available and willing to take the same workload as a 35 years old young adult, which is possible but improbable. Therefore, a threshold system with greater flexibility is needed.

Methods for setting a dynamic threshold

One way to implement a dynamic threshold would be to regress actual working hours by key SDS variables within the PFE group and use the model to predict the thresholds for PUE individuals. In this case, one would need to decide on a sound model that best captures the relationship between variables. The results will be as good and valuable as the model is parsimonious. One could also use a cross-tabulation method to create a local threshold within each of the subgroups defined by a given combination of SDS variables. A limit of this method is that there could be too many combinations of SDS variables that are not always meaningful, and measuring the threshold within these groups may not always be possible.

A workaround to these limitations would be to perform a cluster analysis of the working hours for the PFE individuals. Cluster analysis refers to a large body of statistical methods and computational algorithms for creating groups within which individuals are more similar compared to each other than to those in other groups regarding some features. Like factor analysis and principal component analysis (PCA), such a method would provide the optimal number of cross-tabulation cells and uncover the latent factors underneath the phenomenon under study. However, latent variables have a significant weakness; there are mathematical constructs to which it is difficult to attach explicit semantic information (Taeb & Chandrasekaran, 2018).

Algorithm for the dynamic threshold

None of the above methods is satisfying on its own. Therefore, this study proposes a dynamic threshold that compensates for their limitations while building on their strengths. The Dynamic Labour Utilization Framework (DLUF) combines the technics of cluster analysis and optimal matching to set the underemployment threshold. On the one hand, it extends the cluster concept to allow each individual to have its subgroup of most similar individuals that are PFE. On the other hand, it uses optimal matching to find the PFE individuals to include in the personalized cluster of a given PUE individual while measuring the similarity between individuals based on SDS variables that a regression model would include. Optimal matching is, along with cluster analysis, one of the most used methods in biology, artificial intelligence, machine learning, and, more recently, social sciences.

The estimation of individualized thresholds involves the creation of a wrapper algorithm around the Gower package (Van Der Loo, 2017) in R (R Core Team, 2018). The first step is to split the data table into two groups, PUE and PFE cases. Then, the function $gower\_dist(x,y)$ is invoked for each PUE case, with x the vector of the current PUE case and y the matrix of all PFE cases. The function returns a vector of values representing pairwise similarity measures between the PUE case and each PFE case. The next step is to select all PFE cases for whom the similarity measure is maximal to form the individualized cluster. Doing so implies that each PUE case would have at least one similar PFE case in its cluster while the maximum is allowed to vary (to the limit of the maximum similarity value). Finally, the threshold for each PUE case is calculated as the weighted average of annual working hours for the PFE cases in its cluster, the weight being the level of similarity multiplied by the initial weight of the case. With thresholds calculated for each PUE individual, the PFE individuals are now confirmed full-employed, and their threshold is set at their current working hours.

4. Underemployment in the United States

This section presents an application of the proposed methods for the United States using data from the Annual Social and Economic Supplement of the Current Population Survey (ASEC-CPS) extracted from IPUMS-CPS (2020).

4.1. Variables and analytical sample

This paper uses two sets of variables. The first set contains labour participation variables, including the number of hours annually worked, the employment type (full-time, voluntary part-time and involuntary part-time) of the primary job, the number of unemployed weeks and the number of employed weeks. The last two variables are combined to create the active weeks variable: the duration in weeks an individual has been in the labour market as employed or unemployed in the reference year.

The second set contains socio-demographic variables, including sex, age group, highest educational attainment, marital status, school attendance, household type, immigration status, class of workers, firm size, health status, disability status and province of residence. Household type in created using the *famsize* and *nfams* variables from the ASEC-CPS. For the marital status variable, the statuses of *separated*, *divorced* and *widowed* are combined into a single *Was maried* status. Similary, the health statuses of *excellent* and *very good* are grouped into a single status of *great*. The provinces of residence are grouped into four regions[3] as defined by the Census Bureau. These socio-demographic variables are coded as nominal, except for age group and highest educational attainment coded as ordinal.

It is worth mentioning that, because the Gower distance computation is different for each variable type (numeric, ordinal, or nominal), all the variables above have been recoded into an appropriate R data type to ensure proper inclusion. de Velden et al. (2019) provides a detailed

[3]See details at https://en.wikipedia.org/w/index.php?oldid=1048000404

discussion on how each type of variable contributes to the overall Gower distance. Table 2 presents descriptive statistics of the variables involved in the study for the United States.

Table 2
Weighted means and standard errors of labour force status variable by various socio-demographic status, United States 1999-2019

Source: Author's calculations

	Underemployed(%)		Weekly hours gap		Active weeks		Weeks Unemployed		
Variables/Options	Yes	No	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Sample(%)
Gender									
Male	16.57	83.43	1981	723	48.96	9.44	1.82	6.90	51.93
Female	16.66	83.34	1709	727	47.37	11.22	1.51	6.37	48.07
Age group									
Young:15-24	27.72	72.28	1234	807	40.74	16.46	2.83	8.56	14.34
Adult:25-59	14.89	85.11	1984	650	49.77	7.70	1.52	6.32	77.67
Older:60-69	13.42	86.58	1761	783	47.29	11.44	1.08	5.59	7.99
Education level									
HS Graduate or less	21.61	78.39	1755	755	47.44	11.48	2.28	7.77	39.98
Pre-University	16.59	83.41	1801	740	47.95	10.71	1.62	6.53	29.11
University	10.17	89.83	2023	680	49.42	8.20	0.96	5.00	30.91
School attendance									
No Attendance	15.09	84.91	1981	651	49.53	8.20	1.63	6.58	80.53
Full Year	20.47	79.53	989	707	39.20	16.99	1.80	6.93	12.80
Part Year	27.56	72.44	1891	701	48.85	9.30	1.90	7.08	6.66
Marital status									
Never Married	23.87	76.13	1597	801	45.55	13.37	2.52	8.15	27.97
Still Married	12.67	87.33	1977	678	49.39	8.40	1.13	5.43	58.37
Was Married	18.58	81.42	1918	673	49.32	8.59	1.96	7.22	13.66
Household type									
One Person	17.30	82.70	1963	682	49.38	8.42	1.71	6.68	9.17
2+ Persons	16.13	83.87	1843	745	48.08	10.57	1.62	6.59	83.95
2+ Families	21.52	78.48	1801	713	47.98	10.44	2.14	7.33	6.88
Immigration status									
US Born	16.18	83.82	1845	750	48.04	10.60	1.66	6.66	83.03
Immig. 9 yrs or less	22.36	77.64	1805	700	47.89	10.58	2.08	7.21	4.22
Immig. 10 yrs or more	17.52	82.48	1921	651	49.49	8.26	1.60	6.49	12.75
Employment type									
Full Time	5.98	94.02	2126	536	50.15	7.21	1.16	5.54	72.40
Vol. Ptime	9.54	90.46	983	655	41.06	15.83	1.60	6.47	16.93
Inv. Ptime	100.00	0.00	1311	719	45.86	12.54	5.25	11.27	10.67
Class of worker									
Self-Employed	18.19	81.81	1974	877	48.74	9.36	1.14	5.67	9.49
Employee-Private	17.82	82.18	1829	728	48.16	10.53	1.89	7.06	75.17
Employee-Public	9.73	90.27	1901	677	48.17	10.00	0.84	4.75	15.33
Firm size									
Under 100	20.00	80.00	1792	790	47.72	11.02	1.90	7.09	42.51
100 to 999	14.75	85.25	1911	680	48.65	9.67	1.62	6.49	18.11
1000+	13.82	86.18	1891	698	48.54	9.88	1.45	6.25	39.38
Health status									
Great	14.81	85.19	1873	737	48.26	10.32	1.41	6.06	68.99
Good	19.40	80.60	1841	716	48.55	9.83	2.08	7.45	24.69
Bad-Fair	25.34	74.66	1676	794	46.45	12.28	2.93	8.97	6.32
Has disability									
Yes	30.75	69.25	1306	831	40.95	15.76	3.52	9.92	2.82
No	16.20	83.80	1869	728	48.43	10.06	1.62	6.53	97.18
Total	17.00	83.00	1246	697	48.00	10.00	2.00	7.00	100.00

· individuals that need hours are those willing and available for more hours.

Source: Author's calculations

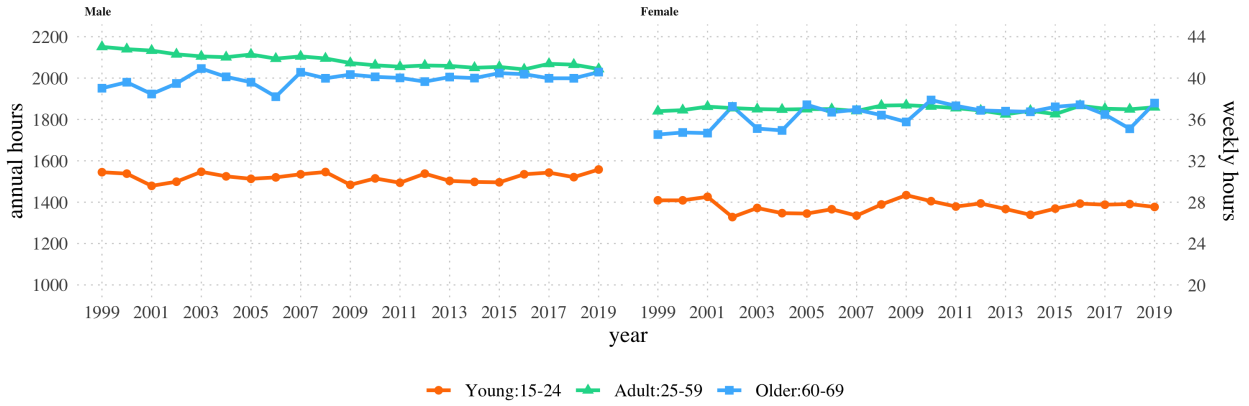
The analytical sample consists of 2 065 551 individuals aged 15 to 69 who have participated in the labour market from 1999 to 2019 for an average of 48 (±10) weeks per year and 2 (±7) weeks in unemployment. The sample contains 48% women, 14% are aged 15-24, and 8% are aged 60 and over. The results from applying the first step of the dynamic framework show that 17% of individuals in the sample would be available and willing to work additional hours. Those are the potentially underemployed (PUE) workers. The variables required to create the groups of PFE and PUE are the number of unemployed weeks and the employment type (full time, voluntary part-time and involuntary part-time). Besides the socio-demographic variables discussed above, the number of active weeks is also used in the matching process to measure the level of labour attachment. Interestingly, while all workers in involuntary part-time employment are PUE as expected, 9% of the voluntary part-time and 6% of full-time workers would also be PUE.

4.2. Threshold summaries and trends

The threshold process described above creates a cluster of neighbours around each PUE individual, similar to social networks. Each individual is the centre of its personalised cluster, which may overlap with many others. There is an average of 3 (±4) PFE individuals in each cluster. The average underemployed worker would require about 37 (±12) hours per week to reach its full employment threshold. Individualised thresholds allow the computation of means and standard deviations for various combinations of SDS categories over time. Figure 10 and Table 3 present average underemployment thresholds by age groups, gender and various SDS categories. Weekly equivalences are calculated from the annual threshold, assuming 50 weeks of labour market participation per year.

Fig. 10

Trend in average thresholds by age group and sex, United States 1999-2019



Source: Author's calculations

Table 3
Average weekly equivalent (hours/week) of annual threshold by age group and selected socio-demographic variables, United States 1999-2019

Variables	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Gender											
Male	16.95	33.58	41.89	43.89	44.72	44.97	45.03	44.81	43.89	41.15	35.31
Female	15.41	29.64	37.18	37.46	37.73	38.28	38.97	39.18	38.38	36.01	30.54
Education Level											
HS Graduate or less	15.57	35.12	39.20	40.11	40.75	41.12	41.26	41.11	40.20	37.73	32.10
Pre-University	18.15	28.07	38.95	40.44	41.20	41.45	41.77	41.68	40.80	38.26	32.77
University	34.69	33.67	40.87	42.09	42.49	42.90	43.39	43.53	42.71	40.02	34.47
School attendance											
No Attendance	26.34	35.96	40.84	41.91	42.45	42.74	42.98	42.90	42.75	40.97	36.89
Full Year	11.83	20.53	26.97	26.43	26.09	26.13	26.48	26.27	24.33	21.48	18.24
Part Year	22.41	32.48	41.12	42.59	43.56	44.08	44.05	44.22	44.07	42.91	42.01
Marital Status											
Never Married	15.82	30.72	39.51	41.06	41.53	41.79	41.78	41.44	40.78	39.07	34.76
Still Married	30.34	36.69	39.97	40.86	41.46	41.79	42.12	42.20	41.31	38.71	32.97
Was Married	24.44	35.91	39.74	41.00	41.64	42.02	42.39	42.11	41.20	38.53	33.24
Household type											
One Person	30.58	36.86	42.39	43.87	44.06	43.72	43.32	42.52	41.37	38.72	32.93
2+ Persons	15.25	30.79	39.17	40.52	41.21	41.61	41.97	42.04	41.22	38.63	33.06
2+ Families	24.98	33.25	40.32	41.33	41.66	42.05	42.26	42.16	41.29	40.17	36.64
Immigration status											
US Born	15.72	31.36	39.75	41.04	41.59	41.90	42.18	42.15	41.21	38.48	32.61
Immig. 9 yrs or less	25.45	34.65	38.76	39.98	40.63	40.96	41.15	41.60	40.57	39.24	36.43
Immig. 10 yrs or more	19.61	33.43	40.07	40.87	41.37	41.71	42.04	41.91	41.51	40.09	36.48
Employment type											
Full Time	28.85	38.42	42.52	43.56	44.18	44.48	44.57	44.53	44.15	43.19	41.79
Vol. Ptime	11.79	20.25	25.00	24.65	24.27	24.54	25.05	25.10	23.34	20.82	17.83
Inv. Ptime	17.76	30.35	36.67	38.08	38.68	38.86	39.05	39.02	38.81	37.37	34.88
Class of worker											
Self-Employed	13.01	35.15	40.94	41.97	42.86	43.54	44.26	43.97	42.86	39.87	34.58
Employee-Private	16.45	31.71	39.55	40.81	41.37	41.74	42.00	41.98	41.21	38.83	33.15
Employee-Public	13.51	30.75	40.27	41.15	41.32	41.11	41.20	41.29	40.22	37.16	31.22
Firm size											
Under 100	15.23	31.86	39.11	40.13	40.72	41.10	41.56	41.57	40.69	37.95	32.40
100 to 999	16.98	32.79	40.49	41.44	42.00	42.23	42.48	42.44	41.56	39.64	33.99
1000+	17.12	31.08	39.93	41.51	42.08	42.41	42.57	42.49	41.67	39.11	33.90
Health status											
Great	15.65	31.56	40.11	41.35	41.91	42.27	42.68	42.77	41.97	39.47	33.83
Good	18.33	32.18	38.74	40.13	40.89	41.38	41.73	41.73	40.95	38.42	33.05
Bad-Fair	19.44	31.72	37.10	37.96	38.40	38.61	38.95	38.73	37.85	35.55	30.36
Has disability											
Yes	16.81	26.47	30.55	31.53	31.80	32.10	31.44	31.48	30.44	28.43	24.17
No	16.18	31.77	39.88	41.14	41.72	42.09	42.47	42.52	41.75	39.30	33.75

Source: Author's calculations

The dynamic threshold is expected to deliver noticeable differences in the thresholds for socio-demographic groups with various levels of labour attachment. Results from Figure 10 and Table 3 seems to fulfill this expectation. For example, adult men aged 25-54 would be willing to work for about 44,18 hours per week, same-age women, on the other hand, would only be available for about 38,17 hours per week, and young men and women aged 15-24 could work only for 26,81 hours (Figure 10). As shown in Table 3, average thresholds are the highest for adult men aged 44-45 (45,03 hours per week), and the lowest thresholds are observed among those aged 15-19 years (15,41 hours per week). It is also interesting to note that voluntary part-time workers have a lower threshold than involuntary ones for all age groups. The variability in thresholds shown in Table 3 demonstrates the flexibility that no previous framework could deliver. These thresholds describe the optimal matching between demand and supply of labour and the adjustment of personal preferences after considering economic conditions.

4.3. Measuring underemployment

The *Bell/Blanchflower Underemployment Index* (Bell & Blanchflower, 2019) discussed previously does not apply to the United States as to most countries because it requires individual responses for desired hours which is unavailable in existing labour force surveys. Therefore, the share of involuntary part-time workers in the labour force remains the most widely used measure of underemployment in academic research (Beukes et al., 2017; F, 2016; Young & Mattingly, 2016). This measure is sometimes augmented with the unemployed and published as a supplementary measure following the ILO's recommendations for official statistical reports. For example, the official unemployment rate U-3 in the United States was around 3.7% in 2019, while the labour underutilization rate represented by U-6 has been much higher, about 7.2% (Bureau of labour Statistics, 2019). However, due to the limitations pointed out earlier, these measures do not capture the actual levels of labour underemployment. For example, Gallup polls reported in 2012 that 18% to 25% of American workers perceived

themselves as underemployed (Thompson et al., 2013) while the official U-6 rates estimated 14.7% for the same period (Bureau of labour Statistics, 2020).

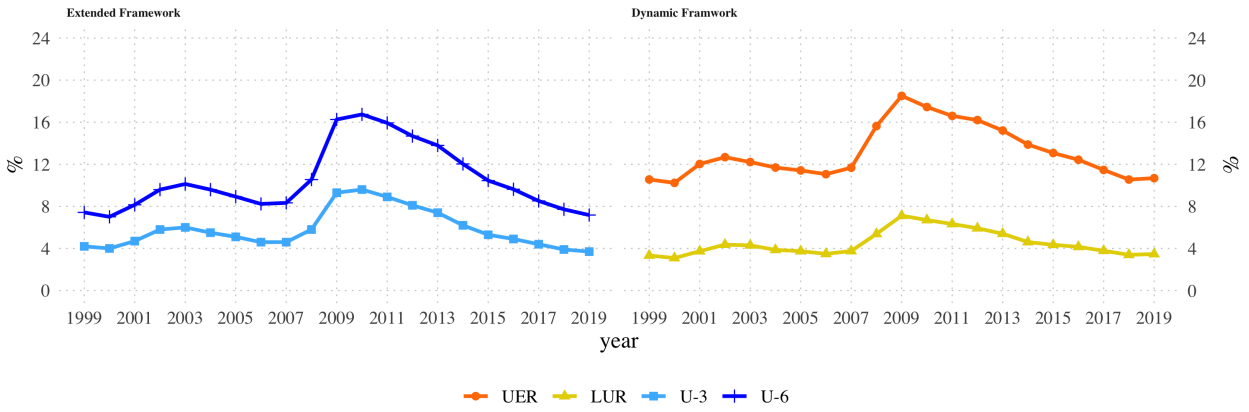
Using individualized thresholds from the Dynamic Labour Utilization Framework (DLUF), this subsection estimates two indicators to gauge the levels of underemployment. On the one hand, the Underemployment Rate (UER) uses the number of persons working under their threshold. On the other hand, the Labour Underutilization Rate (LUR) uses the additional hours required for full employment.

The UER measures the prevalence of underemployment, calculated similarly to the unemployment rate by dividing the number of underemployed persons by the population in the labour force and expressed in percentage. As a rate calculated from population count, UER expresses how the phenomenon of underemployment is spread but says little about the corresponding labour supply that is unused. The Labour Underutilization Rate (LUR) fills this gap. The LUR is calculated from the hours rather than the person count. It divides the additional aggregated hours by the potential aggregated hours worked at full employment for all labour market participants in the reference year. Aggregate additional hours are the sum of the hour gap (described below) from all underemployed persons. Potential aggregated hours worked are the aggregated worked hours augmented with the additional aggregated hours.

Both UER and LUR require variables on hour gap and Underemployment Status. The hour gap is the difference between the threshold and the hours worked annually. Therefore, it represents the number of additional hours an underemployed person requires to reach full employment. Underemployment Status is derived from the hour gap and coded with 1 (Yes, for underemployed) if the hour gap is positive and 0 (No, for full employed) otherwise. Figure 11 presents the trends in the measures from the dynamic framework (UER and LUR) on the one hand and the extended framework (U-3 and U-6) on the other hand throughout the studied period.

Most countries have no official underemployment rate published. In the United States, the most encompassing measure of labour underutilization published by the BLS is the U-6. Over the last two decades, U-6 and U-3 have followed the same trend. However, U-6 has been much higher, averaging 10,5%, almost two times the levels of U-3 (5,8%). And yet, U-6 still underestimates the phenomena of underemployment from the perspective of the dynamic framework, as UER averaged 13,11% (±2,5) over the observed period. Before 2008, UER has been stable at around 10,23% (±12,68). From then, it increased during the recession, reaching 18,51% in 2010 before trending downward to its pre-recession level in 2019.

Fig. 11
Labour underutilization measures from the extended and dynamic framework perspective, United States 1999-2019

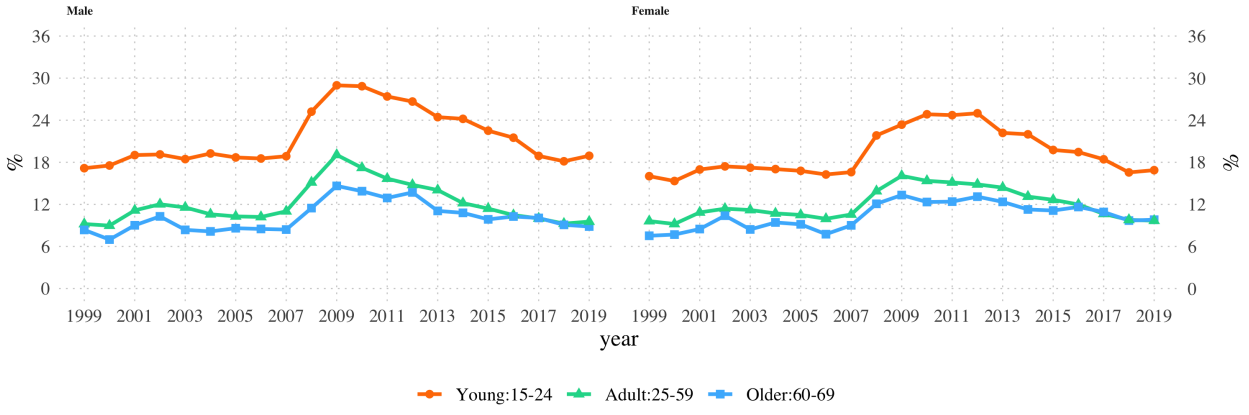


Source: Author's calculations

The high level of UER rate reflects the widespread underemployment. However, workers in the United States are quite close to their full employment threshold than the UER suggests. This is reflected in the relatively low level of LUR, averaging 6,28% (±2,68) of the labour potential over the studied period. In other words, while the prevalence of underemployment is far greater than what the official statistics implied, its intensity has been less dramatic. Interestingly, LUR has about the same trend and levels as U-3. This similarity is unexpected and suggests that the official unemployment could be a proxy for the additional labour supply

from the underemployed, despite being often criticized for not reflecting the actual level of labour underutilization. It could also be a coincidence as the two indicators use two overlapped but distinct reference populations on the one hand and different calculation methods on the other hand. Nevertheless, this unattended result deserves further investigation in future research.

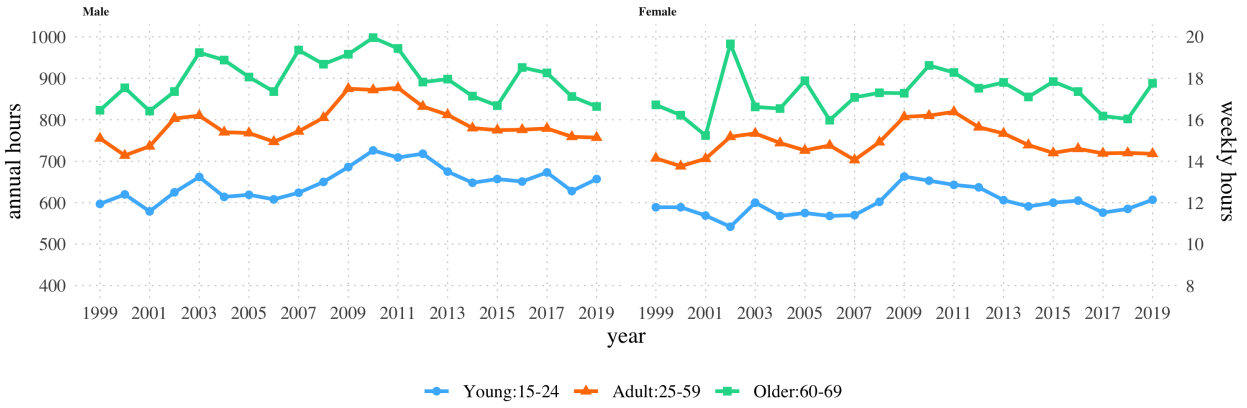
Fig. 12
Underemployment rates by age group and sex in the United States, 1999-2019



Source: Author's calculations

The trends in UER and LUR across sex and age group are similar to the overall trends (Figure 12) except that rates are slightly higher for men and notably higher among younger workers. Assuming participation over 50 weeks in the year, an underemployed worker would require about 15 hours (±3) per week to reach full employment (Figure 13).

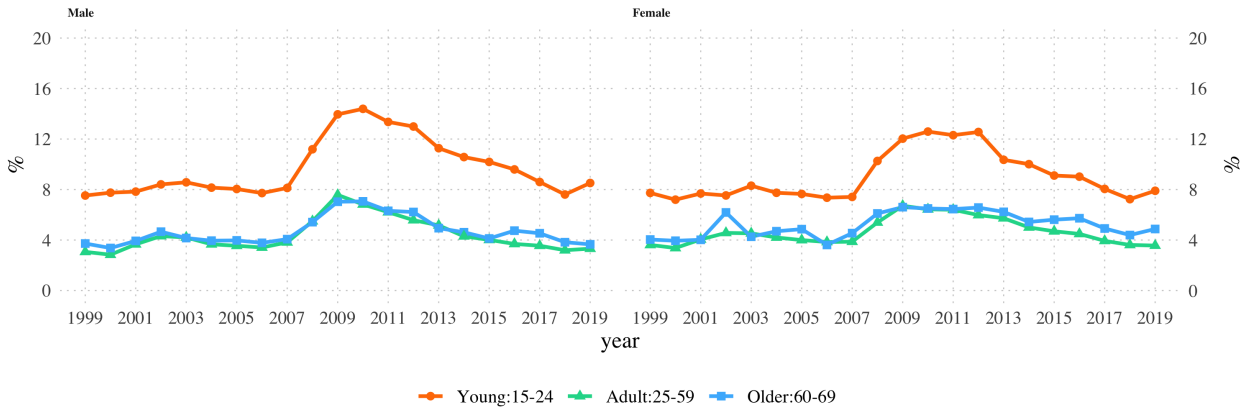
Fig. 13
Trend in hour gap by age group and sex in the United States, 1999-2019



Source: Author's calculations

In relative terms, labour underutilization is much higher among younger workers. It averages 9,39% against 4,51% for adult workers, and about the same as older workers (4,95%) throughout the studied period. Interestingly, while younger workers have a much higher willingness for additional hours, as shown by their high prevalence of UER (Figure 12), they, however, have lower availability as reflected by a lower hour gap (Figure 13). Nevertheless, in relative terms, there would be more to be gained from full employment of the youngers as reflected by their higher LUR (Figure 14).

Fig. 14
Trend in labour underutilisation rate by sex and age group in the United States, 1999-2019



Source: Author's calculations

Overall, these results show that the United States has yet to attain full employment. While UER and LUR also follow the cyclical trends of the economy, average thresholds appear much more stable over the years. This stability suggests that thresholds are less likely to decrease during an economic downturn and increase back as labour prospects improve. In other words, once optimal hours crystalized into living standards, they are less subject to cyclical change in working conditions. On the other hand, the hour gap and, therefore, the UER and LUR fully reflect current labour market conditions and show more variability than the thresholds.

5. Conclusion

For lack of better measurement, most studies on underemployment only focus on involuntary part-time workers. As a result, previous measures do not reflect the actual level of labour underutilization. This study described the limitations in the existing Labour Utilization Framework that limit its application. It then presented a Dynamic Labour Utilisation Framework (DLUF) that includes a systematic method for setting the underemployment threshold.

The DLUF classifies individuals into new Labour Force Status (LFS) categories of *Probably Fully-Employed* (PFE) and *Potentially Under Employed* (PUE), leaving the inactive persons in a separate category as in the ILO's framework. It then assigns a threshold to each individual that is PUE, based on the working hours of similar individuals that are PFE. The DLUF applies to any country with minimal data containing appropriate estimates of annual working hours, the number of weeks per year, and several socio-demographic variables.

Applying the DLUF using data from the United States show a high prevalence of underemployment, as UER averaged 13,11% (±2,5) between 1999 and 2019. However, the intensity of underemployment as measured by the Labour Underutilisation Rate (LUR) is less severe with an average of 6,28% (±2,68) over the studied period. Furthermore, the threshold for underemployment varies widely across groups. For example, while adult men aged 25-54 would be willing to work for about 44,18 hours per week, same-age women, on the other hand, would only be available for about 38,17 hours per week, and young men and women aged 15-24 could work only for 26,81 hours.

The DLUF approach is empirical, relying on available data rather than a pre-existing theory. Nevertheless, building on the economic definition of full employment makes it a robust framework for analyzing underemployment. According to most economists, a country attains full employment when it employs everyone willing and available to work at their required work hours. In full employment, unemployment is possible and should correspond to the time it takes for workers to switch jobs. However, underemployment is excluded and reveals a deficiency in the demand for labour and the macroeconomic system constraining employment opportunities and forcing some individuals into involuntary unemployment or part-time employment (Mitchell & Muysken, 2008). Consistent with the economic definition of full employment, the DLUF allows for unemployment but only to the extent that it does not lead to an annual workload that sets the individual apart from his peers. In the DLUF, the workers classified under the usual terms of employed and unemployed are different only to

the extent that their annual worked hours are different. This method can be relied upon as much as one can on the principle that similar causes will produce similar results.

Despite its novelty, the DLUF has limitations, some of which may be easily improved in future studies. A significant weakness of the DLUF is that it cannot provide timely or month-to-month estimates similar to other labour statistics, such as the unemployment rate. This limit is due to the explicit use of the year instead of the week as a reference period. This condition may be released to some extent, and future studies will look into that possibility.

The Dynamic Labour Utilisation Framework (DLUF) finds the underemployed among workers that have experienced unemployment or involuntary part-time employment during a reference year. Therefore, it is more inclusive than the Extended Labour Utilization Framework (ELUF). Nevertheless, it excludes workers that may desire more hours without ever manifesting this desire by quitting and looking for a different job.

For instance, full-time workers that are not looking for new jobs are not necessarily satisfied with their current workload. They may, as the PUE, have a desire to increase their workload but perceive no hope for a better option. Full-time workers may perceive current economic conditions as unfavourable and thus stay at their unsatisfying job even though they prefer a higher workload at the prevailing rate. Therefore, they are much like discouraged workers who have left the labour market because of prolonged unemployment.

Future expectations and actual conditions of the labour market, as reported in the media, and how these prospects occurred among one's most social similarities, also contribute to enforcing the PFU status, even though these workers would move into the "PUE" group in alternative circumstances. In this regard, the results based on the DLUF would underestimate the level of underemployment. However, the bias may be reasonable if we consider that quitting or looking for a job is evidence of availability and willingness to work additional hours. In any case, the Dynamic Labour Utilisation Framework (DLUF) opens the door for new opportunities to explore underemployment. This phenomenon has not received adequate

attention but has a significant social impact, especially in the context of population ageing and the increasing risk of labour shortage.

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Quatrième article.

Underemployment in an Ageing Population: Evidence from the Canadian Labour Market

par

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ABSTRACT. Population ageing has brought about debates over potential labour shortages in many countries, particularly Canada. With women's participation stagnating and immigration raising heated debates, harnessing the labour supply from the underemployed could be an alternative for compensating for an eventual labour shortage. However, underemployment and the underemployed have received relatively little attention from governments and researchers worldwide.

In this study, we use the Canadian labour force surveys with data covering the period between 1981 and 2017 to analyze the prevalence of underemployment and the additional labour supply that persons working under their full employment potential represent. We also explore the personal characteristics associated with underemployment to guide public policies that aim at greater well-being through full employment.

Results show that between 1981 and 2017, there are, on average 3,4 million underemployed workers per year, representing 20,1% of the labour force, who could have provided an additional labour equivalent to 1,5 million full-year workers, working 40 hours per week for 50 weeks per year. Being single or having a low education level are the main traits of underemployed men, while recent immigrants and less educated best describe underemployed women.
Keywords: Population aging, Underemployment, Labour Utilization Framework

1. Introduction

Ageing and the labour shortage debate

As the Canadian population ages, the share of the working-age population, that is, persons aged 15 to 64 years old, is expected to decrease by about ten percentage points from 1983 to 2063, from 68.4 to 58.9 in a medium growth scenario. At the same time, those aged 65 years and older will see their share of the population increase by about 16 points, from 9.9 to 25.6 (Statistics Canada, tables 1710005701 and 1710005801). If these prospects have brought about debates over potential labour shortage, the latter has been a concern since World War II (Grimmett & Echols, 2002; Spurgeon, 2000), and immigration has been the primary source of additional labour supply. For example, since the early 1990s, the number of landed immigrants has remained relatively high in Canada, with an average of approximately

235,000 new immigrants per year (Canada, 2016). In 2018, the government adopted a historic multi-year levels plan to grow its annual immigration levels to 340,000 by 2020 (2018 Annual Report to Parliament on Immigration). While some (Denton et al., 1997; Newton et al., 1981) justify these high levels of immigration by economic reasons such as labour shortage and economic growth, others (Gingras & Roy, 2000; Green & Green, 1999; Watt-Malcolm et al., 2013) believe that economic reasons should not be the basis for an immigration policy. Immigration, they argue, should now be seen primarily as a cultural, social and humanitarian policy rather than an economic one (Green & Green, 1999).

Of course, a historical alternative to immigration has been promoting labour participation among women. From 18.3% in 1951 to 56.8% and 82% in 1995 and 2014 (Tremblay, 2002) respectively, women's participation has seen one of the most spectacular improvements over the last century. However, the tremendous growth in female participation since the mid-1900 seems to have reached its climax in the late 90s. Since then, the growth rate has decreased, narrowing the gap between men and women. From about 60 percentage points in the 1960s, the participation gap between Canadian men and women of prime age (25-54 years old) narrowed to about 9 points in the 2010s, 8.9% in 2015 (Moyser, 2017). For the United States, the corresponding participation gap was about 50 and 12 points (Black et al., 2017).

With immigration raising heated debates and women's participation seeming to have reached its limit, it is now essential to look for alternative sources of labour supply. In Canada, there is a growing effort to increase the employment level of the underemployed, which includes indigenous peoples, persons with disabilities, visible minorities, and women. These groups, identified as employment equity groups (Public Service Alliance of Canada, 2018), have historically faced barriers in the labour market, resulting in underutilization of their labour supply potential. The concepts used to describe the labour underutilization situation have changed over time. The 13th International Conference of Labour Statisticians (ICLS) in October 1982 introduced the first formal definition of underemployment as part of the Extended Labour Utilization Framework (ELUF). It defines underemployment as a situation

where a person's employment is inadequate compared with specified norms or alternative employment. Initially, the ELUF distinguished between two types of underemployment (ILO, 1982). The first is time-related and reflects an insufficient number of hours worked given a threshold. Time-related underemployment is also referred to as visible underemployment. The second is referred to as invisible underemployment and includes all other forms of underemployment. Invisible underemployment relates to an uneven allocation of labour resources or a fundamental imbalance between labour and other factors of production.

Underemployment and the underemployed

The current international standards resulted from the "Resolution Concerning Statistics of Work, Employment and Labour Underutilization" adopted at the 19th ICLS in October 2013. The 19th ICLS still distinguishes two types of labour underutilization. However, it defines underemployment solely as time-related labour underutilization. In contrast, the *other forms of labour underutilization* are called *inadequate employment*, as in the 16th ICLS (ILO, 1998). Even restricted to time-related, underemployment is still a widespread phenomenon of labour underutilization. The underemployed includes, in addition to the involuntary part-time workers, the unemployed and other employed workers that are available and willing to take additional workload and whose current workload is under a threshold during a reference period (Bell & Blanchflower, 2018; Montcho et al., 2021). In the words of Mitchell and Muysken (2008), underemployment represents a significant source of wastage, and according to many (Congress, 2014; Li et al., 2006), *Canada's real labour market challenge*.

In Canada, a manifestation of underemployment includes, for example, the growing number of persons working part-time, that is, those working under 30 hours a week because they could not find a full-time position. From 12% in the 1970s, the prevalence of part-time employment rose to 19% in the 2010s. At the same time, the share of involuntary part-time workers has been consistently around 25% of all part-time employments (OECD, 2020). Underemployment is also reflected in the increasing unemployment rate among workers aged 55 years and over, following their increased labour participation. For example, the

participation rate for persons aged 65 to 69 years has increased from 15.6% in 1976 to 26.5% in 2018, while during the same period, their unemployment rate has doubled, increasing from 2.2 to 4.7 (Statistics Canada, Table: 14-10-0018-01). This trend suggests that the economy has not fully absorbed the increase in labour supply following increased labour participation.

Despite these signs, official statistics only report the prevalence of involuntary part-time employment as underemployment while excluding a significant part of the unemployed. The result is a discrepancy between official numbers and actual levels of labour underutilization. For example, the most comprehensive labour underutilization rate, R8 published by Statistics Canada (Table: 14-10-0077-01), reports an average of 10.5% between 1997 and 2013. However, Congress (2014) reports about 16% of underemployment over the same period. In the United States, the Bureau of Labour Statistics (BLS) reports a 6.6% rate of underemployment for February 2012, while Gallup polls indicate that 18% to 25% of American workers perceive themselves as underemployed (Thompson et al., 2013). Not only is underemployment under-reported in official publications, but it also receives relatively little attention in empirical studies.

Causes and consequences of underemployment

Studies based on traditional measures of underemployment have followed two main approaches: an economic approach that focuses on the causes and a sociological approach that focuses on the effects. In between are studies that highlight the socio-demographic characteristics of the underemployed.

The general view in the economics literature is that underemployment shares common causes with unemployment (Otterbach, 2009). Therefore, empirical investigations focussed on cyclical fluctuations in aggregate demand and institutional features as the primary source of variation in underemployment over time. These include minimum wages, welfare and taxation systems, employment protection legislation, and trade unions (Haugen, 2009; Wilkins & Wooden, 2011). In economic terms, underemployment implies excess or extra

labour supply that would add to the output of the economy (Tam, 2010; Wilkins, 2006). Therefore, regaining this unused labour potential could compensate, at least partially, for an eventual labour shortage population ageing may induce.

While economic approaches to underemployment usually study causes, sociological approaches usually deal with effects on the individual and the community. From a sociological perspective, underemployment is detrimental to personal and social well-being, as it may lead to increased substance use (Dooley & Prause, 1998; Janlert & Hammarstrom, 1992; Johnson, 2004; Mossakowski, 2008), increases in criminal behaviour (Krivo & Peterson, 2004; Raphael & Winter-Ebmer, 1999; Wadsworth, 2006), increased psychological distress (Cassidy & Wright, 2008; Hammarstrom, 2002; Mossakowski, 2009; Winefield, 1997), and low self-esteem (Prause & Dooley, 1997). For Pedulla and Newman (2011), the whole family is affected when a parent is underemployed. While these behaviours are more prevalent among the younger workers, older workers also face a relatively high risk of underemployment when re-employed after a job loss, after retirement in a bridge job, and within the course of regular employment (Virick, 2011).

For the firm, underemployment leads to a higher level of turnover. Wang (2018) found that in Canada, underemployed workers are more likely to leave an organization that relies heavily on part-time workers. In contrast, they are more likely to stay when their employers regularly hire from within the company through promotions. Whether for the individual, the firm or the community, the detriments of underemployment are far-reaching, and the need for policies is unquestioned. The only question is who is underemployed.

Beyond economic and sociological approaches, some studies are more policy-driven and tend to highlight personal and job characteristics that select individuals into underemployment (Acosta-Ballesteros et al., 2017; Beukes et al., 2017; Doiron, 2003; F, 2016; Reynolds, 2013; Wilkins, 2006). For example, Wilkins (2006) found that household variables, including housing situation and area of residence, are particularly relevant to the likelihood of

underemployment. Using Spain data, Acosta-Ballesteros et al. (2017) show that individuals with special education in sciences, technology and health suffer less from underemployment than those with more general diplomas, including arts, education, and humanities. In the Canadian context, Reynolds (2013) found that supplementary unemployment rates were significantly higher (19.7%) for persons aged 15-24 than for persons aged 25-54 (8.8%) in 2011. Earlier, Li et al. (2006) found that in 2001, 20% of university graduates had worked in a job that required a high school or less education.

The paradox of underemployment

Despite their relatively few numbers, studies focusing on underemployment provide insights that are nonetheless unequivocal. Underemployment reflects a more accurate measure of labour underutilization. Thus, it is more critical than unemployment. Furthermore, its effects are detrimental to the individual, the organization and the community. However, underemployment and the increased well-being resulting from full employment make few to no news headlines. At least not as much as the decrease in the unemployment rate, let alone the increased pressure on the economy from population ageing or the increasing need for immigrants.

The lack of attention to underemployment results in two main consequences. First and fundamentally, there is no appropriate framework for measuring underemployment similar to other labour force indicators such as labour participation and unemployment rates. Specifically, there is no systematic approach for setting the underemployment threshold leaving countries to rely on guesswork. As a result, underemployment has been rarely, if ever, studied to its full extent in most countries, including the United States and Canada.

Second and resulting from the first, official statistics only report on fragmented pieces, thus are unable to present a comprehensive view of the phenomenon. There may be some political considerations to this. For example, it seems politically preferable to present a low

unemployment rate than a high underemployment rate that could increase political tensions. Even the term underemployment rarely appears in official statistics.

Also, the rare studies on underemployment use a binary variable in their approach, thus analyzing only its spread. However, such a variable does not account for the hour gap, thus not reflecting how far individuals are from their desired workload. Therefore, an hour gap variable is required to measure underemployment intensity and estimate the potential additional labour supply from the underemployed.

These limitations are embedded in the extended framework making it impractical for most countries, including the United and Canada. Therefore, a fundamental rewrite of the Labour Utilization Framework is necessary. The newly developed Dynamic Labour Utilization Framework (Montcho et al., 2021) aimed at addressing this issue. It allows for measuring underemployment by correcting the limitations of the extended framework.

This study builds on the Dynamic Labour Utilization Framework to measure underemployment in Canada and estimate how much regaining the under-used labour could compensate for an eventual shortage. It also provides an overview of the personal characteristics associated with underemployment to guide public policies that aim at full employment. The following section presents the data source and describes the variable and methods used. Then, sections 3 to 5 present the trends of underemployment, the corresponding additional labour supply and the personal characteristics of the underemployed. Finally, in the last section, we discuss some policy considerations of the results and their limitations before concluding with a call for public policies that put forward the well-being of all Canadians.

2. Data and methods

2.1. Data source and variable processing

The data used in this study comes from three series of annual surveys complementary to the Labour Force Surveys (LFS) of Statistics Canada and extracted from the Public Use Micro Files (PUMFs) hosted in the Odesi Scholar Portal (ODESI, 2020). The data sources include the Survey of Consumer Finances (SCF) from 1981 to 1997, the Survey of Labour and Income Dynamics (SLID) from 1996 to 2011, and the Canadian Income Survey (CIS) from 2011 to 2017. These annual surveys cover a sub-sample of the labour Force Survey (LFS) and provide a comprehensive view of the Canadian labour market throughout its ageing process. However, combining these surveys requires some processing, mainly regarding the sampling weight.

First, there are two surveys for 1996 and 1997 because SCF and SLID overlapped for these years. Instead of discarding either of the surveys, we combined the two and adjusted the original weight proportionally to the sample size. Preliminary analysis suggests that using either of the two surveys would result in significant bias. Compared to previous and following years, estimates are generally lower for the SCF and higher for the SLID. Various reports from Statistics Canada also show that estimates from the SLID are marginally and consistently higher than those from the SCF (Articles and reports: 75F0002MIE-99007).

Second, we created a composite weight series that rescales the original weights with the relative weight of the sampling rate for each sub-sample. The computation uses the following steps: 1) Compute the sampling rate for each sub-sample by dividing the sub-sample size by its base population (estimated as the sum of the original weights). 2) Compute the weight of each sub-sample by dividing its sampling rate by the sum of all sampling rates. 3) Multiply each original weight by the sampling weight for the sub-sample it belongs to. Multi-year estimates use the composite weights, while annual estimates use the original weight.

This paper uses two sets of variables. The first set contains labour participation variables, including the number of hours annually worked, the employment type (full time, voluntary part-time and involuntary part-time) of the primary job, the number of unemployed weeks and the number of employed weeks. The last two variables are combined to create the active weeks variable: the duration in weeks an individual has been in the labour market as employed or unemployed in the reference year. Missing values for worked hours are estimated by multiplying the number of hours usually worked per week and the number of weeks worked during a given year. Original values for weekly and annually worked hours ranged from 0 to 521 and 9 736, respectively. Rather than reducing the sample by removing outliers, we have applied a 99% winsorizing transformation.

The second set contains socio-demographic variables, including sex, age group, educational attainment, marital status, school attendance, household type, immigration status and province of residence. Household type uses the same definition as the household composition variable (HHCOMP) in the Canadian Income Surveys. For the marital status variable, the statuses of *separated*, *divorced* and *widowed* are combined into a single *Was maried* status. The provinces of residence are grouped using the four-region[4] model. These socio-demographic variables are coded as nominal, except for age group and educational attainment coded as ordinal. Table 4 presents the descriptive statistics of labour participation by selected socio-demographic variables.

[4]See details at https://en.wikipedia.org/w/index.php?oldid=1042340153

Table 4

Descriptive statistics (weighted) of labour participation by selected socio-demographic status, Canada 1981-2017

	Need hours(%)		Hours worked		Active weeks		Weeks unemployed		
Variables/Options	Yes	No	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Sample(%)
Gender									
Male	24.74	75.26	1674	924	46.09	14.20	4.48	11.50	53.36
Female	27.95	72.05	1339	851	44.46	15.72	4.18	11.23	46.64
Age group									
Young:15-24	37.68	62.32	879	838	35.53	20.18	5.55	11.96	19.55
Adult:25-59	23.49	76.51	1698	840	48.00	11.79	4.01	11.10	74.25
Older:60-69	23.05	76.95	1365	971	43.81	16.72	4.52	12.65	6.19
Education level									
HS Graduate or less	35.42	64.58	1260	1006	41.53	18.02	6.67	13.89	25.26
Pre-University	25.12	74.88	1545	876	45.85	14.40	4.02	10.88	58.80
University	15.81	84.19	1757	795	48.31	11.14	2.56	8.86	15.94
School attendance									
No Attendance	25.26	74.74	1660	859	47.53	12.47	4.39	11.57	85.22
Full Year	33.09	66.91	564	636	29.81	20.81	3.98	9.96	11.66
Part Year	27.48	72.52	1488	819	46.66	12.97	4.49	11.30	3.12
Marital status									
Never Married	33.65	66.35	1180	919	40.47	18.29	5.48	12.41	28.18
Still Married	22.88	77.12	1685	855	47.58	12.51	3.63	10.49	63.72
Was Married	26.84	73.16	1575	885	47.07	13.03	5.38	13.15	8.10
Household type									
One Person	25.74	74.26	1623	871	47.21	12.64	5.15	12.64	8.65
2+ Persons	23.06	76.94	1579	841	47.31	11.96	3.81	10.88	45.23
2+ Families	29.44	70.56	1441	969	43.00	17.48	4.69	11.55	46.12
Province of Residence									
Western	22.91	77.09	1560	919	45.42	14.84	3.73	10.42	35.46
Central	24.79	75.21	1519	892	45.52	14.82	4.31	11.44	44.13
Atlantic	35.16	64.84	1381	964	43.59	16.08	7.00	13.84	20.41
Immigration status									
Canadian Born	27.06	72.94	1500	914	44.99	15.28	4.36	11.30	82.99
Immig. 9 yrs or less	27.13	72.87	1448	914	44.58	15.36	5.58	12.91	4.39
Immig. 10 yrs or more	20.53	79.47	1653	859	47.41	12.66	3.79	11.09	12.62
Employment type									
Full Time	13.34	86.66	1988	579	50.18	7.24	2.11	7.23	69.37
Vol. Ptime	27.01	72.99	469	487	33.09	21.16	4.67	10.47	16.90
Inv. Ptime	100.00	0.00	483	531	33.79	20.92	8.20	13.36	9.07
Did No work	71.80	28.20	151	359	37.52	20.05	29.32	23.03	4.67
Data source									
SCF: 1980-1998	29.72	70.28	1436	979	42.78	17.71	4.92	11.82	50.32
SLID: 1996 to 2011	23.01	76.99	1615	827	48.05	10.84	3.46	10.30	36.89
CIS: Since 2012	21.85	78.15	1572	808	47.35	11.38	4.67	12.43	12.79
Total	26.00	74.00	639	689	45.00	15.00	4.00	11.00	100.00

Source: Author's calculations

The analytical sample consists of 1 702 142 individuals aged 15-69 who have participated in the labour market between 1981 and 2017 for an average of 45 (±15) weeks per year and 4 (±11) weeks in unemployment. The sample contains about 47% women, 74% young aged 25-59, and 6% older people aged 60-69. The results from applying the first step of the dynamic framework show that 26% of individuals in the sample would be available and willing to work additional hours. Those are the potentially underemployed (PUE) workers. Moreover, while all workers in involuntary part-time employment are PUE as expected, 27% of the voluntary part-time and 13% of full-time workers are also PUE.

2.2. The Dynamic Labour Utilization Framework

One of the issues that undermine studies on underemployment is the absence of a systematic and flexible method for setting its thresholds. This study uses the newly developed Dynamic Labour Utilization Framework (DLUF) and its algorithm to estimate the underemployment threshold. An advantage of the DLUF method is that it allows accounting for the contextual labour market environment through key socio-demographic (SDS) and Labour Force Status (LFS) variables. The DLUF classifies individuals as Probably Fully-Employed (PFE) and Potentially Under Employed (PUE), leaving the inactive persons in a separate category as in the extended framework. The variables required for creating the PFE and PUE groups are the number of unemployed weeks and the employment type (full time, voluntary part-time and involuntary part-time).

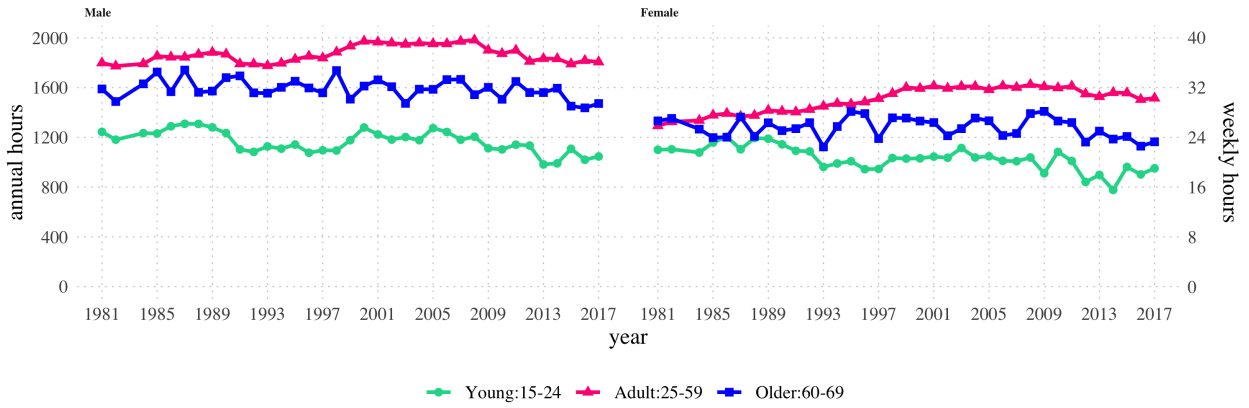
Applying the same algorithm as in Montcho et al. (2021) allows creating an underemployment threshold for each PUF individual. Besides the socio-demographic variables discussed above, the number of active weeks is also used in the matching process to measure the level of labour attachment. Table 5 and Figure 15 present average underemployment thresholds by age group, gender and various SDS categories. Weekly equivalences are calculated from the annual threshold, assuming 50 weeks of labour market participation per year.

Table 5
Average underemployment threshold by age group and selected socio-demographic variables, Canada 1981-2017

Variables	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69
Gender											
Male	12.76	28.27	38.26	41.02	42.08	42.56	42.60	42.09	39.91	35.92	28.52
Female	11.18	24.87	32.22	32.36	33.18	34.27	35.04	34.26	31.84	28.01	20.85
Education Level											
HS Graduate or less	9.71	29.22	33.54	35.04	36.63	37.46	37.77	37.36	35.64	32.71	25.46
Pre-University	15.13	26.24	35.63	37.06	37.97	38.55	38.86	38.42	36.32	32.53	25.28
University	17.82	25.91	36.03	38.29	39.04	40.04	41.00	40.45	38.17	33.92	26.88
School attendance											
No Attendance	24.09	33.24	36.87	37.50	38.28	38.89	39.22	38.62	36.48	32.84	25.66
Full Year	8.49	14.58	21.18	25.18	26.56	27.94	29.82	33.63	32.68	24.25	21.04
Part Year	19.50	29.28	36.31	37.22	37.68	37.77	38.08	38.31	36.20	34.67	28.91
Marital Status											
Never Married	11.79	25.53	35.69	38.17	39.02	39.01	38.51	37.91	35.76	33.90	28.49
Still Married	19.88	30.78	35.27	36.68	37.81	38.66	39.16	38.73	36.66	32.96	25.97
Was Married	21.60	30.19	34.62	36.79	37.80	38.53	38.96	38.05	35.70	31.90	23.51
Household type											
One Person	22.82	31.94	38.20	39.85	40.42	39.85	39.24	37.90	35.35	31.77	23.59
2+ Persons	14.24	26.68	35.94	37.63	38.45	39.05	39.53	39.17	37.28	33.90	27.70
2+ Families	9.79	25.79	34.32	35.91	37.07	38.05	38.50	37.92	35.72	31.89	23.60
Province of Residence											
Western	13.67	28.47	35.83	37.31	38.37	39.13	39.71	39.10	37.15	33.36	26.93
Central	11.36	25.92	35.38	37.04	37.93	38.54	38.87	38.39	36.18	32.60	24.93
Atlantic	10.30	25.43	34.24	36.06	36.93	38.11	38.38	38.08	36.03	32.53	25.88
Immigration status											
Canadian Born	12.04	26.78	35.45	37.04	37.96	38.60	38.91	38.32	36.11	32.29	25.24
Immig. 9 yrs or less	11.36	25.72	34.18	35.79	37.18	37.95	38.71	38.02	36.19	32.52	24.37
Immig. 10 yrs or more	11.93	25.66	36.44	38.16	38.64	39.27	39.70	39.37	37.40	34.06	26.77
Employment type											
Full Time	26.42	35.94	40.49	41.65	42.18	42.43	42.61	42.48	41.99	41.21	39.72
Vol. Ptime	7.82	12.96	16.10	16.52	17.60	18.16	18.67	17.75	16.21	13.87	10.72
Inv. Ptime	11.41	18.02	23.43	25.37	26.87	28.23	29.36	28.56	25.29	22.49	18.47
Did No work	11.42	17.26	21.56	23.39	24.94	25.52	25.70	25.31	23.45	21.06	16.97
Data source											
SCF: 1980-1998	9.79	25.92	34.47	36.18	37.20	38.15	38.58	37.87	35.60	31.63	23.22
SLID: 1996 to 2011	15.07	28.34	36.78	38.16	38.91	39.31	39.47	39.17	37.11	33.92	27.46
CIS: Since 2012	13.38	25.22	36.16	37.96	38.54	38.64	39.43	38.74	37.03	33.43	27.05

Source: Author's calculations

Fig. 15
Trend in average underemployment thresholds by age group and sex, Canada 1981-2017



Source: Author's calculations

On average, there are about 21 (±35) PFE individuals in each cluster. The average underemployment threshold is about 1 511 (±656) hours per year. Assuming 50 weeks of labour market participation per year, the average weekly underemployment threshold would be 30,2 (±13,1). While this average is quite close to the threshold for part-time employment in Canada, this is coincidental as the two measures arise from two different processes with equally different implications. For instance, the part-time employment threshold is static for all labour market participants. On the contrary, the underemployment threshold resulting from the DLUF is individualized for each labour participant.

By design, the DLUF is expected to deliver flexible thresholds compatible with the labour attachment of various SDS groups. Results in Table 5 seems to fulfill this expectation. For instance, thresholds are relatively high for adult men aged 45-49 (about 42,6 hours per week) and low for young men and women aged 15-19 (about 12 hours per week). Also, voluntary part-time workers have lower thresholds than involuntary ones for all age groups. Trends in thresholds presented in Figure 15 also seem to reflect the changes in work hours preferences for various demographic groups throughout the studied period. Initially, there has been an

increase until the late 1990s, most notably for women. Since the 2000s, however, thresholds have been decreasing for men while stagnating for women, narrowing the gap between men and women Figure 15.

2.3. Modeling Underemployment

The main focus of this study is to estimate the levels of underemployment in Canada and to assess the extent to which full employment could be an option for additional labour supply in the context of population ageing. However, effective public policies for full employment would also require the identification of the underemployed. For this purpose, this study provides an overview of the socio-demographic characteristics of the underemployed.

The variables of interest (dependent) are the underemployment status and the hour gap, the former building from the latter. The hour gap is the difference between the underemployment threshold and the hours worked annually. Therefore, it represents the number of additional hours an underemployed person requires to reach full employment. Underemployment status is derived from the hour gap and coded with 1 (Yes, for underemployed) if the hour gap is positive and 0 (No, for fully employed) otherwise. The analysis uses a two-step hurdle model, one for the incidence based on the underemployment status and the other for the intensity based on the hour gap.

Hurdle models apply to count data and allow handling excess zeros and over-dispersion (Zeileis et al., 2008). In a hurdle model, there are two processes, one for zero counts (incidence) and another for positive counts (intensity). The models are estimated using the hurdle function from the *pscl* package for R. The incidence is estimated by regressing a probit model on the underemployment status variable. Assessing the model fit with the Akaike Information Criterion (AIC) show that a Probit model is slightly better than a Logit model. Because the hour gap variable is rounded to a whole number of hours per week, a Poisson distribution would have been an appropriate choice for its modelization. However, Poisson distribution requires the mean and variance to be equal, a condition violated by an

over-dispersion in the data. Using a negative binomial model, which accounts for over-dispersion, allows overcoming this limitation.

The predictors in both steps are sex, age, household type, educational attainment, province of residence, immigration status, marital status, school attendance and the number of active weeks. The first component estimates the incidence of underemployment with data containing all labour market participants, underemployed and fully employed included. In contrast, in the second component, the intensity of underemployment is estimated only for the underemployed, that is, those with a positive hour gap. It is also worth mentioning that following Wasserstein et al. (2019) in “Moving to a World beyond "p ¡ 0.05"” standard deviations and/or confidence intervals have been used as measures of uncertainty around the estimates rather than the traditional significance levels.

3. Trends in underemployment

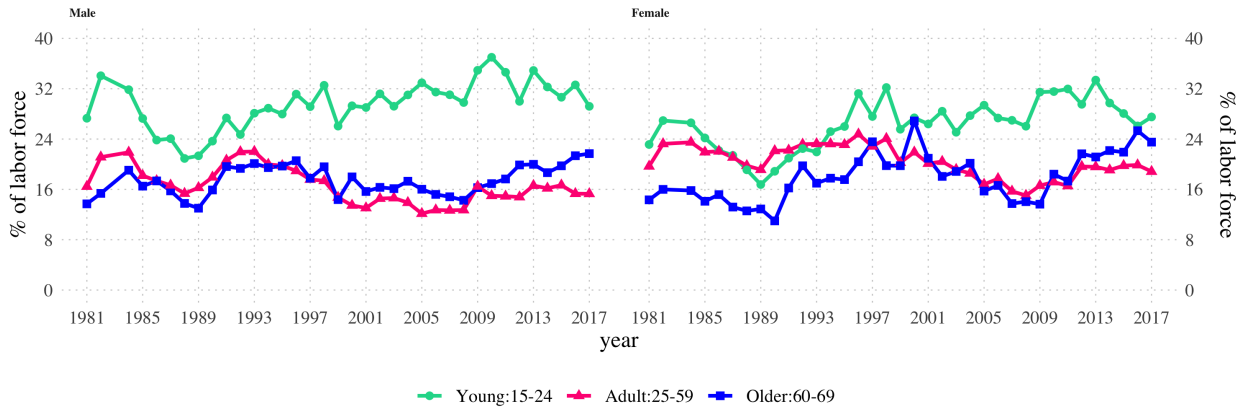
The prevalence of underemployment is given by its rate, calculated similarly to the unemployment rate by dividing the number of underemployed persons by the population in the labour force and expressed in percentage. While the unemployment rate in Canada has been 8,3% (±1,7) between 1981 and 2017, underemployment, on the other hand, has been much higher, averaging 20,1% (±2) over the period. Following the typical boom and bust cycle of the economy, underemployment for both sexes combined has decreased from a relatively high level (about 24%) to a relatively low level (about 18%) between the early and late 80s. In the 90s, it increased to reach a second peak of 24,1% in 1996, before decreasing to its minimum of 16,3% just before the 2008 financial crisis. Since then, the underemployment rate has increased to above 20% as of 2017. The trends are roughly the same for men and women (Figure 16) with the exception that the second peak for women was much higher and much later than that of men.

Fig. 16
Trend in average underemployment and unemployment rates by sex, Canada 1981-2017

Source: Author's calculations

Women have a higher underemployment rate than men (Figure 16), but the gap is rather small, with an average of 19% for men and 21,4% for women over the period. In the early 80s, men and women had about the same level of underemployment. However, the gap between men and women widened toward the decade's end, favouring men. In the early 90s, the gap disappeared. However, it appeared again in the late 2000s. Since 2009, the gap has been closing again. The same pattern appears between age groups (Figure 17) with a smaller gap at the beginning and the end of the period and a larger one throughout the 2000s. However, the gap between age groups is much higher, especially among men, with an average underemployment rate of 29,5% for young aged 15-34 against 16,5% and 17,4% for adults aged 25-53 and 55-69 respectively.

Fig. 17
Trend in average underemployment rates by age group and sex, Canada 1981-2017

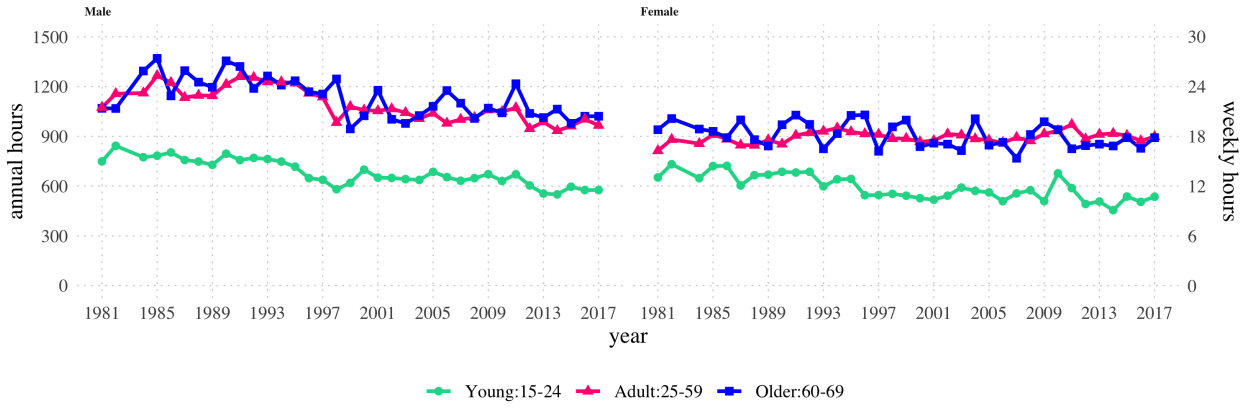


Source: Author's calculations

Although about one Canadian worker is underemployed out of five, the degree of underemployment varies across workers. Figure 18 presents trends in hour gap averages across sex and age groups. The hour gap is generally higher among men than women throughout the studied period. However, for both sexes, adult and older workers have about the same, but much higher, hour gap than young adults aged 15-24. Furthermore, the difference in hour gap between the age groups has slightly decreased for men while it increased for women also slightly. Men had a relatively high hour gap in the 80s, but it decreased noticeably in the 90s before stabilizing around 2000. Women show the same pattern but with a less pronounced drop and even a slight increase in the last decade.

In summary, the results above suggest that Canada is still a long way from full employment. Therefore, the underemployed persons could be a potential source of additional labour supply as population ageing slows down labour force growth, increasing the labour shortage risk. We will explore these possibilities in greater detail in the next section.

Fig. 18
Trend in hour gap by age group and sex, Canada 1981-2017

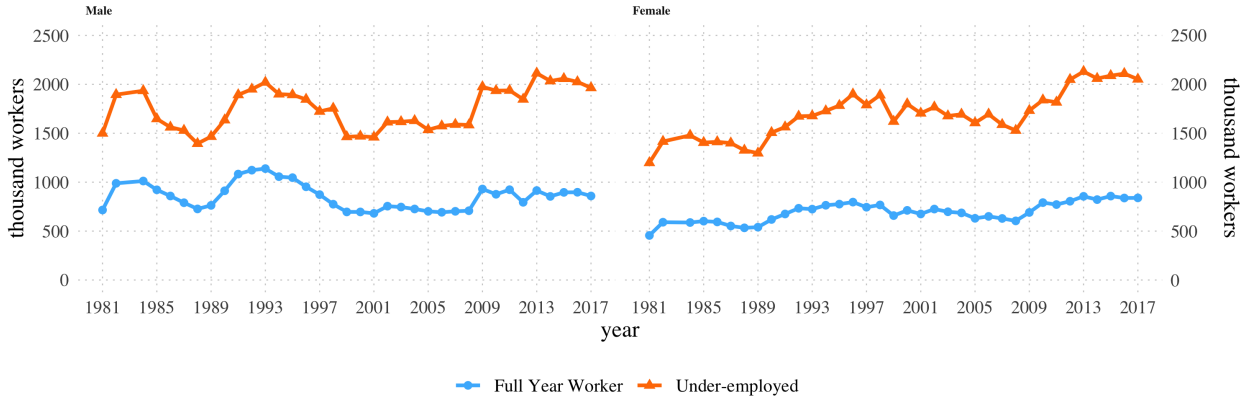


Source: Author's calculations

4. Additional labour supply

One of the objectives of this study is to evaluate the extent to which underemployed workers could be an alternative solution to the depletion of the labour supply caused by population ageing. For this purpose, we measure the additional labour supply as the aggregated hour gap from the underemployed. For convenient interpretation, this labour supply is translated into a full-year person equivalent, assuming that a full-year equals 2000 hours, 40 hours per week for 50 weeks. Figure 19 displays the actual number of underemployed workers along with the corresponding additional labour supply in terms of full-year workers for men and women. Also, an equivalent additional labour supply rate is calculated by dividing the aggregated hour gap from the underemployed by the aggregated hours worked by all employees during the reference year. Figure 20 presents the trend in additional labour supply rate by age group and sex throughout the studied period.

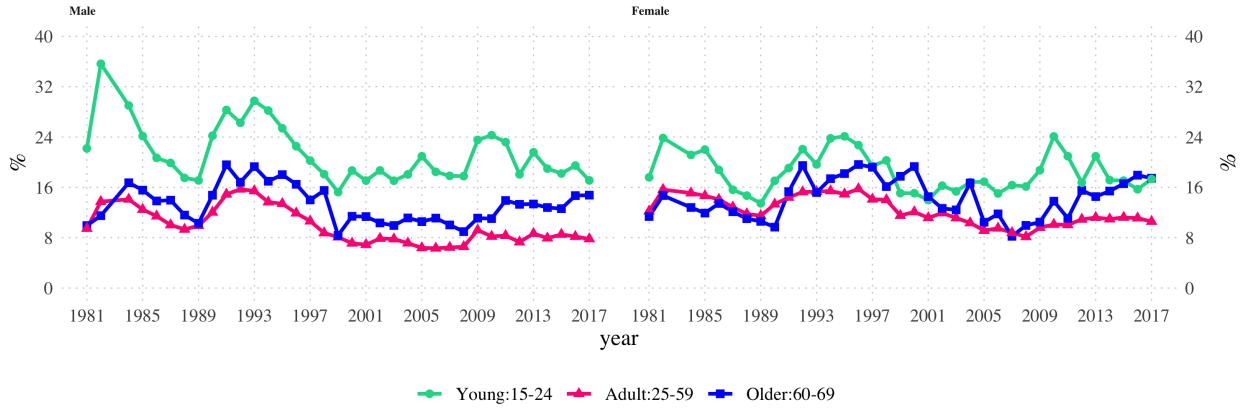
Fig. 19
Trend in underemployed population in absolute number and full-year equivalent, Canada 1981-2017



Source: Author's calculations

Between 1981 and 2017, there have been, on average, 3,4 (±0,4) million men and women that worked under their full employment threshold. Should these workers be employed at their full employment level, they would have supplied, on average, an additional labour equivalent to 1,5 (±0,2) million full-year workers annually, increasing annual aggregated hours by 14,9% (±5). The additional labour supply would come slightly more from young workers aged 15-24 (19,9%) than adults aged 25-54 (11%) and older workers aged 55-69 (13,8%).

Fig. 20
Trend in additional labour supply as a percentage of aggregated worked hours by age group and sex, Canada 1981-2017



Source: Author's calculations

In recent years, the population in underemployment has increased along with the overall population, averaging 3,8 million between 2007 and 2017 (Table 6). The additional labour supply, however, has stagnated for men while increasing slightly for women (with an annual average of 1,6 million for both sexes). Given labour participation rates and worked hours observed among immigrants during that same period, this amount of labour would have required about 3,5 million newcomers. Based on recent immigration targets, full employment could provide the same amount of labour as immigration for at least a decade (with 250 000 intakes per year for 13 years). In comparison, Canada received about 3.2 million new immigrants, all categories included, between 2001 and 2016 (Statistics Canada Catalogue no. 98-400-X2016366). These results do not account for a potential mismatch between skills and job requirements. However, they provide some ground for serious investigation on increasing the labour supply of underemployed.

Table 6
Additional labour supply in equivalent full-years workers and new immigrants, Canada 2007-2016

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Under-Employed	3178.5	3113.8	3707.1	3775.5	3754.9	3896.1	4244.7	4094.1	4147	4135.2	4017	3824
Full-year workers	1331.5	1312.7	1620.8	1667.6	1694.6	1599.6	1770	1676.7	1753.8	1735.5	1698.6	1623.8
Immigrants intake	2787.2	2760.3	3586.5	3683.6	3705	3436.5	3964.5	3681.7	3793.6	3755.2	3570.4	3520.4
UtoI Ratio	87.7	88.6	96.7	97.6	98.7	88.2	93.4	89.9	91.5	90.8	88.9	92

- All population are in thousand workers
- UtoI Ratio: Number of newcomers per 100 underemployed workers
- Equivalent immigrants equal total potential hours divided by product of immigrant participation rate (3 years moving average) and annual hours among immigrants
- Employment rate for landed immigrant rate are taken from Statistics Canada: Table 14-10-0085-01

Total stands for the average between 2007 and 2016

Source: Author's calculations

The results above reveal the differences in underemployment rates and additional labour potential across age groups and sexes. However, they have yet to account for other variables that may be driving the differences. In other words, to what extent are differences in underemployment simultaneously explained by age, sex, and other SDS variables such as education, marital status, etc... The following section attempts to answer this question by estimating the incidence and intensity of underemployment for selected sub-populations.

5. Characteristics of the underemployed

This study contributes to the existing literature by analyzing the incidence and intensity of underemployment. The incidence refers to the Odds Ratio (OR) of being underemployed for an individual in a given socio-demographic status (SDS) compared to a reference status. The Intensity Ratio (IR), on the other hand, refers to the difference in the percentage of Hours Gap for an underemployed with a given SDS compared to one with a reference SDS status. The latter is usually called Incidence Rate Ratio (IRR), the exponent of the coefficients from

a count regression. The term *Intensity Ratio* is used here to avoid confusion with the incidence of underemployed, which measures the relative risk. Since large samples tend to transform minor differences into statistically significant differences (Khalilzadeh & Tasci, 2017), the models described in subsection 2.3 are estimated separately for men and women on a subsample covering the period 2013-2017 (Figure 21). Table 7 presents the descriptive statistics of employment characteristics by selected socio-demographic variables in the subsample.

Table 7
Descriptive statistics (weighted) of employment characteristics by selected socio-demographic variables, Canada 2013-2017

	Underemployed(%)		Weekly hours gap		Active weeks		Weeks unemployed		
Variables/Options	Yes	No	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev	Sample(%)
Gender									
Male	17.87	82.13	154	449	47.85	10.77	4.70	12.27	51.46
Female	19.72	80.28	163	431	46.86	11.92	4.75	12.78	48.54
Age group									
Young:15-24	28.36	71.64	140	383	39.22	16.71	6.93	14.01	14.51
Adult:25-59	16.48	83.52	157	446	49.29	8.57	3.92	11.42	73.40
Older:60-69	21.11	78.89	194	484	46.56	12.42	7.08	16.36	12.09
Education level									
HS Graduate or less	28.19	71.81	213	512	44.42	14.54	8.48	16.56	10.96
Pre-University	18.99	81.01	157	435	47.28	11.42	4.74	12.43	62.25
University	14.38	85.62	144	424	48.46	9.81	3.54	10.91	26.78
School attendance									
No Attendance	17.11	82.89	156	439	49.25	8.70	4.32	12.17	84.96
Full Year	29.81	70.19	154	415	36.02	17.35	7.02	14.24	11.43
Part Year	22.67	77.33	225	535	47.41	10.91	5.16	12.39	3.61
Marital status									
Never Married	25.54	74.46	182	467	44.13	14.26	6.43	14.02	28.72
Still Married	15.70	84.30	142	416	49.06	9.01	3.69	11.28	63.45
Was Married	18.70	81.30	186	494	48.71	9.70	5.37	13.88	7.83
Household type									
One Person	20.15	79.85	201	505	48.47	9.85	5.72	13.88	11.18
2+ Persons	18.34	81.66	149	422	47.30	11.48	4.60	12.39	83.42
2+ Families	22.44	77.56	193	503	46.68	11.74	4.60	11.78	5.41
Province of Residence									
Western	17.46	82.54	153	440	47.16	11.47	4.17	11.68	39.63
Central	18.57	81.43	159	438	47.54	11.22	4.92	12.89	43.78
Atlantic	22.38	77.62	176	462	46.87	11.88	5.61	12.83	16.59
Immigration status									
Canadian Born	18.70	81.30	145	417	47.14	11.61	4.48	12.08	74.38
Immig. 9 yrs or less	21.87	78.13	236	535	46.56	12.16	6.34	14.11	6.89
Immig. 10 yrs or more	17.88	82.12	171	467	48.47	9.99	4.87	13.15	18.73
Employment type									
Full Time	10.56	89.44	61	280	48.83	9.29	2.31	7.52	78.43
Vol. Ptime	22.29	77.71	175	437	40.18	16.53	4.43	9.97	10.54
Inv. Ptime	87.39	12.61	624	601	41.75	15.73	4.62	10.26	4.72
Did No work	63.58	36.42	819	769	47.23	11.83	30.64	24.49	6.30
Total	22.00	78.00	682	691	47.00	11.00	5.00	13.00	100.00

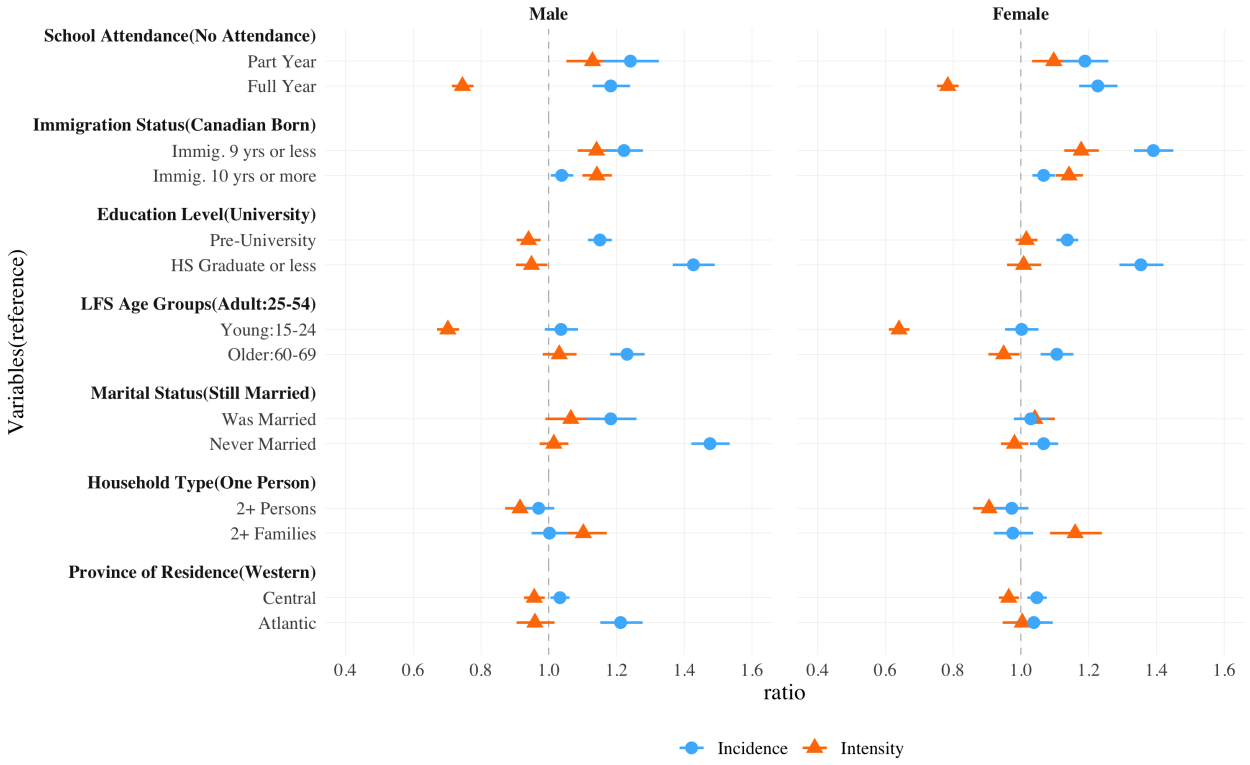
Source: Author's calculations

This subsample consists of 184 405 individuals aged 15-69 who have participated in the labour market between 2013 and 2017 for an average (standard deviation) of 45 (15) weeks per year. 21.11% of individuals in the sample are underemployed, requiring an average (standard

deviation) of 18 (13) hours per week to reach full employment. Men represent 51% of the sample, young aged 15-24 account for 15% and olders aged 60-69 only 12%. To complement these results, and also for sensitivity analysis, estimations for each year between 1981 and 2017, with both sexes combined, were performed (Figure 22).

Among men, being single or high school graduates are the main traits that select individuals into underemployment. These factors increase the odds of being underemployed by about 50% compared to being married or university graduate, respectively. However, these factors, along with the province of residence, have only minor effects on the intensity of underemployment which decreases by about 25% for full-year students and young aged 15-24 compared to those not attending school and adults aged 25-54, respectively. For women, school attendance and age have the same effect on the intensity of underemployment as for men. However, being a recent immigrant or a high school graduate is the main characteristic of underemployed women. For instance, the odds of being underemployed among women is 40% higher for recent immigrants (compared to natives) and 45% higher for high school graduates (compared to university graduates). The effects of immigration status are less severe among men than women, for whom being a recent immigrant increases the odds of being underemployed by 25% compared to natives. For established immigrants with ten years or more of residency, men have about the same odds of underemployment as counterpart natives, while women are about 10% more likely to be underemployed than native women. All else equal, both men and women underemployed immigrants require about 20% more hours than a native to reach full employment.

Fig. 21
Odds and Intensity Ratio of underemployment by selected socio-demographic status, Canada 2013-2017



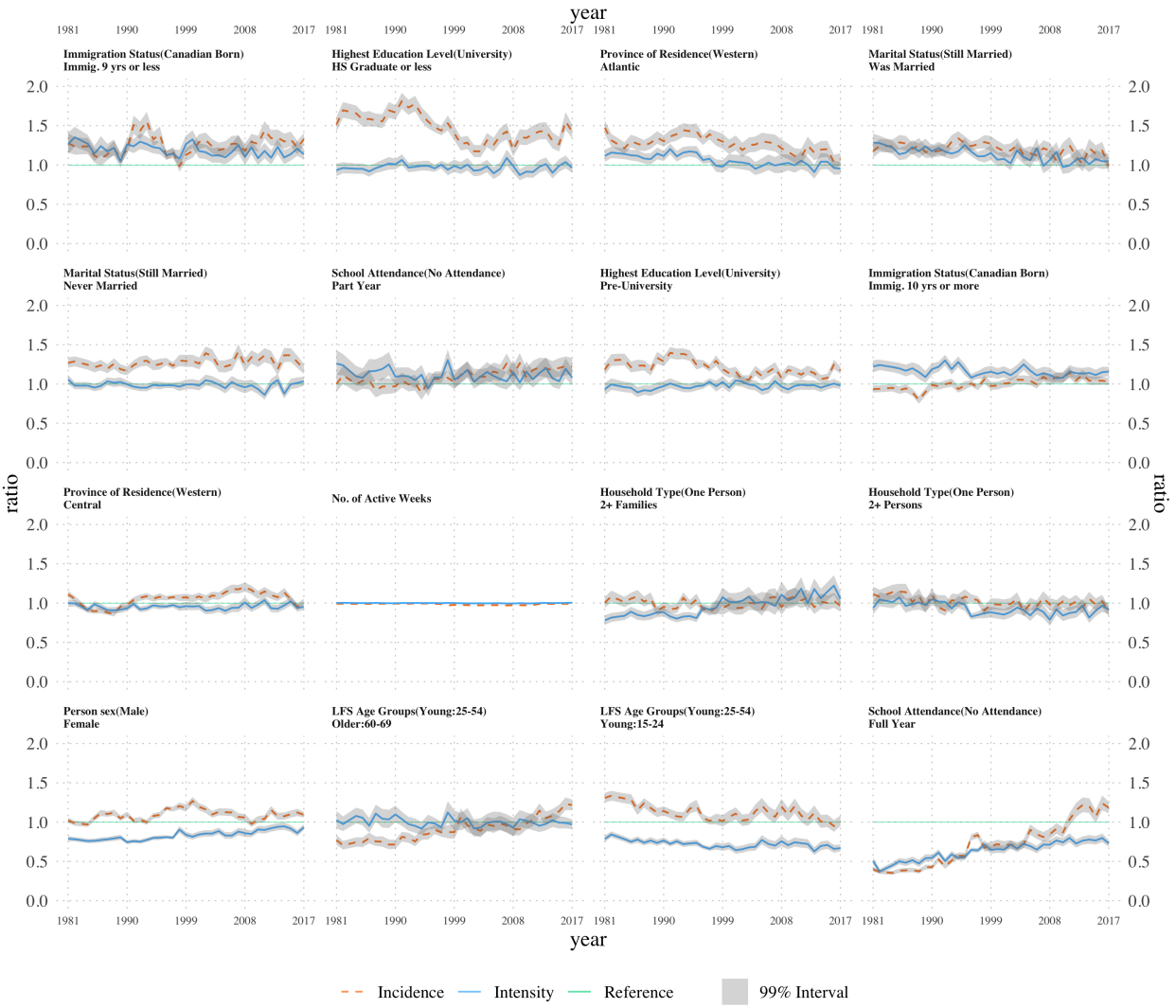
Source: Author's calculations

Contrary to the crude unemployment rate in Figure 17, the odds of underemployment among young (men and women) aged 15-24 are pretty similar to those aged 25-54. Furthermore, their Hours gap is 35 to 40% lower. The opposite is true among older workers, where men and women aged 60-69 are more likely (22% for men and 11% for women) to be underemployed but require about the same additional hours as adults aged 25-54. Men and women who combine school and work are about 20% more likely to be underemployed than those not attending school. However, full-year students require far less (about 30%) additional hours, while part-year students require slightly more hours (about 10%) than those not attending school. For both sexes, the intensity of underemployment varies very little across education level, marital status, household types, and the province of residence. Although the province of

residence shows the least variability in underemployment, men living in Atlantic provinces are 20% more likely to be underemployed than those in Western provinces.

Results from single-year estimations presented in Figure 22 are not only consistent with previous ones but also provide new insights. For example, women are usually only slightly (about 10%) more likely to be underemployed than men, except in the late 90s (26% in 1996). They also require fewer hours, although the gap has been steadily closing (from 20% in 1990 to only 4% in 2017). In terms of overall effect during the studied period, recent immigrants followed by high school graduates and residents of Atlantic provinces have the highest levels of underemployment. On the other hand, the least affected are full-year students, young aged 15-24, and older workers aged 60-69. Interestingly, in all estimations, the number of active weeks does not affect the odds and intensity of underemployment. In other words, the time length an individual has been in the labour market as employed or unemployed does not affect their underemployment outcome.

Fig. 22
Trends in Odds and Intensity Ratio of underemployment by selected socio demographic status with overall effect sorted from positive to negative, Canada 1981-2017



Source: Author's calculations

6. Implications and discussion

The high level of underemployment implied that the country has much to gain from full employment. However, is full employment possible and feasible, and what policy would it require? In this section, we explore not specific policies but general directives to prioritize based on the origins of underemployment.

Full employment implies enough demand for all the labour supply to fill, supply qualifications match the demand requirements, and no friction or institutional deficiency undermines the matching in the labour market. For policy purposes, each of these implications requires careful analysis.

First, full employment requires enough jobs to absorb the labour supply. To assess this requirement, one could compare the total hours of opened job positions with the additional labour supply from the underemployed. If the first lag significantly behind the former, then the focus of public policies would be to encourage job creation. Such policy would be challenging, given that objections to full employment usually emphasize the lack of economic growth and the advancement of technology and globalization. For instance, the long-term low growth experienced in most developed countries has led to the belief that social and economic development has reached its limits. The emergence of Artificial Intelligence (AI) technology seems to strike fear, not unlike that of the immigrants, that robotization will replace or reduce employment opportunities. Although there is no convincing evidence that any or all of these reasons make full employment unattainable (Lee, 1997), the challenge remains for creativity and innovation to keep up with creating new jobs that continuously absorb the supply as it changes forms and nature.

Second, there may be enough or more jobs than the labour supply can fill, but underemployment can still exist, resulting from a mismatch between individual skills and job requirements. Skills mismatch is possible in a general sense. However, it goes beyond the underemployment debate and reflects a more fundamental misalignment between the educational and economic institutions. One way to investigate skills mismatch is to analyze the trend in over-employment. Although not discussed in this paper, over-employment is possible and can be analyzed using the Dynamic Labour Utilization Framework (DLUF) proposed in this study. It characterizes a situation where a person is assigned a higher workload than they can or are willing to handle. Should there be a skills mismatch instead of a deficiency in labour demand, a relatively high level of over-employment would reflect it.

For instance, those with better education and mobility would be called upon to take on a workload they would not be available or willing for in alternative situations. Redirecting a significant part of the entire educational system toward the need of the labour market could be an option, for example, by reducing barriers or increasing support for fields of education with consistently low levels of underemployment and high level of over-employment while increasing requirements for other fields.

Similar to education and skills, job mobility could also be a reason for underemployment and over-employment to co-exist. However, since the economy is getting more digital, job mobility should not be a critical factor in labour mismatch. Analyzing underemployment distribution by province while controlling for education and other factors may explain how improved job mobility can provide better matching. If job mobility is a decisive factor, government support for family and job relocation may help reduce these mismatches.

Third, even with enough jobs, sufficient education and job mobility, labour market deficiency could still cause underemployment to persist. Such deficiencies, for instance, make it easy and profitable for an employer to prefer multiple part-time workers rather than a single full-time for a given job position. For example, social protection programs (health insurance, retirement plans, unemployment benefits, overtime laws and other benefits) and laws seem to have some limits of workload below which employers are not obliged to subscribe to these programs on behalf of their employees. Thus, an employer can skip most employee benefits by tailoring the number of hours worked per employee. Designing policies that make all employment benefits mandatory but on prorate basis or without minimal workload requirements would remove incentives for employers to prefer part-time positions. Such a policy would not ignore or remove the beneficial nature of part-time employment for both employers and employees. However, it would ensure that employment of any kind does not become a source of underemployment or social injustice.

Similarly, as some have argued, the persisting income gap between immigrant and Canadian-born workers is a potential incentive for employers to prefer ongoing immigration rather than fully utilizing existing labour resources. It may be possible that immigration provides better job skill matching than would the underemployed, but this is unlikely given that recent immigrants are one of the groups with the highest level of over-qualification (Li et al., 2006).

Last but not least, results show that the prevalence of underemployment is much higher among young graduates. In that case, extending employment insurance to this subgroup would be beneficial in reducing underemployment. Some studies would suggest otherwise, underlining a positive relationship between unemployment insurance and the duration of unemployment (Christofides & McKenna, 1996). However, receiving stable financial support in the early stage of their career would allow young graduates to be more selective about potential jobs and thus increase the odds of finding an adequate job in terms of hours, wage and skill alignment (Dooley & Prause, 1998). In this sense, unemployment benefits can help reduce the prevalence of involuntary part-time positions and increase job tenure (Jacob, 2008).

A rather radical extension of this proposal is the institution of what some call the Job Guarantee Program (also referred to as the Employer of Last Resort (ELR) program or the Public Sector Employment (PSE) program). In its various forms, the Job Guarantee Program is a centrally funded and locally administered public program aiming at creating full employment that it considers an intrinsic right of citizenship (Murray & Forstater, 2018). Such a proposal may seem radical. However, it questions the proper relationship between society and its citizens. This relation is a contract that will lose most of its value unless it provides either income or jobs while ensuring that the individual's potential is not wasted (king, 2010) through underemployment.

This study highlights the wasted labour potential in Canada. However, there are some limitations worth considering for further research. We will discuss these limitations in the following section.

The Dynamic framework uses workers' experience of unemployment and involuntary part-time work to infer their willingness and availability for more hours on the one hand and the workload of similar individuals to infer their threshold on the other hand. It may appear that survey responses on their availability, willingness, and desired workload would be of better interest and accuracy. The Labour Force Surveys in the UK, for example, collect this data (Wilkins & Wooden, 2011) making the study of underemployment more straightforward. However, in most countries, including Canada and the United States, this information is available, either not at all or not in a single survey.

In Canada, only the Workplace and Employee Survey (WES) administered to employers and employees annually between 1999 and 2006 provides information related to additional hours workers would want to work. Using the WES data Wang (2018) found that employees, regardless of their status, wanted to work 2.20 hours more per week than they did. Applying the Dynamic framework over the same period results in an hour gap of 2,09 hours with a standard deviation of 7,17 hours. This result suggests that the Dynamic framework can predict optimal working patterns without relying on subjective survey responses. Therefore, the Dynamic framework is as reliable as is the principle that similar causes produce similar results, especially if there is no better method.

Because of the long trend nature of this study, it has not been possible to include some relevant variables in the matching process and regression models, as these variables were not (consistently) available over the studied period. For example, workplace variables, including industry, type of activity, unionization, hourly rate, tenure and occupation, would undoubtedly affect the matching results and provide more fine-tuned thresholds.

Furthermore, the two-part hurdle model used differs somewhat from typical hurdle specifications. For instance, being underemployed is not a hurdle (a selection) prior to positive counts of hours gap but rather a conceptual classification of hour gap. In other words, individuals do not choose to be underemployed. Instead, the *Potentially Under Employed* become underemployed if their hour gap is positive. Therefore, a much more complete specification would include, as a hurdle, the decision to participate in the labour market through a selection process, after which any hour gap can occur. Then, the underemployment or new employment status variable would have, as options, fully employed, underemployed and over-employed for null, positive and negative values of hour gap, respectively. Models to consider for such specification would be Tobit model, Cragg Market Participation model, Complete Dominance model, and Heckman model (Brouhle & Khanna, 2005; Hu et al., 2011).

This study measures underemployment as the unfulfilled willingness and availability to work additional hours. However, underemployment is but one manifestation of labour underutilization. It does not capture other essential manifestations of labour underutilization, such as over-qualification. Feldman (1996) identified as many as four other types of labour underutilization: (a) over-education, (b) involuntary employment outside of their educational credentials, (c) surplus skills and work experience for a given job, and (d) low or poverty-wage work. These are inadequate employment situations that may influence underemployment to some extent. For example, skills mismatch and low wages could lead some people to turn down a job offer and remain unemployed for a more extended period. Therefore, not accounting for such inadequate employment could overestimate underemployment.

7. Conclusion

Population ageing is probably one of the most debated topics in recent decades. While more studies are needed to unveil the role of population ageing in an eventual labour shortage, this study highlights the unused labour supply in Canada.

The study estimates at 20,1% (±2) the proportion of persons in underemployment in Canada, on average between 1981 and 2017. At full employment, the underemployed could additionally supply the equivalent of 1,5 million (±0,2) full-year workers. If having a low education level is a common trait of underemployed men and women, men are more likely to be single while women are more likely to be recent immigrants. For both sexes, full-time (not attending school) labour market participants and adults aged 25-54 required the most hours to reach full employment. These results suggest that underemployment is one of the major, if not the primary, problems of the Canadian labour market.

This study brings significant nuances to the existence of an overall labour shortage in Canada. The high prevalence of underemployment suggests that immigration should not be the only option for additional labour supply. Immigration may be necessary for filling labour shortages in specific industries or professions. It may even be inevitable to prevent a decreasing labour force in some distant future. However, results from this study suggest that full employment could provide an additional labour supply comparable to immigration in short and medium terms.

Full employment would not only regain the lost labour in underemployment. It may also inspire the discouraged and other non-participants to enter the labour market. However, promoting full employment goes beyond preventing a labour shortage and represents an all-encompassing social and economic goal. It is a step further toward greater social well-being. Prioritizing full employment without closing the door to immigration means optimal working hours for individuals at all levels of society, for native Canadians and immigrants. In both cases, the challenge will remain to evaluate and address the skills mismatch between the supply and demand of labour. While policymakers may be responsible for stimulating creativity and innovation to continuously create new jobs that absorb the excess labour supply, ensuring that the labour force is adequately qualified is no less challenging.

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Chapitre 4

Discussion et Conclusion Générales

En avril 2013, le comité d'experts sur l'avenir du système de retraite québécois déposa son rapport intitulé *Innover pour pérenniser le système de retraite* (D'Amours et al., 2013, p 77). Entre autres, ce rapport souligne que les Canadiens, les Québécois en particulier, travaillent moins longtemps pour financer une retraite plus longue, car l'espérance de vie s'accroit régulièrement alors que l'entrée dans la vie active a lieu plus tard et la sortie du marché de travail plus tôt. Le rapport estime qu'au Québec par exemple, la part de la période de vie au travail dans la vie totale est passée d'environ 60% à 45% entre 1970 et 2009.

Cette analyse et d'autres similaires soulignent que les changements démographiques et comportementaux constituent une menace importante de pénurie de main-d'œuvre et de faillite des finances publiques. Il faudrait donc prendre des mesures préventives , dont l'augmentation de l'âge de la retraite ou des quotas d'immigration. Si ces conclusions sont courantes dans les débats académiques et politiques autour du vieillissement démographique, elles se basent le plus souvent sur une analyse transversale des estimations des âges d'entrée et de sortie de la vie active, ce qui a pour résultat de biaiser l'estimation de l'offre de travail tant au niveau individuel qu'au niveau agrégé.

L'utilisation des âges d'entrée et de sortie biaise les estimations de la durée de vie au travail et de l'offre agrégée de travail pour deux raisons principales. D'une part, la popularité des

emplois à temps partiel permet aux jeunes de s'impliquer dans le marché du travail plus tôt, longtemps avant qu'ils ne soient diplômés, d'où la complexité d'estimer un âge de début de vie active. D'autre part, l'utilisation de l'âge moyen ou médian de la retraite afin d'estimer l'âge de sortie du marché du travail ne donne pas une idée suffisamment précise de la participation au marché du travail des personnes âgées. En plus d'être affecté par la structure par âge de la population active, cet âge moyen ne marque pas nécessairement une sortie définitive du marché du travail et il est calculé en ne tenant compte que des personnes ayant pris leur retraite au cours d'une année donnée, ne donnant aucune idée de l'intensité du phénomène, contrairement à une approche qui ferait appel à des taux de retraite par âge (Carrière & Galarneau, 2011).

Cette thèse utilise des approches nouvelles et génère des résultats de recherche originaux qui tiennent compte des changements de comportements individuels dans l'offre de travail. Elle apporte des nuances importantes aux débats liés aux défis du vieillissement démographique et à l'apport de l'immigration pour y faire face. Entre autres, elle dissocie les effets des facteurs démographiques de ceux des changements comportementaux dans la détermination des offres individuelles et agrégées de travail. Ceci est rendu possible par l'inclusion des heures travaillées au même titre que les taux d'activité dans l'estimation de l'offre de travail d'une part, et l'utilisation du modèle de changement continu proposé par Horiuchi et al. (2008) d'autre part. Ce même modèle est également utilisé, en plus des Comptes Nationaux de Transferts (CNT), pour comparer les contributions fiscales des immigrants et des natifs aux finances publiques. Une autre contribution méthodologique de cette thèse est l'utilisation d'un nouveau Cadre Dynamique d'Utilisation du Travail que nous proposons et qui permet une mesure systématique du sous-emploi.

Par ses différents résultats, cette thèse enrichit le débat entourant le vieillissement démographique et l'immigration au Canada. Elle révèle que l'effet du vieillissement démographique sur l'offre de travail a été jusqu'à maintenant limité, car largement compensé par des changements dans les comportements individuels. La thèse démontre aussi que si

l'immigration contribue à l'offre de travail, cet ajout ne se fait pas à coût nul. En effet, nos résultats indiquent que la contribution fiscale des immigrants est déficitaire, contrairement à celle des natifs. Ce déficit fiscal observé depuis plusieurs années est en partie dû au sous-emploi de la main-d'œuvre immigrante. Cependant, les résultats de la thèse montrent aussi que le sous-emploi est particulièrement important au Canada et n'affecte pas que les immigrants.

En somme, jusqu'à maintenant les changements de comportements face au marché du travail ont compensé les effets du vieillissement démographique sur l'offre de travail. Dans le futur, une meilleure utilisation de la main-d'œuvre potentielle serait en mesure d'atténuer de façon importante une pénurie de travailleurs qui serait causée par le vieillissement démographique. On devra donc s'assurer d'une meilleure utilisation de la main-d'œuvre potentielle, qu'elle soit issue de l'immigration ou des natifs du Canada. Ce chapitre discute les différents résultats de la thèse ainsi que leurs contritions à certains débats que suscite le vieillissement de la population canadienne.

4.1. Augmenter l'âge normal de la retraite dans un contexte de vieillissement démographique : sûrement pas au nom d'une réduction du nombre d'années travaillées

Nos résultats suggèrent que le vieillissement démographique n'a pas eu un effet néfaste sur l'offre de travail, et ce tant au niveau individuel que collectif. D'une part, au niveau individuel, si l'augmentation de l'espérance de vie a contribué au vieillissement de la population, elle n'a pas été accompagnée, contrairement à ce qui est souvent proclamé, d'une réduction du poids des années passées sur le marché du travail. D'après nos résultats, les Canadien(ne)s ont, au cours des récentes décennies, non seulement augmenté leur nombre d'années de travail(durée de vie au travail), mais aussi la proportion que ces années représentent par rapport à l'ensemble de l'espérance de vie (ratio travail-vie). En effet, entre 1981 et 2016, la durée de vie

au travail au Canada a augmenté de 4,96 années alors qu'en proportion de l'espérance de vie, elle est en hausse de 3,55 points de pourcentage.

La participation au marché du travail a été le principal moteur de ces changements, contribuant 3,57 années contre 0,73 et 0,65 pour les heures travaillées et l'espérance de vie respectivement. Si des trois composantes, la longévité contribue le moins à la hausse observée de la durée de travail pour les deux sexes combinés, elle est la seule ayant une contribution positive (1,25) chez les hommes. L'analyse par groupe d'âge montre que les contributions proviennent principalement des adultes de 35 à 54 ans, suivis de près des personnes âgées de 55 ans et plus (2,51 ans et 1,68 an respectivement). La contribution des jeunes âgés de 15-34 ans n'a été, pour sa part, que de 0,77 année. Si le vieillissement démographique, dont la manifestation au niveau individuel se résume à l'augmentation de l'espérance de vie, a un effet positif sur l'offre de travail individuelle, qu'en est-il de ces effets sur l'offre agrégée de travail?

Au niveau agrégé, le vieillissement démographique se traduit par une augmentation de la proportion des personnes âgées dans la population. Toutes choses étant égales par ailleurs, le vieillissement de la population aura pour effet de diminuer la proportion de la population considérée comme active et par conséquent, soit de réduire l'offre agrégée de travail ou, du moins, ralentir sa croissance. Mais ses effets sur l'offre de travail se confondent avec ceux des changements dans les comportements individuels et l'apport continuel de l'immigration. D'où la nécessité de prendre en compte tous ces facteurs simultanément afin d´évaluer l'impact isolé du vieillissement des populations sur l'offre agrégée de travail. Pour ce faire, nous avons mesuré cette offre (en personnes-années) et analysé les contributions à son évolution des taux d'activité, des heures travaillées, de la taille de la population et de l'immigration entre 1981 et 2016.

Nos résultats montrent que le changement dans la structure par âge de la population a réduit l'offre agrégée de travail additionnel de 11,7%, confirmant l'effet négatif du vieillissement démographique sur la main-d'œuvre. Cependant, cet effet est compensé par celui des

changements dans les comportements individuels. En effet, sur la même période, les changements dans la participation et le nombre d'heures travaillées comptent, respectivement, pour une augmentation de 19,3% et 5,8% de la croissance de l'offre agrégée de travail. Les changements comportementaux ont donc plus que compensé les effets négatifs entraînés par les changements démographiques sur l'offre de travail, et ceci sans qu'aucune politique de report de la retraite n'ait été mise en place. Mais la non-prise en compte de ces facteurs suggère le contraire et conduit certain à un appel pour relever l'âge normal de la retraite.

En somme, le vieillissement démographique ne semble pas, pour le moment, constituer un argument justifiant une augmentation de l'âge normal de la retraite, surtout si les politiques actuellement en vigueur sont financièrement soutenables pour les 40 à 75 prochaines années (Institut Canadien des Actuaires, 2019, p. 2). Mais si le vieillissement des populations a un effet limité sur la main-d'œuvre, c'est aussi à cause de l'apport continuel de l'immigration dont la contribution aux finances publiques est rarement évaluée. Nos résultats suggèrent que si l'immigration est, en partie, une solution pour pallier à une pénurie éventuelle de main-d'œuvre, elle contribue par ailleurs au déséquilibre des finances publiques.

4.2. Immigration : une opportunité, mais aussi un défi

L'augmentation de l'offre agrégée de travail au cours des décennies récentes est en bonne partie attribuable à la population immigrante dont la contribution est estimée à 32,9% de l'accroissement total entre 1981 et 2016. En fait, si l'effet du vieillissement démographique sur l'offre de travail est négatif sur cette période, il ne l'est pas pour la population immigrante dont le rajeunissement continuel a permis d'accroître l'offre de travail de 12,1%. Le vieillissement de la population native l'a quant à lui réduit de numDnprpPopStructureNatives%. Il n'est donc pas étonnant que l'augmentation des quotas d'immigration ait pris une place importante dans les débats politiques et économiques autour du vieillissement démographique. Mais alors que la population immigrante a contribué

environ au tiers à l'accroissement de l'offre de travail entre 1981 et 2016, son effectif a doublé sur la même période, passant d'environ 4,4 millions en 1981 à 8,7 millions en 2016. Cet accroissement de la population immigrante, ajouté aux politiques récentes d'augmentation des quotas, suscite des questionnements quant à son rendement économique qui serait négatif selon plusieurs études (Akin, 2012; Dungan et al., 2013; Dustmann et al., 2016; Hering & Klassen, 2010; İleri, 2019).

Il ressort des résultats de nos recherches que les immigrants contribuent moins aux finances publiques que les natifs. En effet, sur la période allant de 1997 à 2015, un immigrant recevait en moyenne 17 420$ et contribuait 15 830$, soit un solde négatif de 1 590$, alors qu'une personne née au Canada recevait environ 15 890$, mais contribuait 16 000$ aux finances publiques, soit un solde positif de 110$. L'écart entre immigrant et natif est donc de 1 710$. Ces résultats laissent croire que le déficit fiscal entre immigrants et natifs provient des transferts reçus alors que l'immigrant moyen contribue presque autant que le natif. Mais ceci n'est qu'apparence, car ne prenant pas en compte les différences dans la structure par âge des deux populations. Pour éliminer ce biais, nous avons décomposé le surplus net en différentes composantes fiscales.

Cette décomposition permettant de comparer immigrants et natifs de même âge, révèle que l'immigrant moyen a reçu environ 3 640$ annuellement de plus qu'un natif. Avec un tel déficit net, l'immigration contribue à une surcharge fiscale importante et de ce fait, serait trop coûteuse pour pallier une éventuelle pénurie de main-d'œuvre. Cependant,la décomposition montre aussi qu'un montant d'environ 3 090$, représentant 85% du deficit, est attribuable aux différences de contributions en taxes sur les ventes et en impôts sur le revenu. Le salaire étant la source principale des revenus, il s'ensuit que le surplus net de transferts entre immigrants et natifs est en bonne partie le résultat d'un marché du travail défavorable à ces derniers. Entre autres, la discrimination à l'embauche et de plus faibles salaires sont autant de facteurs qui contribuent à réduire le salaire moyen de la population immigrante. Ils ont aussi pour effet d'augmenter les risques de sous-emploi, contraignant cette dernière à

accepter des emplois temporaires, saisonniers ou à temps partiel (sous-emploi) ou encore des emplois pour lesquels elle est massivement surqualifiée (surqualification).

4.3. Le sous-emploi : défi d'autant plus important dans un contexte de vieillissement démographique

Nos estimations indiquent qu'entre 2013 et 2016, le risque de sous-emploi est plus élevé pour un immigrant qu'un natif, avec un rapport des cotes d'environ 40% chez les femmes et 20% chez les hommes. Ce déséquilibre se reflète directement sur l'offre agrégée de travail, réduisant la contribution des immigrants à son accroissement. Par exemple, alors que les changements de comportements individuels expliquent 25,1% de l'accroissement de l'offre agrégée de travail entre 1981 et 2016, la contribution de la population immigrante à cette hausse n'a été que d'un point de pourcentage contre 24,1 points de pourcentage pour la population native (1,9 point contre 17,4 points pour la participation au marché du travail et $-0{,}9$ contre 6,7 pour les heures travaillées). Ainsi, le sous-emploi restreint considérablement la performance des immigrants sur le marché de travail, réduisant leur revenu moyen et, par conséquent, leurs contributions aux finances publiques. En d'autres termes, l'une des raisons qui expliquent le déficit fiscal des immigrants comparés aux natifs est l'importance de leur sous-emploi et de leurs plus faibles salaires.

Si le sous-emploi explique une partie non négligeable du déficit fiscal entre immigrant et natifs, il ne se limite pas à la population immigrante et touche toutes les couches de la population canadienne, les jeunes et les femmes en particulier. Alors que le taux de chômage moyen au Canada a été de8,3% ($\pm 1{,}7$) entre 1981 et 2017, le taux de sous-emploi en revanche a été beaucoup plus élevé, soit une moyenne de 20,1% (± 2) pendant la même période. En effectif, la perte moyenne de main-d'œuvre due au sous-emploi s'élève à 1,5 million de travailleurs à temps plein, c'est-à-dire travaillant 40 heures par semaine et 50 semaines par an.

Pour mieux apprécier la magnitude de cette perte, réduire à zéro[1] le sous-emploi équivaudrait à une entrée massive d'environ 3,5 millions d'immigrants. La perte apparait encore plus stupéfiante lorsqu'on la compare à celle occasionnée par le vieillissement de la population canadienne qui, en près de quatre décennies, n'a réduit l'offre agrégée de travail que d'environ 0,7 million de travailleurs. En somme, le sous-emploi est sans doute *le véritable défi du marché du travail au Canada* (Congress, 2014). Il constitue un gaspillage important de main-d'œuvre potentielle (Li et al., 2006; Mitchell & Muysken, 2008), ce qui est d'autant plus vrai dans un contexte de vieillissement démographique et de pénurie de main-d'œuvre appréhendée. Mais qu'est-ce que le plein-emploi et comment y parvenir ?

4.4. Plein-emploi : quelques considérations pour y parvenir

Le plein-emploi pourrait être un moyen efficace non seulement pour prévenir ou pallier une pénurie éventuelle de main-d'œuvre, mais aussi pour améliorer les conditions de vie de toute la population canadienne, immigrante et native. Mais le plein-emploi n'est pas l'absence totale du sous-emploi. On s'entend généralement pour dire qu'il y a plein-emploi lorsque le taux de sous-emploi ne peut plus diminuer sans qu'il y ait pression à la hausse sur le taux d'inflation. Il n'y a aucun consensus sur ce niveau minimal, mais on y est raisonnablement proche lorsque le sous-emploi se réduit uniquement au chômage volontaire, par exemple lorsque l'individu quitte son emploi pour en chercher un meilleur. Puisque les immigrants sont plus susceptibles de se retrouver en situation de sous-emploi, un premier pas vers le plein-emploi serait de réajuster la politique d'immigration pour qu'elle soit davantage compatible avec les besoins du marché de travail. Plusieurs politiques peuvent contribuer à cet objectif.

D'abord, les entreprises pourraient participer davantage à la gestion de l'immigration économique, étant mieux placées pour apprécier la qualification des candidats. Aussi, une plus grande reconnaissance des diplômes obtenus à l'extérieur du pays demeure un enjeu

[1]Ceci ne sous-entend pas que le sous-emploi pourrait être réduit à zéro, et surtout pas en une seule année, mais simplement souligne l'ampleur du phénomène

important, tout comme la facilitation du processus de résidence permanente accordée aux étudiants internationaux. Toutes choses égales par ailleurs, l'immigrant ayant obtenu un diplôme canadien serait moins susceptible au sous-emploi, car ayant eu le temps de s'intégrer culturellement et socialement avant qu'il ne lui soit nécessaire de chercher un emploi. Mais si une politique d'immigration mieux ciblée peut assurer une meilleure intégration économique et sociale des immigrants et de fait réduire le sous-emploi, elle ne doit pas perdre de vue que les immigrants ne représentent qu'une faible proportion des personnes qui en sont victimes. Il faudra donc mieux comprendre le décalage entre l'offre et la demande de travail parmi la population native. Ainsi, la réduction du sous-emploi permettrait d'améliorer le bien-être de la population canadienne; immigrante et native.

En somme,la réduction du sous-emploi permettrait d'une part de soutenir la croissance de la main-d'œuvre et d'autre part, d'augmenter la contribution fiscale des travailleurs, celle des immigrants en particulier.

4.5. Vieillissement et main-d'œuvre: perspectives d'évolution à moyen terme

En Résumé, cette étude contribue aux débats du vieillissement démographique et de l'immigration sur plusieurs aspects. D'abord, les résultats suggèrent que le vieillissement démographique présente plus d'opportunité que de défis pour la main-d'œuvre et que le coût fiscal de l'immigration limite l'utilisation de cette dernière comme source principale de main-d'œuvre. Aussi, les analyses révèlent que le sous-emploi est un problème majeur de la main-d'œuvre au Canada, dont l'élimination ou la réduction pourrait contribuer plus qu'une augmentation raisonnable de l'âge de la retraite ou des quotas d'immigration. Néanmoins, elle laisse plusieurs questions en suspens. Notamment comment évolueront la durée de vie au travail et l'offre de travail au cours des prochaines décennies? Le plein-emploi est-il possible et réalisable, et quelles politiques exigerait-il?

Au cours des dernières décennies la participation au travail, notamment celle des femmes, a été la principale source de l'augmentation de la durée de vie au travail. Cependant, les analyses suggèrent que les hommes et les femmes ont atteint un équilibre dans la répartition du temps de travail qui durera plus ou moins longtemps. Ainsi, l'évolution de la durée de vie au travail au cours des prochaines décennies serait largement le fruit des tendances de la mortalité, spécialement aux grands âges où la majorité des améliorations apparaitront et des gains en espérance de vie en bonne santé (Eggleston & Fuchs, 2012).

Du point de vue de l'offre agrégée de travail, l'effet négatif du vieillissement démographique aura atteint son niveau maximal dans les années 2030, alors que les baby-boomers auront très largement quitté le marché du travail. Dans ces conditions, l'offre agrégée de travail subirait moins de pression à la baisse que dans les années plus récentes qui était en partie due à l'arrivée de cohortes très nombreuses à des âges où la participation au marché du travail et le nombre d'heures travaillées tendent à diminuer. On peut donc s'attendre à ce que la croissance de la main-d'œuvre surpasse, ou tout au moins maintienne, les tendances des dernières décennies, à moins qu'une crise naturelle ou humanitaire, ou encore une pandémie telle que la COVID-19 bouleverse substantiellement les comportements individuels.

Par ailleurs, une réduction du sous-emploi pourrait contribuer à accroître l'offre agrégée de travail, même au-delà de ses niveaux antérieurs. Ceci passera par des politiques de soutien à la création d'emplois, l'amélioration de l'arrimage entre l'offre et la demande de travailleurs qualifiés et une meilleure régulation de l'environnement légal du travail. En augmentant les heures travaillées, la réduction du sous-emploi augmente la productivité de la main-d'œuvre en général et compense dans une bonne mesure son vieillissement.

4.6. En conclusion

Le vieillissement démographique transforme profondément la structure par âge de la population canadienne depuis plusieurs années. Il présente un défi important pour, entre autres, la croissance de la main-d'œuvre et les finances publiques. Il est toutefois important de

départager les effets du vieillissement démographique de ceux d'autres facteurs, dont l'évolution des comportements individuels. Cette thèse s'est intéressée plus particulièrement à l'effet isolé du vieillissement démographique sur la croissance de la main-d'œuvre. Les résultats suggèrent, que ce soit au niveau individuel ou agrégé, que l'effet négatif du vieillissement est, jusqu'à présent, limité et beaucoup moins important que celui du sous-emploi. Ce dernier affecte toutes les couches de la population et contribue en partie au coût fiscal plus élevé d'un immigrant par rapport à un natif.

Au vu de ces résultats, il nous semble que le débat autour de l'impact du vieillissement de la population sur la société et l'économie canadienne devrait accorder une attention particulière au sous-emploi et à la mise en place de politiques publiques favorisant le plein-emploi.

Cette étude contribue à cette réflexion par sa nature novatrice, notamment en introduisant les heures de travail dans l'estimation des effets du vieillissement démographique au niveau individuel et agrégé. D'une part, elle a permis d'éclairer plusieurs coins d'ombres, notamment en invalidant l'argumentaire selon lequel les Canadiens travaillent moins longtemps pour financer une retraite plus longue. D'autre part, elle révèle un écart important entre la contribution aux finances publiques des immigrants et des natifs. Un des aspects les plus novateurs de cette thèse est d'avoir identifié les postes de transferts qui expliquent le déficit fiscal qu'entraîne l'immigration. Ce déficit serait le résultat de contributions moindres et non de transferts plus élevés en faveur de la population immigrante. Le rétablissement de l'équilibre passe d'abord et avant tout par une meilleure intégration au marché du travail, conduisant à une augmentation des contribution en taxes et impôts.

Il est aussi important de noter la contribution d'un nouveau Cadre Dynamique d'Utilisation du Travail qui apporte des corrections aux lacunes limitant l'application du cadre existant. Le Cadre Dynamique d'Utilisation du Travail proposé utilise l'analyse des clusters pour séparer la population active en deux groupes, soit les personnes pleinement employées et celles qui sont sous-employées. Avec ce nouveau cadre d'analyse, il est maintenant plus facile d'estimer et de

comparer les niveaux de sous-emploi entre différents groupes sociodémographiques d'un pays donné ou entre pays.

Malgré ces contributions, plusieurs vides restent évidemment à combler dans l'évaluation des effets du vieillissement démographique à long terme. Entre autres, il serait utile de projeter les changements futurs dans les comportements individuels qui permettraient de pallier les effets de la poursuite du vieillissement de la population canadienne. Si jusqu'à maintenant ces comportements ont réussi à neutraliser une bonne partie des effets du vieillissement de la population sur l'offre de travail agrégée, cette tendance pourrait ne pas s'avérer dans le futur. Aussi, d'autres pays montrent un vieillissement démographique plus accentué que celui observé au Canada. Reproduire l'analyse proposée dans cette thèse pour l'Italie et le Japon, par exemple, permettrait de situer le Canada dans une perspective plus large et d'identifier certaines pistes à explorer pour faire face aux défis que posent la transformation profonde de la structure par âge des pays économiquement avancés.

En terme méthodologique, cette thèse fait usage de l'analyse de tendance sur une période relativement longue et couvrant presque totalement le cycle de vie professionnelle des baby-boomers. Vu la taille de cette cohorte, on s'attend a ce qu'elle affecte les résultats. Ainsi, une analyse APC (âge période cohorte) est nécessaire pour isoler les effets de la cohorte des baby-boomers dans les analyses de tendance. Il en va de même pour les analyses des différences ou des changements basés sur le modèle de changement continue (MCC) d'Horiuchi et al. (2008) ne permettant pas explicitement d'isoler les effets de cohorte.

MCC fait l'hypothèse que le changement des covariables se produit de manière continue ou graduelle selon une dimension temporelle réelle ou hypothétique. Cependant, il assume aussi que la trajectoire de ce changement est linéaire. Cette dernière hypothèse n'est pas toujours vérifiée surtout lorsque la période de changement est longue. Par exemple, le changement de la durée de vie au travail entre 1981 et 2016 n'est pas tout à fait linéaire et la méthode ne rend pas compte des changements intermédiaires durant cette période. Une autre lacune de la

méthode MCC est l'ambiguïté de la ligne de démarquage entre contributions et causalité dans l'interprétation des résultats de la décomposition. Nos analyses se sont penchées plus sur des contributions, ce qui n'est pas satisfaisant lorsqu'on s'intéresse à la causalité.

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