Inflation, Nominal Portfolios, and Wealth Redistribution in Canada

by Césaire A. Meh and Yaz Terajima

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Acknowledgements

Abstract

There is currently a policy debate on potential refinements to monetary policy regimes in countries with low and stable inflation such as the U.S. and Canada. For example, in Canada, a systematic review of the current inflation targeting framework is underway. An issue that has generally received relatively less attention in this debate is the redistributional effects of inflation. This omission is likely to be important since the welfare costs of inflation depend not only on aggregate effects but also on redistributional consequences. The goal of this paper is to contribute to this policy debate by assessing the redistributional effects of inflation in Canada that arise through the revaluation of nominal assets and liabilities. We find that the redistributional effects of inflation are sizeable even for low and moderate inflation episodes. The main winners are young middle-class households with substantial amounts of mortgage debt. Besides young households, inflation also represents a windfall gain for the government because of its long-term debt. Old households, rich households, and the middle-aged middle-class lose from inflation, largely due to their sizeable holdings of bonds and non-indexed defined benefit pension assets.

JEL classification: D31, D58, E31, E50
Bank classification: Monetary policy framework; Sectoral balance sheet; Inflation: costs and benefits; Inflation targets; Inflation and prices

Résumé

Les améliorations dont pourraient bénéficier les régimes de politique monétaire font actuellement l'objet d'un débat public dans les pays caractérisés par un taux d'inflation bas et stable, comme les États-Unis et le Canada. Ainsi, le régime canadien de cibles d'inflation est soumis en ce moment à un examen en profondeur. Par le passé, un aspect du débat s'est trouvé généralement négligé : les effets de redistribution de l'inflation. Cette omission ne va pas sans risque car les coûts de l'inflation sur le plan du bien-être dépendent non seulement d'effets globaux, mais encore des effets de redistribution. Les auteurs entendent enrichir les discussions en quantifiant pour le Canada les effets de redistribution liés à la dévalorisation par l'inflation des actifs et des passifs, mesurés en termes nominaux. Il ressort que ces effets sont importants, même en période d'inflation basse ou modérée. Les jeunes ménages de classe moyenne qui ont une lourde dette hypothécaire s'en tirent le mieux. Du fait de sa dette à long terme, l'État profite aussi de l'inflation. Par contre, les personnes âgées, les ménages fortunés et les membres de la classe

moyenne d'âge médian comptent parmi les perdants, en raison surtout de la taille appréciable de leur portefeuille obligataire et de l'importance que les régimes de retraite à prestations déterminées non indexées représentent dans leurs actifs.

Classification JEL : D31, D58, E31, E50
Classification de la Banque : Bilan sectoriel; Cadre de la politique monétaire; Cibles en matière d'inflation; Inflation : coûts et avantages; Inflation et prix

1 Introduction

One of the most important arguments in favor of price stability is that inflation generates arbitrary changes in the distribution of income and wealth among different economic agents. These redistributions occur because many loans in the economy are specified in fixed dollar terms. Unanticipated inflation redistributes wealth from creditors to debtors by lowering the real value of nominal assets and liabilities. In this paper, we quantify the redistributional effects of inflation that arise through the revaluation of nominal claims. We estimate the extent of the inflation-induced redistribution of wealth by conducting an experiment in which Canadians experience various inflation episodes, some of which resemble the experience of the late 1970s and early 1980s. We ask how the distribution of wealth among economic agents would change and find that the redistributional effects of inflation are sizeable.

One motivation for measuring the redistributional effects of inflation is the current public debates in several countries about potential refinements to their monetary policy regimes. For example, since the arrival of Chairman Bernanke at the Federal Reserve Bank, discussion has intensified as to whether the U.S should adopt an inflation targeting regime. In Canada, where the inflation targeting experience has been successful, a systematic review of the monetary policy regime is underway in preparation for a potential reform in 2011. The review considers two broad sets of questions.[1] The first is about the potential costs and benefits of lowering the inflation target rate below two percent, and the second concerns the potential costs and benefits of replacing the inflation targeting framework with an alternative regime such as price-level targeting.[2] In evaluating this potential monetary policy reform, it is important to account for the redistributional effects of inflation since the welfare implications of any monetary policy regime depend not only on aggregate effects but also on redistributional consequences. A sense of who would win and who would lose is essential to assess transitional costs and potential support for reform. With the baby boom generation quickly aging, the number of retirees with fixed nominal income and nominal assets (including many pensions) is rapidly increasing, and, therefore, popular support is growing for any reform that reduces fluctuations in nominal income and wealth. For these reasons, it is important to evaluate the potential redistributional effects of inflation and this is what we do in this paper.

In doing so we make two contributions to the literature on portfolios and inflation. First, to the best of our knowledge, we provide the first comprehensive analysis of the nominal assets and liabilities of various economic agents in Canada as well as the maturity structures underlying these portfolios. By so doing, we also show that nominal portfolios in the U.S. and Canada are different in the sense that middle-aged Canadians are savers on average while their American counterparts are borrowers on average. Second, using the documented nominal portfolios we offer an assessment of the redistributional effects of inflation that arise from the revaluation of nominal assets and liabilities in Canada.

Our approach follows the innovative work of Doepke and Schneider (2006), who develop a methodology to compute the redistribution of wealth. They consider the impact of inflation on direct nominal

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[1]See the background document to the 2006 renewal, Bank of Canada, 2006.

[2]Under price-level targeting the central bank corrects any deviations of the price level from its targeted path.

positions and indirect nominal positions which arise through equity holdings in businesses and investment intermediaries. We calculate the inflation-induced redistribution of wealth in two stages. First, using aggregate data from the National Balance Sheet Accounts (NBSA) and cross-sectional household data from the Survey of Financial Security (SFS), we document the nominal assets and liabilities of the foreign sector, the government sector and several household groups. We highlight the role of pension assets and liabilities, many of which are sensitive to inflation. Second, using these nominal positions, we conduct the following experiment which stresses the role of money as a unit of account for the valuation of nominal claims: if the real effects of inflation were primarily due to the revaluation of nominal assets and liabilities, who would lose and who would gain from a low inflation episode lasting several years during which inflation exceeds initial expectations by one percent beginning in a given benchmark year? Furthermore, how large are the transfers that would occur and what changes would occur as the inflation episode varies in magnitude between low and moderate episodes?

The answers to these questions depend on inflation expectations and the way in which agents adjust their portfolios as these expectations are updated. Therefore, we report the results for two different scenarios: a full surprise scenario where the inflation episode is unanticipated and a gradual inflation scenario where the path of the inflation episode is partially anticipated. In general, the latter provides a lower bound on gains and losses while the former provides an upper bound. In the full surprise scenario, the maturity structure of nominal portfolios is irrelevant to the present value of gains and losses, which depend only on the initial nominal positions and the inflation shock. In contrast, under the gradual inflation scenario, the maturity structure also matters for the present value of gains and losses. Specifically, gains and losses are larger for positions with longer maturity.

In the first stage of the analysis, we document sectoral and household level facts that are important for computing the effects of inflation on the redistribution of wealth. The stylized facts at the sectoral level can be summarized as follows. First, overall, the government is the main net nominal borrower and the household sector is the main net nominal lender. In general, the foreign sector's net nominal position is small. It began in the early 1990s as a nominal lender and shrank over the course of the decade; with government debt decreasing, it emerged as a borrower in late 2006. This result contrasts with the experience in the U.S., where Doepke and Schneider (2006) show that the foreign sector is both very large and a major lender. Second, since the beginning of the 1990s, there has been a move away from short maturity nominal instruments to longer maturity nominal claims. For example, households have become borrowers mainly through mortgage debt and savers chiefly through long-term bonds and pensions. This shift towards long-term contracts may have been driven by several complementary forces such as (i) recent developments in financial markets that permit households to increase their nominal savings through pensions and mutual funds, (ii) the implementation of an inflation targeting regime in 1991 that contributes to a partial reduction in price-level uncertainty and (iii) the increased issuance of long-term government debt. Third, a significant part of the household sector's nominal assets is held in the form of pension assets. A large portion of these assets consists of employer-sponsored defined benefit pension plans that are non-indexed.

The facts about the household sector are obtained by using the SFS data where we divide the population by age and economic class. Generally, old households are net nominal lenders and young

households are net nominal borrowers. As a proportion of household net worth, young middle-class households are the largest borrowers in the mortgage market and the young poor borrow significantly in the form of student loans. Old rich households are the major lenders in long-term bond markets while old middle-class households hold the largest part of pension assets in the form of defined benefits. Poor old households save mostly using short-term nominal instruments.

Contrasting these household-level stylized facts with those from the U.S. as documented by Doepke and Schneider (2006), we show that most net nominal positions across age cohorts and economic classes are relatively similar between the two countries, but the nominal positions of middle-aged middle-class households differ substantially. Specifically, while U.S middle-aged middle-class are large borrowers, their Canadian counterparts are large savers.

We now turn to the findings of the second stage of our work where we present winners and losers from an inflation episode. On the losers' side, we find that rich and old households stand to lose since inflation reduces the real value of their nominal assets. In the benchmark year 2005, the loss of the household sector is up to 1.95% of GDP when there is a low inflation episode during which inflation exceeds expectations by 1% for five years. The elderly rich and middle-class households (i.e., above age 75) lose the most and their losses go up to 1.45% and 1.64% of their average net worth respectively. More generally, rich households over 46 and middle-class households over 56 bear most of the household sector's losses, mainly due to their positive positions in long-term bonds and pension assets. Older poor households also suffer some losses, though these result from their positive short positions. On the winners' side, young middle-class households under 36, who are the major holders of fixed-rate mortgage debt, are big winners; they account for a large part of the sector's gains. At most their gains amount to 4.34% of their average net worth. The government sector, being a net nominal borrower, also benefits from inflation. In the benchmark year 2005, the gain of the government from the low inflation episode is up to 2.09% of GDP. With regard to foreigners, they lose but not substantially since they were small net nominal savers in 2005. Specifically, their losses from a low inflation are up to 0.23% of GDP.

The shift towards long-term instruments since the 1990s also has important implications for the size of the inflation-induced redistribution of wealth, particularly under the gradual inflation scenario in which gains and losses are larger for longer maturity nominal claims than for short instruments. As a result, losses and gains become similar between unanticipated and partially anticipated inflation episodes. For example, the household sector's 2005 losses during a gradual inflation episode total 64.62% of its losses with unanticipated inflation, while in 1999 the figure was 62.16%. Similar changes occurred in the foreign sector and in government.

There are other papers that are related to our work. For Canada in the 1970s, Maslove and Rowley (1975) assess the redistributional consequences of inflation but focus on the expenditure effects that arise from the consumption pattern of households while we focus on the wealth effects that come from the valuation of nominal assets and liabilities. The paper is also related to earlier literature, such as Bach and Stephenson (1974) and Cukierman, Lennan, and Papadia (1985), who document redistribution of wealth in the 1970s in other countries. However, they do not conduct their analyses within a unified framework where direct and indirect positions are considered together. Our focus on both sectoral and household data also distinguishes our approach from theirs. There is also

a literature that considers the welfare costs of inflation in monetary models where inflation affects the distribution of wealth (see Albanesia 2007 and Erosa and Ventura 2002). Burnside, Eichenbaum and Rebelo (2006) investigate the fiscal consequences of currency crises in emerging market economies. Their findings suggest that the devaluation of nominal government debt is a more important source of government revenue than seigniorage. Persson, Persson and Svensson (1998) show that because of incomplete indexation of the tax system and the transfer program, moderate inflation has large effects.

The remainder of the paper is organized as follows. In the next section we present the framework used to compute the inflation-induced redistribution of wealth. In section 3, we document nominal assets and liabilities in Canada while in section 4 we use the methodology and nominal positions discussed in the previous two sections to estimate the redistribution of wealth implied by low and moderate inflation episodes. We conclude in section 6.

2 Framework to compute the redistribution of wealth

The extent of the inflation-induced redistribution of wealth depends on how fast economic agents adjust to inflation. Put differently, the size of the redistribution of wealth depends on inflation expectations. We follow Doepke and Schneider (2006) by considering two inflation scenarios which provide in general upper and lower bounds on the redistribution of wealth. The upper bound is captured by a "Full Surprise" scenario (hereafter FS). In this scenario, during multi-year shocks, agents do not anticipate that shocks will continue in subsequent periods; nominal interest rates remain unchanged and the inflation shock lowers the real value of nominal positions each period regardless of the duration of these positions. The lower bound is given by an "Indexing ASAP" scenario (hereafter IA), where agents adjust their expectations after the initial shock to take into account the full duration of the shock. This scenario is also known as a gradual inflation episode since inflation is partially anticipated. Under the IA scenario, the nominal yield curve is adjusted upwards to incorporate the inflation shock. As a result, under the IA scenario, inflation-induced gains or losses depend on the maturity of the nominal position: the position is "locked-in" at the pre-shock nominal interest rate until its maturity date but must be discounted using the new nominal rate, resulting in a lower present value. Intuitively, the reason why present value gains or losses for a claim are larger under the FS scenario is because all the positions are affected equally by the inflation episode while under the IA scenario long-term positions are affected more than shorter positions. Agents are able to mitigate their losses on instruments that mature before the inflation episode ends.

2.1 Full Surprise and Indexing ASAP scenarios

2.1.1 Full Surprise scenario

Consider an n-year, zero-coupon bond with a total nominal yield at time t of i_t^n. In the absence of unexpected inflation, the present value of one dollar earned in n periods through investment in this security is $V_t(n) = \exp(-i_t^n)$. Suppose that at time t, there is a one-time *surprise* increase in inflation of θ percent per year that lasts for T periods. Under the FS scenario, since the inflation

shock in each subsequent period is unanticipated, market expectations do not adjust and the nominal term structure is unchanged. As a result, only a proportion $\exp(-\theta T)$ of a position's present value remains; this proportion falls as the shock's size and duration increase. The present value, $V_t^{FS}(n)$, under FS is thus given by

$$V_t^{FS}(n) = \exp(-i_t^n)\exp(-\theta T) = V_t(n)\exp(-\theta T). \tag{1}$$

Equation (1) shows that the present value of a one-dollar claim at time t is independent of the maturity of that claim. The present value gain or loss G^{FS} is given by the following expression:

$$G_t^{FS} = V_t(n) - V_t^{FS}(n) = V_t(n)\left[\exp(-\theta T) - 1\right]. \tag{2}$$

As equation (2) shows, the net present value of gain or loss depends only on the size and duration of the shock and the initial nominal position. The gain is, indeed, proportional to the pre-shock position with a coefficient $[\exp(-\theta T) - 1]$. If $G^{FS} > 0$ then there is a gain from the inflation episode and otherwise there is a loss. In the sections that follow, equation (2) will be used to compute the size of the redistribution under the FS scenario.

2.1.2 Indexing ASAP scenario

The Indexing ASAP scenario corresponds to a one-time *announcement* at period t that starting from the current period t, inflation will be θ percent higher than expected each period for the next T periods. Assuming the announcement is credible, bond markets will *immediately* revise their inflation expectations and incorporate these updates into the nominal yield curve. Assuming that the real yield curve does not change after the shock and that the Fisher equation holds, the new nominal interest rate used to discount a claim is $\widehat{i_t^n} = i_t^n + \theta\min\{n, T\}$. Therefore, the present value, V_t^{IA}, of a claim under IA is

$$V_t^{IA}(n) = \exp(-\widehat{i_t^n}) = \exp(-i_t^n)\exp(-\theta\min\{n, T\}) = V_t(n)\exp(-\theta\min\{n, T\}). \tag{3}$$

As can be seen from equation (3), in contrast to the FS scenario, under the IA scenario, a nominal position of maturity $n < T$ will only be impacted for the n periods of its duration before which the agent is assumed to reinvest at the pre-shock real yield. This is analogous to the agent's reinvesting in a claim which offers a nominal rate of return that has been indexed to take the inflation announcement into account. The present value gain or loss of a claim of maturity n under IA is given by

$$g^{IA}(n) = V_t^{IA}(n) - V_t(n) = V_t(n)\left[\exp(-\theta\min\{n, T\}) - 1\right]. \tag{4}$$

Equation (4) shows that, under IA, the present value gain or loss, $g^{IA}(n)$, of a claim depends on i) the inflation shock (θT), ii) the initial nominal position ($V_t(n)$) and iii) the maturity of the claim (n). On the other hand, as mentioned above, the gain or loss under FS for any position is independent of its duration. The IA scenario provides a lower-bound for gain or loss on a claim since it assumes full adjustment of expectations to the path of inflation following the initial announcement. This scenario additionally captures important qualitative features of a gradual inflation episode, during which this

path is partially anticipated.[3] The total gain of an economic agent (eg., a sector or a household group) is given by G^{IA} and defined as follows:

$$G^{IA} = \sum_n g^{IA}(n). \tag{5}$$

2.1.3   Size of the inflation shock

As was just discussed, the duration of a claim matters under the IA scenario but not under the FS scenario, where the only relevant variables are the initial net nominal position and the inflation shock. One issue that arises is whether the role played by the duration of a claim under the IA scenario depends on the size of the inflation shock.

The relationship between the maturity and the loss in asset value is non-linear under IA. It is illustrated in Figure 1, which plots as a function of inflation the remaining value of three nominal assets with different durations. The solid, dotted, and dashed lines represent assets of maturity one, five and ten or more years respectively. The dashed line also represents all maturities under the FS scenario for the case $T = 10$. Under FS, all positions are reduced by the same proportion while, under IA, positions with short and long maturities are reduced in different proportions.

A few points are apparent from the figure. First, for a given inflation shock, assets with shorter maturity retain more of their value. Second, when the inflation shock increases, assets with shorter maturity lose less value than those with longer maturity. For example, when the inflation shock is 10%, the remaining values are about 95%, 65%, and 40% respectively for assets with one, five and ten or more years to maturity while the remaining values are 85%, 40%, and 15% for the same durations when the shock rises to 20%. Finally, when the shock is sufficiently high, the values of all assets, regardless of maturity, converge to zero. This suggests that for high inflation, duration plays a relatively small role in determining the inflation-induced wealth redistribution and therefore the differences between FS and IA scenarios shrink.[4]

3   Nominal Assets and Liabilities in Canada

In order to assess the redistribution of wealth induced by inflation, it is essential to identify the nominal positions. As a result, in this section we document comprehensively nominal assets and liabilities of several economic sectors and groups of households in Canada.

3.1   Construction of direct and indirect nominal positions

In this section, we provide an overview of the methods and specific variables used to construct net nominal positions. A detailed presentation of these methods and variables is in Appendix. We define *nominal* assets and liabilities to be all nominal securities denominated in *Canadian dollars*. We

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[3]Therefore we treat gradual inflation and IA scenarios as though they were interchangable.

[4]Given that there is a non-linear relationship between a nominal claim's value and the inflation shock, it is possible, depending on the portfolio's maturity structure, that an agent could gain under the FS scenario but lose under the IA scenario — or vice versa.
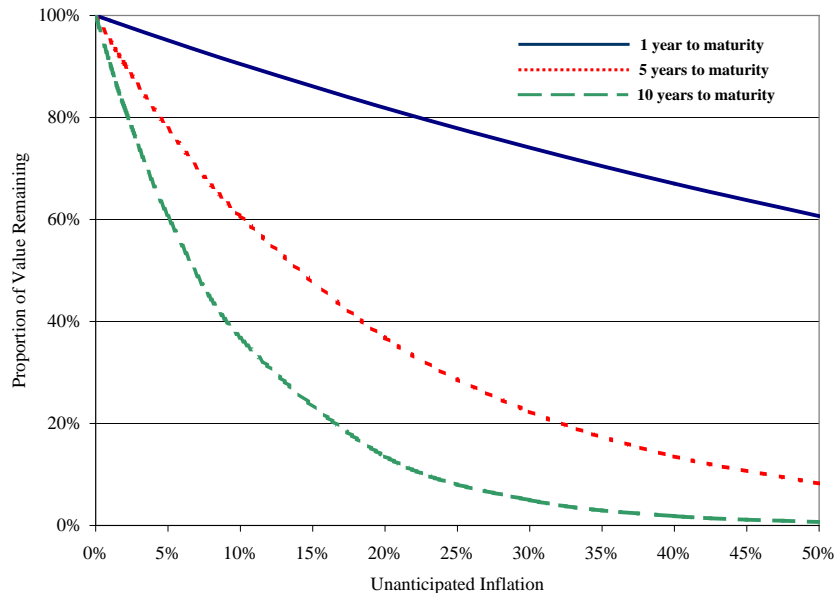
Figure 1: Relationship between Inflation and Remaining Value of a Position under the Indexing ASAP scenario

observe four sectors of the economy: household, government, foreign and business sectors. Since the business sector is entirely owned by other sectors through their holdings of equity, we define household, government and foreign sectors to be the three *end-user* sectors where the redistributional effects on the business sector are indirectly carried over to the end-user sectors through the equity claim they hold against businesses. The computation of the net nominal position involves the indirect positions (through equity holdings) of a sector or a group of households. Therefore the net nominal position (NNP) of a sector or a household group is the difference between the market value of its nominal assets and liabilities, both direct and indirect. To compute the indirect nominal position, we follow McGrattan and Prescott (2005) in taking a frictionless approach to the valuation of the business sector. More specifically, we make the assumption that net equity is equal to the market value of real assets of the business sector plus the direct nominal positions (DNP) of the business sector. Net equity is defined as the market value of all equity claims on domestic firms not possessed by other domestic firms. Therefore, we compute the ratio η^s of each sector's equity holdings, E^s, to net equity holdings within the economy, E, as

$$\eta^s = \frac{E^s}{\sum E^s} = \frac{E^s}{E},$$

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where s indicates a sector and $s \in \{H, G, F\}$ for the household, the government and the foreign sector, respectively.

For the average household within each household group[5], h, the ratio of this household's equity to all equity held by households, η_h^H, is

$$\eta_h^H = \frac{E_h}{E^H} = \frac{E_h}{\sum E_h}.$$

An indirect nominal position (INP) for each sector is obtained by multiplying its equity holdings as a proportion of net equity holdings within the economy by the direct nominal position (DNP) of the business sector. This represents the particular sector's indirect holdings of assets and liabilities through its claims on corporations:

$$INP^s = \eta^s \, DNP^B,$$

where DNP^B is the direct nominal position of the business sector. The net nominal position (NNP) of a particular sector is then

$$NNP^s = DNP^s + INP^s.$$

At the household level, we compute the INP for the average household within each household group as

$$NNP_h^H = DNP_h^H + INP_h^H.$$

The shares, η^s, for each aggregate sector are derived from the NBSA data while the shares, η_h^H, for the average household within each household group are derived from the SFS data.

The frictionless approach to the valuation of the business sector implies that household equity holdings represent the net value of nominal and real assets and liabilities of the business sector. Thus, we define the net worth of a household to include the value of its direct nominal position and real holdings as well as the value of the indirect nominal and real holdings associated with its equity position.

3.2   Data

Our main data source for computing the positions of government, foreign, household and business sectors is the National Balance Sheet Accounts (NBSA) from 1990:1 to 2007:4, as provided by Statistics Canada.[6] The NBSA document the ownership of financial and non-financial assets by sector. Specifically, it details assets and liabilities for persons and unincorporated businesses, corporations

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[5]Household groups will be defined later according to age and economic class.

[6]There are data from the NBSA prior 1990 but only book values are reported, not market values. Since maturity and interest rate data are not readily available to impute the market values for the periods before 1990, we start from 1990. The methodology for constructing market values within the NBSA is given in the Statistics Canada release "Balance Sheet Estimates at Market Value" (June 24, 2004) from the series "Latest Developments in the Canadian Economic Accounts", available at: http://www.statcan.ca/english/freepub/13-605-XIE/2003001/conceptual/2004marketvalue.htm

(including investment intermediaries), governments (at the federal, provincial and municipal levels), and non-residents. In our study, these sectors identify respectively the household, business, government and foreign sectors that we discussed in subsection 3.1.

For detailed household nominal positions, we use the 1999 and 2005 versions of the Survey of Financial Security (SFS), which provides microdata on income and wealth collected by Statistics Canada.[7] The 1999 survey involved 15,933 households and the 2005 survey involved 5,267 households with weights to produce Canadian aggregates. These microdata provide a comprehensive picture of assets, liabilities and wealth. The SFS also over-samples the rich since they own a disproportionate share of the economy's assets. For our analysis, we mainly use the 2005 version of the SFS but also consider the 1999 data in order to identify changes in nominal position over time.

As previously mentioned, after 1990, values of assets and liabilities are already given as market values within the NBSA by Statistics Canada. For financial positions, the total values of liability-side bonds and equity have been estimated directly in the NBSA; asset-side figures are then linked to these estimates. The market value for shares of all listed companies is based on information taken from the exchanges and reconciled to survey data. Assets of the major domestic institutional sectors (e.g., pension funds, segregated funds of life insurance companies, mutual funds) are converted to market values based on data in Statistics Canada surveys. The market value of the non-resident sector's assets is estimated by Statistics Canada using microdata in a debt inventory system, as are domestic bond liabilities. Therefore, unlike Doepke and Schneider (2006), we do not impute market values from payment streams within our dataset.

3.3 Categories of Nominal Instruments

We define four broad categories of nominal financial instruments: Short-term Instruments, Bonds, Mortgages, Employer Pension Plans.[8] For the purpose of our study, all nominal assets and liabilities of sectors and household types are assigned to one of these categories.

Assets held within Registered Retirement Savings Plans (RRSPs) are assigned to one of these categories. In the 2005 SFS data, the values of assets within RRSPs are documented and therefore we assign RRSP assets to short-term instruments, bonds and equities.[9] We also compute the equity holdings in public corporations for the purpose of deriving each household type's η_h^H and INP_h. Since the NBSA includes the assets of private corporations within the household sector, we do not consider ownership of private corporations as equity. The series aggregated into each category of instrument are detailed in the Appendix.

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[7]The SFS is also available for 1984. However, the 1984 survey involved significantly fewer variables. The variables and structure of the SFS are relatively consistent between the 1999 and 2005 datasets.

[8]We separate mortgages as in Doepke and Schneider (2006) but we also separate pensions from bonds. In Doepke and Schneider (2006), pensions are included in bonds. Pensions and mortgages are specially treated because they have recently attracted attention from academics and policymakers.

[9]In the 1999 SFS, only an aggregate value is available for RRSP assets. For simplicity, we decompose this aggregate between short instruments, mortgages, bonds and real assets according to the proportions of 2005 RRSP holdings for each of these asset categories.
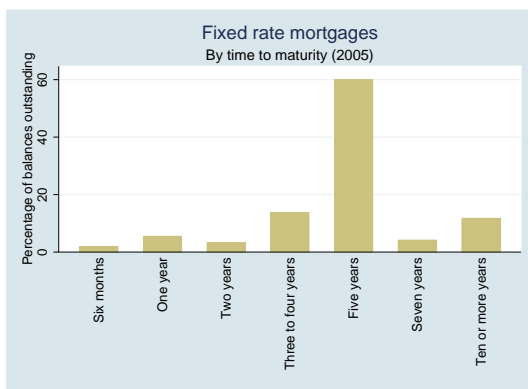
Figure 2: Distribution of fixed-rate mortgages by term to maturity, 2005

Short-term instruments   Short-term instruments are assets and liabilities with a term-to-maturity of one year or less and include the following items: domestic currency and bank deposits, other deposits, consumer credit, Canada short-term paper, other short-term paper, trade receivables and payables, and IMF reserve position, and short-term components of foreign investments.

Mortgages   In this study, we employ distributions over terms-to-maturity for fixed-rate mortgages. Figure 2 presents the 2005 distribution, weighted by outstanding balances. It shows that the most common maturity of Canadian fixed-rate mortgages is about five years. Fixed-rate mortgages account for a significant fraction of all mortgage debt although there has been a shift toward variable mortgage rates. For example, fixed-rate mortgages account for 90 and 80 percent of all mortgages in 1999 and 2004 respectively. The distributions were produced using data recorded in the Canadian Financial Monitor, an annual household survey conducted by Ipsos Reid.[10]

Bonds   The bond category comprises non-mortgage and non-pension instruments with maturity greater than one year and includes the following NBSA categories: Canada bonds, provincial bonds, municipal bonds, corporate and other bonds, bank loans, other loans, government claims, long-term components of foreign investments and other financial instruments that have not been assigned to the mortgage, pension or short categories. For our purposes, we employ distributions over terms-to-maturity for bonds. We derive these distributions from quarterly data on the maturity and face value of federal government debt outstanding. These were provided by the Bank of Canada's Financial Markets Department, drawn from the Communication, Auction and Reporting System database and supplemented by data provided by Statistics Canada (see the Appendix).

During the 1998 to 2005 interval, the average term-to-maturity for outstanding Government of Canada securities was between 9 and 10 years. Figures 3 and 4 show the face value-weighted distri-

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[10]Unfortunately, these data are not available prior to 1999 so we have assumed that the 1999 distribution holds over the 1990-1998 period.
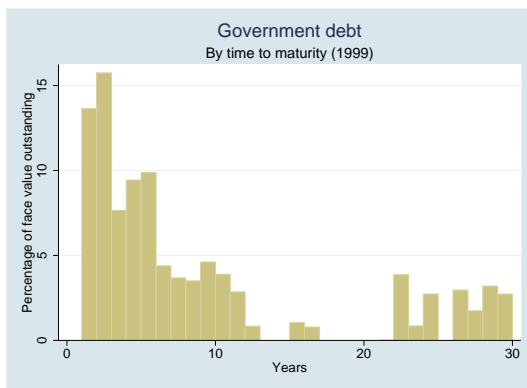
Figure 3: Distribution of Government of Canada Outstanding Securities for December 1999
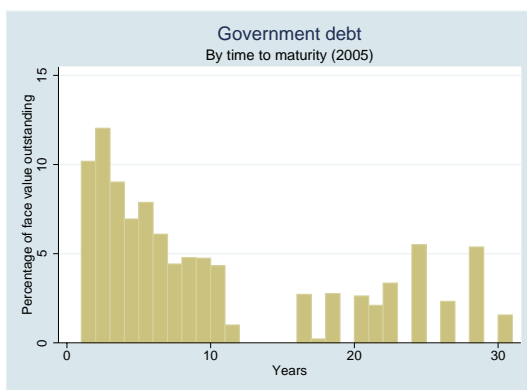
Figure 4: Distribution of Government of Canada Outstanding Securities for December 2005

bution of term-to-maturities for outstanding federal government securities for the fourth quarters of 1999 and 2005 respectively. These distributions highlight the increased proportion of long-term debt (with maturities exceeding 20 years) in 2005, relative to 1999.[11]

Data on the maturity of bonds are not readily available for investors and private-sector issuers. For simplicity, we assume when dealing with the IA scenario (which requires details on the portfolio's maturity structure) that the distribution of terms-to-maturity for government bonds approximates the distribution of terms-to-maturity for all bonds.

Pensions   We differ from Doepke and Schneider (2006) in our treatment of pensions. They assume that all nominal risks associated with pensions are born by the business sector, implying that there is no direct effect to households from inflation shocks. A large fraction of employer-sponsored pensions in Canada is of the non-indexed defined benefit type, with benefit payments that are directly subject

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[11]The increased issuance of longer-term securities is a stated objective of the Government of Canada's *Debt Management Strategy* (GC, 2007). Such long-term instruments are desired by capital market participants as pricing and hedging tools.

to inflation shocks. Furthermore, defined contribution pensions are also subject to the shocks and the magnitude of the effect depends on the portfolio in which contributions have been invested. As a result, it is important for us to pay closer attention to pensions for studying the Canadian economy.

There are three types of Employer Pension Plans (EPPs) among which we distinguish: non-indexed defined benefit, indexed defined benefit and defined contribution. Defined benefit plans are those in which the plan pays the beneficiary based on a benefit formula, typically involving years of service and average earnings. Under defined contribution plans, contributions to a managed fund are made on an employee's behalf with beneficiaries receiving benefits at retirement based on the value of their contributions and the performance of the portfolio. Furthermore, defined benefit plans may involve provisions for indexation. Positions in EPPs are therefore further segmented as positions within indexed defined benefit EPPs, non-indexed defined benefit EPPs and defined contribution EPPs. These positions are affected differently by an inflation shock: Fully indexed defined benefit EPPs are treated as real positions and hence are not affected by inflation shocks. If a plan is not fully indexed, we consider it non-indexed for our purposes. While non-indexed defined benefit plans are impacted as are any nominal assets under the Full Surprise scenario, the impact on these plans under the Indexing ASAP scenario is a function involving the years to retirement and years to life expectancy. Defined contribution plans hold a portfolio of assets, managed by the plan sponsor or their agent. The impact of inflation on a household's assets in a defined contribution plan will depend on the overall impact on this portfolio.

3.4   Sectoral nominal positions

The present value gains or losses in a sector's net nominal positions under our two inflation scenarios depend on the initial nominal positions within each category of assets and liabilities. Figure 5 summarizes the evolution of NNPs over the 1990 to 2007 interval for the Household, Government, and Foreign sectors (i.e., end-user sectors). To understand the indirect positions, we also report in Figure 6 the evolution of the business sector's DNP.[12] Recall that the business sector's positions in each instrument are assigned to the three end-user sectors as indirect positions, based on their equity holdings.

Figure 5 shows that Canadian households are the main lenders in Canada and that the government is the main borrower. Household saving and government borrowing peaked in the mid-1990s and declined thereafter.[13] Relative to the other two sectors, the foreign sector is small in terms of nominal borrowing and lending. This sector was a lender in the 1990s, though it declined in importance over the decade; recently it has become a borrower, particularly since late 2006. The foreign sector data also contrast with experience in the U.S., where the foreign sector has been since the late 1980s a major net nominal lender (Doekpe and Schneider 2006). The household sector's indirect position is negative (i.e., indirect debt) and decreasing in absolute value, as is evident from the negative difference between its NNP and DNP.

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[12]Note that the business sector includes both financial and non-financial businesses.

[13]The decline in the government's nominal debt is due to the fact debt was being serviced out of surpluses realized in the late 1990s.
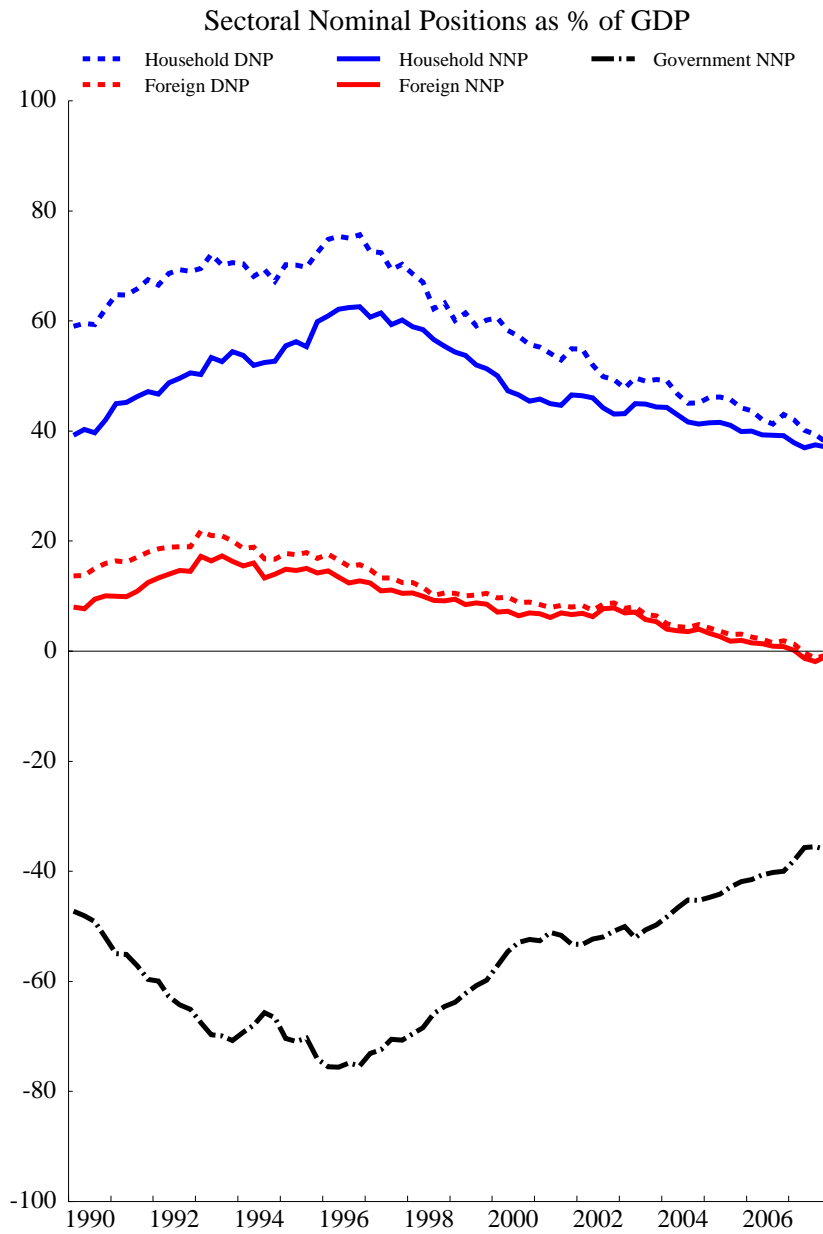
Figure 5: Sectoral Nominal Positions in the Canadian Economy as a Percentage of GDP from 1990 to 2007
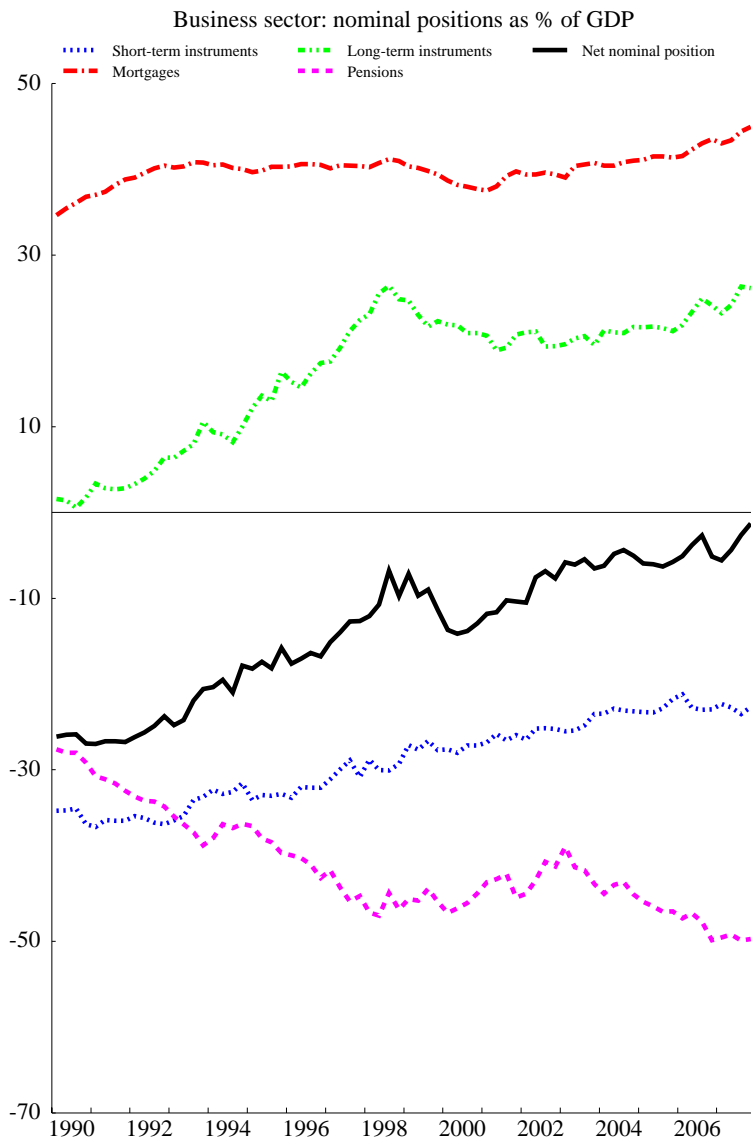
Figure 6: Direct Nominal Positions of the Canadian Business Sector as a Percentage of GDP from 1990 to 2007
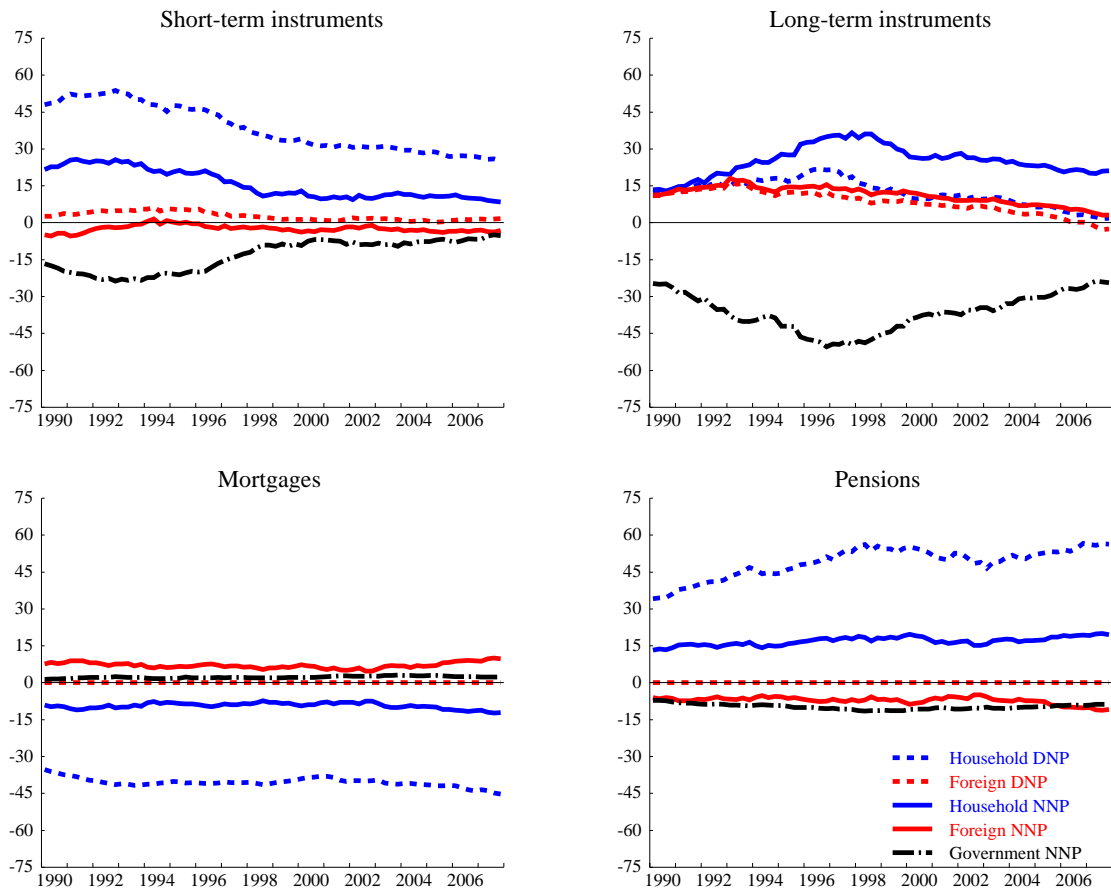
Figure 7: Sectoral Positions in various Nominal Asset Categories in the Canadian Economy as a Percentage of GDP from 1990 to 2007

What type of instruments are used by the different sectors for nominal borrowing and lending? Figure 7 attempts to address this question by summarizing the sectoral nominal positions in different asset categories: short instruments (panel a), bonds (panel b), mortgages (panel c), and pensions (panel d). The scales in all four panels in Figure 7 are identical, so that the sum of a sector's net positions in panels a, b, c, and d equals its position in Figure 5.

Several interesting observations can be made from the plots shown in Figure 7. The figure shows that government is mostly a net borrower in longer maturity claims, particularly bonds. The household sector is mainly a net nominal lender in long-term bonds and pensions and a net borrower in the mortgage market; bonds are their major nominal savings instrument. The amount of pension assets held directly and the amount of pension liabilities held indirectly through equity holdings have both been increasing since 1990. Therefore the positive net nominal pension asset position,
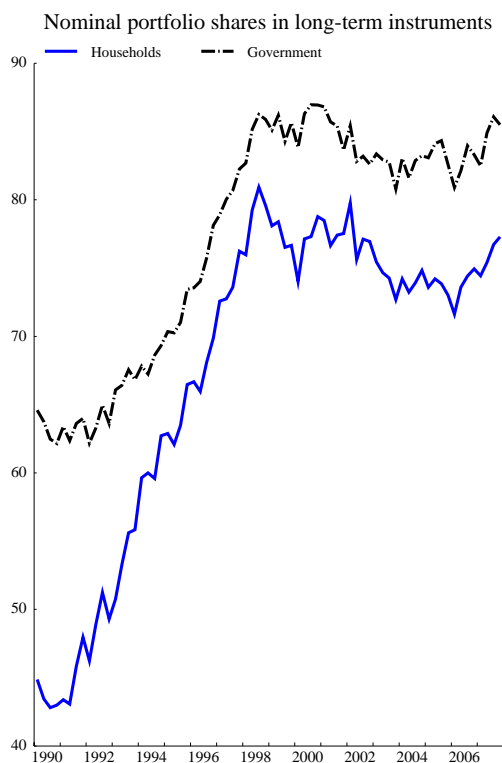
Figure 8: Fraction of Net Nominal Positions in Long-term Instruments

expressed as part of GDP, has not experienced much change. The household sector's net nominal positions in long-term bonds increased dramatically through the late 1990s and are still significant despite having since declined and, more recently, levelled off to a non-trivial level. The positions in short instruments began decreasing in 1993 as long-term nominal claims grew.

Figure 8 further illustrates the growing importance of longer maturity instruments in nominal financial markets by plotting the ratio of net nominal position in longer maturity claims to total net nominal position for the household and government sectors from 1990 to 2006. We can see that there was an acceleration in the use of long-term instruments through to the late 1990s; then a slight decrease was followed by a levelling off around 2006. The fraction of total nominal household savings in long-term financial instruments has increased from about 44% in 1990 to more than 74% in 2006.

Several forces may have given rise to these shifts towards long-term contracts. First, recent financial developments have allowed households (particularly baby boomers) to increase their nominal savings for retirement through pension plans and mutual funds; as a result, their nominal holdings have moved toward long-term assets. Second, the implementation of an inflation targeting regime in 1991 contributed to a reduction in long-run price level uncertainty, which encouraged agents to enter into long-term nominal contracts. Third, the increased issuance of long-term government debt

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played a role in the holding of long-term bonds by households.

Figure 7 also shows that the foreign sector uses mainly longer maturity instruments for borrowing and lending. Specifically, it was a net borrower in pensions and a net lender in mortgage markets over the period 1990 to 2007. The foreign sector was also a lender in long-term bonds until 2003. For example, in the benchmark year 1999, foreigners had positive net nominal positions in long-term bonds of 12.44% of GDP. The direct nominal position of the foreign sector in the mortgage market is nearly zero. The NBSA assume that the sector has no direct exposure to pensions in order to balance national supply and demand in the market for these claims. Therefore, the sector's positive net nominal position in the mortgage market and its negative position in pensions arise mainly through indirect exposures.

3.5 Nominal positions within the household sector

The previous section looked at nominal positions across different sectors of the economy. In this section, we use the SFS data to analyze in detail the household sector by documenting cross-sectional nominal positions for different groups of households. We divide the sample into groups based on age and income. We define six age cohorts based on the household head's age: under 36, 36-45, 46-55, 56-65, 66-75 and over 75. Within each age cohort we identify households as *rich*, *middle-class* and *poor*. Rich households are defined as those in the top 10% of the wealth distribution. Poor households are those in the bottom income quintile. The remaining 70% of each age group is assigned to the middle class.

Net nominal positions for the benchmark year 2005 Table 1 describes the net nominal positions and the nominal portfolio for different income classes and age groups in the benchmark year 2005. (Much more detailed observations in terms of indirect and direct nominal positions are provided in Table A9 in the appendix.) Table 1 shows that, overall, young households are net nominal borrowers and old households are net nominal lenders.

There is, however, heterogeneity within age groups in terms of borrowing and lending. For example, in the two age groups under 46, the middle class and the poor borrow while the rich between ages 35 and 46 save. In fact, with the exception of the youngest cohort (under 36), all rich age groups are net nominal savers. The positive net nominal positions of the elderly rich are large, and their ratio of net nominal savings to net worth (29.82%) is the second highest, preceded by the elderly middle class (33.88%). In contrast, middle-class households under 36 have the highest ratio of net nominal debt to net worth (89.44%), followed by the young poor (52.11%). The poor on average remain borrowers later in life than other income classes. For example, poor households are borrowers until age 56 while middle-class households have stopped borrowing by age 46, on average.

Poor households save mainly through short-term nominal instruments (such as cash). In general, rich households save through real assets. However, to the extent they use nominal claims, rich households save through long-term nominal instruments, particularly those 46 and up. The old and middle-aged middle class use more pensions in the form of non-indexed defined benefit assets for their savings, compared to their counterparts among the poor and rich, who rely more on short-term

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Table 1: Nominal Positions as a Fraction of the Mean Net Worth of each Age and Income Class in 2005

			Age Cohort			
Type of instrument	≤ 35	36-45	46-55	56-65	66-75	> 75
			All households			
Short	4.83	-1.01	1.48	2.40	9.00	12.27
Mortgage	-37.95	-13.57	0.07	4.48	3.55	3.29
Bond	-2.63	4.70	6.50	7.90	6.70	7.68
Pension	-0.05	-1.31	5.01	7.36	8.68	8.65
Total NNP	**-35.80**	**-11.19**	**13.06**	**22.14**	**27.93**	**31.89**
			Rich households			
Short	3.86	-3.73	-1.97	-2.36	8.48	8.57
Mortgage	-11.31	4.71	12.92	13.66	7.15	5.71
Bond	7.71	9.72	11.73	13.00	10.50	12.37
Pension	-2.92	-8.53	-6.25	-6.77	1.38	3.18
Total NNP	**-2.66**	**2.16**	**16.43**	**17.53**	**27.51**	**29.82**
			Middle-class households			
Short	5.83	2.24	4.40	5.49	9.06	14.91
Mortgage	-81.62	-35.43	-11.11	-2.91	1.62	1.70
Bond	-18.11	-0.90	2.16	4.10	4.56	4.56
Pension	4.46	7.63	15.96	19.36	14.11	12.71
Total NNP	**-89.44**	**-26.47**	**11.40**	**26.04**	**29.36**	**33.88**
			Poor households			
Short	18.90	-0.06	5.04	13.84	12.58	10.95
Mortgage	-37.77	-19.44	-9.39	2.35	-2.56	2.10
Bond	-37.66	-3.53	0.17	2.59	1.40	6.06
Pension	4.42	-4.09	0.92	1.95	2.73	4.63
Total NNP	**-52.11**	**-27.13**	**-3.26**	**20.73**	**14.15**	**23.75**

Inflation for Canada (1955-2006)
(Annual Frequency of Observations, Annual Rate)
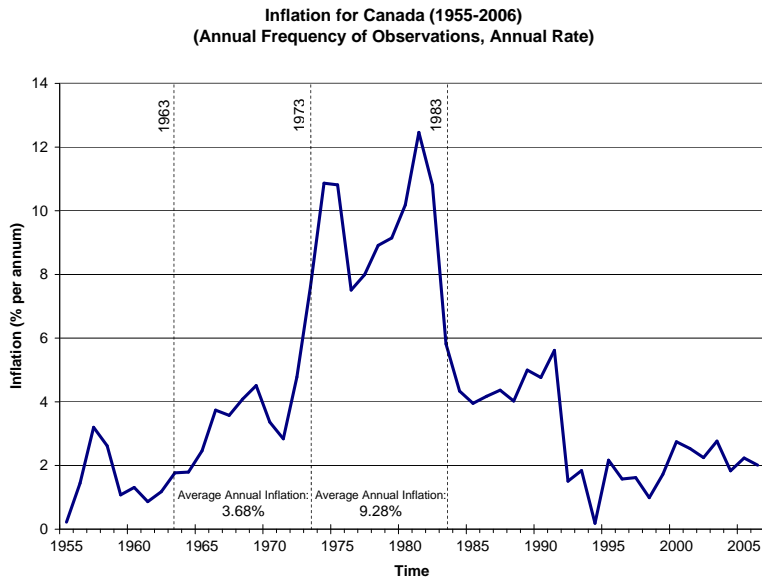
Figure 9: Annual Rate of Inflation for Canada from 1955 to 2006

instruments and bonds respectively. Young middle-class households are the largest borrowers, and most of their direct borrowing occurs through mortgages. The ratio of their overall net nominal debt to net worth is 89.44% while the ratio for mortgage debt is 81.62%.[14] The young poor have the second highest ratio of nominal mortgage debt to net worth, after the young middle-class. Only the young poor and the young middle-class hold negative positions in long-term bonds, which are largely due to student loans. Indirect nominal pension liabilities are substantial for the rich on account of their large equity holdings.[15]

4   Inflation-Induced Redistribution of Wealth

In this section we use the nominal positions of the sectors and household groups, combined with the methodology developed in Section 2, to estimate the redistribution of wealth induced by a five-year inflation episode during which inflation exceeds expectations by $\theta = 1\%$ every year, starting in a given benchmark year. This inflation episode roughly resembles the inflation experience in Canada between 2000 and 2005. This is illustrated in Figure 9, which shows that the average annual inflation rate over 2000-2005 is about 2.39%.

Our analysis considers the redistribution of wealth implied under FS and IA scenarios. The

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[14]Note that households could conceivably hold a positive net nominal position in mortgages. This is because their indirect mortgage position through shares held in financial institutions could be positive. As we would expect, all *direct* nominal mortgage positions are negative.

[15]These households own the largest proportion of the sector's equity holdings and so have the largest indirect positions. See the appendix for more details.

Table 2: Redistribution of Wealth across Sectors as a Percentage of GDP, with a Low Inflation Episode of 1% Inflation Shock Lasting Five Years

Sectors	Government	Foreigners	Households		
			Net	Gains	Losses
Benchmark Year 2005					
Full surprise scenario	2.09	-0.14	-1.95	12.53	-14.48
Indexing ASAP scenario	1.49	-0.23	-1.26	7.61	-8.86
Benchmark Year 1999					
Full surprise scenario	2.72	-0.50	-2.22	11.30	-13.52
Indexing ASAP scenario	1.84	-0.46	-1.38	6.46	-7.84

redistribution occurs because of the fact that money is a unit of account for the revaluation of nominal assets and liabilities.

4.1 Redistribution across sectors

We first discuss the redistribution of wealth for the benchmark year 2005 and then we analyze changes in redistributive trends over time.

4.1.1 Sectoral redistribution of wealth in the benchmark year 2005

The first panel of Table 2 summarizes, for the benchmark year 2005, the sectoral present value gains and losses induced by an inflation episode with 1% shocks that continue for five years under FS and IA inflation scenarios.

It is apparent from the first panel of the table that, under the two inflation scenarios in 2005, the household sector loses, while the government sector wins. The loss of the household sector and the gain of the government are both large. Under FS, the loss of households amounts to 1.95% of GDP while the gain of the government is 2.09%. The foreign sector loses but the loss is small and it is just 0.14% of GDP. To understand these findings, recall that, under FS, gains and losses are obtained simply by multiplying the initial nominal position by a constant factor $(\exp(-0.05) - 1 = -0.049)$. Since the household sector is the economy's main lender and the government sector is the major borrower, it is not surprising that these sectors are most dramatically affected by the shock under the FS scenario.

It is also clear that gains and losses are generally smaller under the IA scenario. The loss of households under the IA scenario is 1.26% of GDP compared to 1.95% under FS. This change is driven by a reduction in the losses associated with the sector's net savings in long-term bonds and

pensions relative to the FS case. The change is offset somewhat since instruments with shorter maturity are less sensitive to gradual inflation and the gains associated with the sector's net debt in mortgage markets shrink relative to the FS case. The gain of the government drops from 2.09% of GDP under the FS scenario to 1.49% under the IA scenario; this represents a decrease of 28.71%. It occurs because the government borrows in some bonds that have maturities less than the five-year length of the inflation episode. The foreign sector's losses increase from 0.14% of GDP under FS to 0.23% of GDP under IA, though the losses are small. This increase is due to the maturity mismatch in the foreign sector portfolio.

4.1.2 Sectoral redistribution of wealth over time

In the previous section, we considered in detail the sectoral redistribution of wealth implied by a low inflation episode that begins in 2005. In this section, we briefly discuss how our results would vary if we considered benchmark years 1990 through 2007.

Figures 10 and 11 present wealth gains and losses over time under FS and IA scenarios respectively. Time on the horizontal axis is the benchmark years for the arrival of the five-year inflation episode, and the vertical line represents sectoral gains and losses as a percentage of GDP. For each year on the horizontal axis, we compute the wealth gain or loss by using sectoral nominal positions in that year. The gains and losses in Figure 10 are proportional to the overall net nominal positions and as a result this figure is a mirror image of Figure 5. Comparing Figure 10 and Figure 11, one can see that the overall redistribution of wealth is higher under the FS scenario than under the IA scenario from 1990 to 2007. A key trend in both figures is that the government's gain began decreasing in the late 1990s. At the same time, the foreign sector's losses began to fall off. In late 2006, the foreign sector began to experience gains and this is because in that period foreigners became borrowers in nominal claims in Canada. This gain is, however, small. The household sector's losses peaked around the late 1990s and started decreasing until late 2006. These losses are almost the mirror image of the gains of the government.

To further illustrate changes in the inflation-induced redistribution of wealth over time, let us compare the benchmark year 1999 against 2005 (see Table 2). It is evident from the table that the losses of both the household and foreign sectors as well as the gains of the government have decreased since 1999 under both scenarios. For example, from 1999 to 2005 the loss of households decreased by up to 12.16% and the gain of the government fell by up to 23.16%.

4.2 Redistribution between household types

In this section, we report, for different groups of households, the redistribution of wealth induced by a five-year inflation episode of 1% a year commencing in the benchmark year 2005.

Table 3 reports the present value gains and losses as a percentage of the average net worth of each household group for the FS and IA scenarios. Overall, regardless of the inflation scenario, young households win and old households lose. The main winners are young middle-class households, who own large fixed-rate mortgage debts. Their gain as a proportion of their mean net worth is large: about 4.34% under FS and about 3.91% under the IA scenario. The second group of winners is the
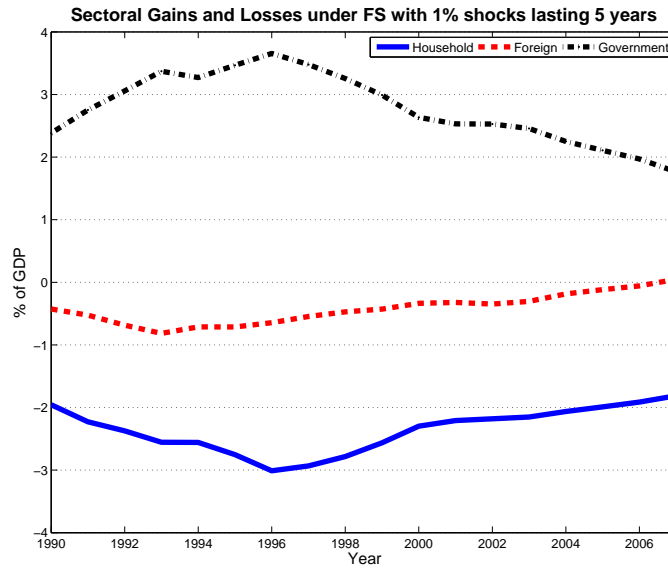
Figure 10: Sectoral Gains and Losses as a Percentage of GDP under Full Surprise Scenario from 1990-2007
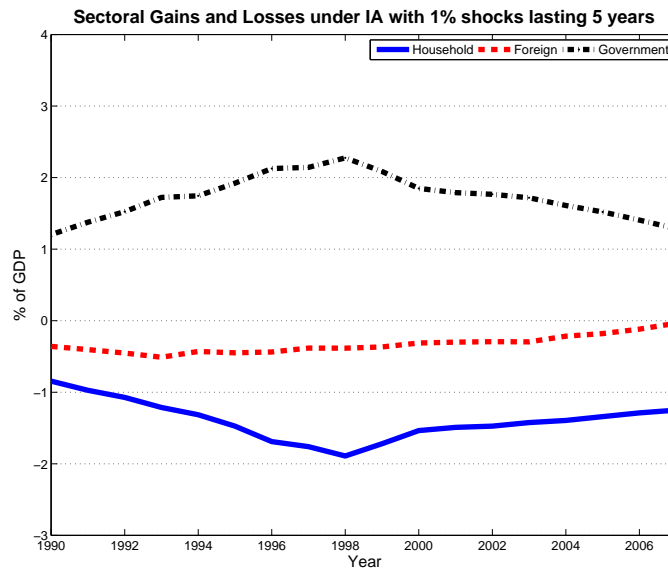
Figure 11: Sectoral Gains and Losses as a Percentage of GDP under Indexing ASAP Scenario from 1990-2007

Table 3: Redistribution of Wealth Across Households as a Percentage of the Mean Net Worth of each Age and Income Class in 2005, with a Low Inflation Episode of 1% Inflation Shock Lasting Five Years

Age group	< 36	36 - 45	46 - 55	56 - 65	66 - 75	> 75
			Full surprise scenario			
All	1.74	0.54	-0.63	-1.07	-1.36	-1.55
Rich	0.13	-0.10	-0.80	-0.85	-1.34	-1.45
Middle class	4.34	1.28	-0.55	-1.26	-1.42	-1.64
Poor	2.53	1.32	0.16	-1.01	-0.69	-1.15
			Indexing ASAP scenario			
All	1.66	0.44	-0.54	-0.84	-0.83	-0.82
Rich	0.26	-0.18	-0.74	-0.76	-0.82	-0.86
Middle class	3.91	1.15	-0.43	-0.94	-0.89	-0.81
Poor	2.66	1.15	0.28	-0.42	-0.17	-0.56

young poor who enjoy on average gains between 2.53% and 2.66% of their average net worth. The gains of the young poor come largely from their holdings of student loans and mortgage debt. Note that this group actually experiences greater gains under IA. As was explained in subsection 2.1.3, this occurs when there is a maturity mismatch. More specifically, while the gains associated with their net borrowing positions in bonds and mortgages do not vary much between inflation scenarios, the losses associated with their nominal savings in short-term instruments are mitigated under IA since these claims mature before the shock has ended.

More age groups benefit from the inflation episode among the poor than among the middle class or the rich under the Full Surprise scenario. This is because poor households remain net borrowers through to age 56, and therefore, the youngest three groups among the poor are winners.

In general, older middle-class and rich households bear most of the losses under the two inflation scenarios. More specifically, under the FS scenario, rich and middle-class households over 75 are the sector's greatest losers, with losses accounting respectively for 1.45% and 1.64% of their respective average net worth. These losses are largely due to their large nominal positions in bonds and non-indexed defined benefit pensions. The table also shows that most rich households lose from the inflation episode.

4.3   Cross-sectional redistribution between 1999 and 2005

This section examines the changes in inflation-induced redistribution that arise through the revaluation of nominal claims across households between the two benchmark years 1999 and 2005.

Table 4 respectively presents the redistribution of wealth by household type under the FS and IA scenarios for the benchmark year 1999 while Table 3 summarizes that of the benchmark year 2005. Overall, we can see from the tables that the gains of the young middle-class are larger in 2005 than in 1999.

Table 4: Redistribution of Wealth Across Households as a Percentage of the Mean Net Worth of each Age and Income Class in 1999, with a Low Inflation Episode of 1% Inflation Shock Lasting Five Years

Age group	< 36	36 - 45	46 - 55	56 - 65	66 - 75	> 75
Full surprise scenario						
All	1.06	-0.02	-0.71	-1.16	-1.35	-1.44
Rich	-0.04	-0.48	-0.69	-1.05	-1.41	-1.28
Middle class	2.75	0.42	-0.77	-1.27	-1.35	-1.61
Poor	4.27	0.81	-0.24	-0.75	-0.83	-1.15
Indexing ASAP scenario						
All	0.87	0.04	-0.54	-0.82	-0.80	-0.71
Rich	-0.10	-0.47	-0.63	-0.81	-0.92	-0.72
Middle class	2.40	0.53	-0.52	-0.86	-0.75	-0.74
Poor	3.61	0.76	-0.04	-0.40	-0.32	-0.36

Some of the large gains accruing to the young in 2005, relative to 1999, have to do with the fact that mortgage debts among the young middle-class have substantially increased during this period. For example, from 1999 to 2005, the gain on mortgage debt of middle-class households under 36 increased by 28.90% from 3.01 to 3.96% under the FS scenario. Under the IA scenario, the gains on mortgage debt of the same group rose from 2.54% to 3.50% of the group average net worth. For these reasons we find some of the largest increases in gains among the young middle-class. For instance, middle-class households under 36 experience a 57.82% increase in their gains under FS and a 62.92% increase in their gains under IA. Young middle-class households between 36 and 45 also have a non-negligible increase in their gains between the two benchmark years. In contrast, the youngest poor experience smaller gains in 2005 than in 1999 and this is due to the decrease in their student loans. Specifically, the poor under 36 witness a 40.75% reduction in their gains under FS; the figure comes in around 26.32% under IA. However, over the period 1999-2005 poor households of age 36-45 observe a significant increase in their gains. This increase in the gain of this group comes

Table 5: Redistribution of Wealth across Sectors for Low and Moderate Inflation Episodes as a Percentage of GDP in the 2005 Benchmark Year

Sectors	Government	Foreigners	Households
Baseline (Low Inflation Episode)			
Full surprise scenario	2.09	-0.14	-1.95
Indexing ASAP scenario	1.49	-0.23	-1.26
Moderate Inflation Episode			
Full surprise scenario	9.31	-0.62	-8.69
Indexing ASAP scenario	6.70	-1.02	-5.68

from the rise in their mortgage debts.

Among households over 75, losses are greater in 2005 than in 1999, irrespective of income class. The change is pronounced among the elderly rich, whose losses have increased by up to 13.28% between 1999 and 2005 on account of a shift towards bonds and pensions. A move away from nominal instruments of short maturity also explains why the elderly poor experienced a 55.36% increase in their losses under IA. Whereas in 1999 these positions only accounted for about 18.56% of their average net worth, the figure comes in around 10.95% in 2005.

In general, the trend is towards lower losses for non-retiree net nominal savers (age between 46 and 65) and higher losses for retirees (age over 66).

5   Alternative Inflation Episode

We have so far considered a low inflation episode during which inflation exceeds expectations by 1% for five years. To study how the inflation-induced redistribution depends on the size of the inflation shock, we now consider as an experiment the arrival of a moderate inflation episode similar to what actually happened in Canada almost three decades ago. More specifically, we seek to answer the following question: how would the distribution of wealth change if Canada were to experience in 2005 an inflation episode like the one that occurred in the late 1970s and early 1980s? To get a sense of the size of the inflation shock and the duration of this inflation episode, Figure 9 illustrates Canadian inflation rates over the 1955 to 2006 interval. As shown in the figure, a 5% unanticipated shock roughly approximates Canada's experience over the 1973 to 1983 interval, during which inflation averaged 9.3% per annum. Therefore, we consider a moderate inflation episode during which inflation exceeds expectation by 5% for ten years. The results of this experiment are reported in Table 5.

It can be seen from the table that the results under the moderate inflation episode are qualitatively similar to those of the baseline (low inflation episode) but not quantitatively. The gains of the

government sector and the losses of the household and foreign sectors are much larger under the moderate inflation episode. For example, the loss of households is between 5.68% and 8.69% of GDP during the moderate inflation episode while it was just between 1.26% and 1.95% of GDP under the low inflation episode. Put differently, if Canada were to experience in 2005 the moderate inflation episode that it faced in the late 1970s and early 1980s, Canadian households will lose up to 8.69% of GDP. The government will witness a boom of up to 9.31% of GDP under the moderate inflation episode while the foreigners observe a loss of up to 1.02% of GDP.

6   Conclusion

Motivated by the public debate on monetary policy regimes, we have, in this paper, assessed quantitatively the redistributional effects of inflation in Canada. To do so, we first provided comprehensive documentation of the nominal assets and liabilities of various economic sectors and household groups. Then we conducted an experiment that examined the inflation-induced redistributional consequences of the arrival of a moderate or low inflation episode.

There are three key messages with regards to the inflation-induced redistribution of wealth in Canada. First, we argue that the redistributional effects of inflation are large and therefore need to be taken into account when evaluating different monetary policy regimes since such redistributional effects affect the transition costs of regime changes as well as long-run welfare. The transition costs can be due to the initial nominal portfolios since agents with different initial portfolios will be affected differently under both regimes. The winners are young middle-class households who are major holders of fixed-rate mortgage debt and the government since inflation reduces the real burden of their debts. The losers are a union of rich households, middle-aged middle class and old households who hold long-term bonds and non-indexed pension wealth. Non-indexed pension assets play an important role in the loss of old households.

Second, we show that the Canadian situation differs from that in the U.S. On one hand, middle-aged middle-class households in Canada are major savers while their American counterparts are large borrowers. On the other hand, the foreign sector in Canada is relatively small in terms of nominal borrowing and lending and has become since late 2006 a borrower. In contrast, foreigners are major nominal lenders in the U.S. since the late 1980s. Inflation could entail a potential wealth transfer from Canadian households to foreigners.

Third, we show that there has been a shift from short-term nominal instruments to long-term nominal claims over time. A direct consequence of this change is that, although Canadians have become less exposed to surprise inflation, they are still subject to partially anticipated inflation. This is because gradual inflation generates larger gains or losses for long-term positions than short-term positions.

In future work, we intend to study the aggregate effects and welfare implications of inflation-induced redistribution under different monetary policy regimes such as inflation and price-level targeting. Since the size of macroeconomic and welfare effects will depend on how government uses the windfall gains associated with a reduction in the real value of its nominal debts, the analysis will also consider different fiscal policy rules.

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Appendix

This appendix describes in detail our data and variables used to derive nominal assets and liabilities in Canada. Section A summarizes the sources of the data. Sections B and C explain how nominal positions were identified in the sectoral and household-level datasets respectively, and section D reconciles some differences between these datasets. We explain our approach to pensions in section E.

A   Data sources

Our main source for sectoral data is the National Balance Sheet Accounts (1990-2007), which report quarterly the assets and liabilities of various macroeconomic sectors at market value.[16] Our main source for household-level data is the Survey of Financial Security (1999 and 2005), a highly detailed study of household finances, including balance sheets, income, and expenditures.[17] Both datasets are produced by Statistics Canada. We also use several supplementary sources:

- Statistics Canada's **International Investment Position Program** (IIP), which provides more data on the liabilities that foreigners face in issues of marketable securities than are available in the NBSA;

- data from the Bank of Canada's **Banking and Financial Statistics** (BFS) and the **Dominion Bond Rating Service** on the currencies denominating bonds and short-term paper issued in Canadian capital markets. With this information, we identify the assets and liabilities that sectors have in domestic and foreign currency denominated bonds and short-term paper;

- the **Tri-agency Database System** (TDS) maintained by the Bank of Canada, the Office of the Superintendent of Financial Institutions, and the Canadian Deposit Insurance Corporation, for data on the currencies denominating non-mortgage loans extended by domestic financial institutions. These data, provided by the Bank of Canada's Monetary and Financial Analysis Department, identify the assets and liabilities that sectors carry in domestic and foreign currency denominated loans;

- the **Communication, Auction and Reporting System Database** maintained by the Bank of Canada's Financial Markets Department, for data on the maturity of outstanding federal government bonds. These data provide a distribution of terms-to-maturity for long-term investments;

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[16]Details on the way in which market values were calculated are available in Statistics Canada (2007). Price data from stock exchanges are used to value shares in widely held domestic firms and data from a micro inventory system are used to compute the present value of bonds. The approach also relies on micro data on the assets and liabilities of large institutional investors, including their cross-border holdings, from which the foreign sector's positions have been estimated. These micro data come from separate Statistics Canada programs or outside sources. Prior to 1990, NBSA data are only available on a book value basis.

[17]1999 and 2005 were the two most recent waves of the Survey of Financial Security. The Survey was also conducted in 1984 but the variables are not very consistent with those of 1999 and 2005.

- the **Canadian Financial Monitor** (CFM), an annual survey of household finances conducted by Ipsos Reid, for data on the term to renewal of Canadian mortgages. These data provide a distribution of terms-to-maturity for mortgages;

- the **Human Mortality Project** at the University of Montreal, for data on life expectancy in Canada, and the **Labour Force Survey** conducted by Statistics Canada, for data on the average retirement age in Canada. These data are used to construct payment streams accruing to participants in defined benefit pension plans.

B Sectoral positions

Sectoral data come from the National Balance Sheet Accounts (NBSA). These data are available from Statistics Canada's CANSIM data retrieval platform. CANSIM Table 378-0009 reports assets and liabilities in various instruments at market value and quarterly frequency for the following sectors:

- **persons and unincorporated businesses**, which correspond to our household sector;

- **government**, including the federal, provincial, and municipal levels, which corresponds to our government sector;

- **non-residents**, which correspond to our foreign sector;

- **financial institutions** and **non-financial corporations** (both including government business enterprises), which together correspond to our business sector.

We refer to the first three sectors as "end users." Their holdings in equity instruments are assumed to represent fractional claims on the business sector portfolio. The assets and liabilities of businesses are reallocated to the end users in proportion to their equity holdings. Doepke and Schneider (2006) treat the business sector in the same way.

B.1 Classification of sectoral positions

We classify each of the NBSA instruments as either **nominal** or **real**.[18] "Nominal" means that an instrument's real value is sensitive to Canadian inflation. Any financial instruments denominated in Canadian dollars are assumed to be nominal unless their return is fully indexed to inflation. Real instruments for our purposes include non-financial assets and liabilities and any financial instruments denominated in foreign currencies. Nominal instruments are divided into four broadly defined instrument categories according to the scheme outlined in Tables A1 and A2:

- **short-term instruments** are assumed to mature in one year's time. These include currency and deposits, trade and consumer credit, and short-term paper;

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[18]See Statistics Canada (1989) for details on how the various NBSA categories have been defined.

Table A1: Classification of NBSA Variables by Instrument Category for the Household, Government, and Foreign Sectors

CANSIM definitions	CANSIM series			Instrument categories
	Households	Government	Foreigners	
Shares	v28368602	v28368780	v28368818	Equity assets
Net corporate claim assets			v28368817 (v28368830)	
Currency and bank deposits	v28368589	v28368767	v28368805	
Deposits at other institutions	v28368590	v28368768	v28368806	
Trade accounts receivable		v28368770	v28368808	Short-term
Canada short-term paper	v28368593	v28368772	v28368810	instruments,
Other short-term paper	v28368594	v28368773	v28368811	assets
Consumer credit	v28368592			
Foreign investments†	v28368603	v28368781		
Mortgages	v28368595	v28368774	v28368812	Mortgages, assets
Other loans		v28368771	v28368809	
Canada bonds	v28368596	v28368775	v28368813	
Provincial bonds	v28368598	v28368776	v28368814	
Municipal bonds	v28368599	v28368777	v28368815	Bonds,
Other Canadian bonds	v28368600	v28368778	v28368816	assets
Other financial assets	v28368604	v28368782	v28368819	
Foreign investments†	v28368603	v28368781		
Government claims		v28368779		
Life insurance and pensions	v28368601			Pensions, assets
Non-financial assets	v28368580	v28368759		
Foreign currency deposits	v28368591	v28368769	v28368807	Real assets
Foreign investments†	v28368603	v28368781		
Currency and bank deposits		v28368785		
Deposits at other institutions		v28368786		
Trade accounts payable	v28368608	v28368787	v28368827	Short-term
Canada short-term paper		v28368790		instruments,
Other short-term paper		v28368791		liabilities
Consumer credit	v28368607			
Foreign investments†			v28368831	
IMF reserve position			v28368824	
Special drawing rights			v28368825	
Mortgages	v28368611	v28368792		Mortgages, liabilities
Bank loans	v28368609	v28368788	v28368828	
Other loans	v28368610	v28368789	v28368829	
Canada bonds		v28368793		
Provincial bonds		v28368795		Bonds,
Municipal bonds		v28368796		liabilities
Other Canadian bonds		v28368797		
Other liabilities		v28368800	v28368832	
Foreign investments†			v28368831	
Government claims		v28368799		
Life insurance and pensions		v28368798		Pensions, liabilities
Official holdings of gold and FX			v28368823	
Foreign currency deposits			v28368826	Real liabilities
Foreign investments†			v28368831	

† Components of foreign investment have been assigned to the short-term, bond and real categories as explained in Section B.1.

Table A2: Classification of NBSA Variables by Instrument Category for the Business Sector

CANSIM definitions	CANSIM series		Instrument categories
	Financials	Non-financials	
Currency and bank deposits	v28368719	v28368672	Short-term instruments, assets
Deposits at other institutions	v28368720	v28368673	
Trade accounts receivable	v28368723	v28368676	
Canada short-term paper	v28368726	v28368678	
Other short-term paper	v28368727	v28368679	
Consumer credit	v28368722	v28368675	
Foreign investments[†]	v28368736	v28368688	
IMF reserve position	v28369717		
Special drawing rights	v28368825		
Mortgages, assets	v28368728	v28368680	Mortgages
Bank loans	v28368724		Bonds, assets
Other loans	v28368725	v28368677	
Canada bonds	v28368729	v28368681	
Provincial bonds	v28368730	v28368682	
Municipal bonds	v28368731	v28368683	
Other Canadian bonds	v28368732	v28368684	
Other financial assets	v28368737	v28368689	
Foreign investments[†]	v28368736	v28368688	
Government claims	v28368734	v28368686	
Non-financial assets	v28368708	v28368664	Real assets
Official holdings of gold and FX	v28368716		
Foreign currency deposits	v28368721	v28368674	
Foreign investments[†]	v28368736	v28368688	
Corporate claim liabilities	v28368751	v28368700	Net equity liabilities
Shares issued	v28368753	v28368702	
Corporate claim assets	(v28368733)	(v28368685)	
Shares held	(v28368735)	(v28368687)	
Currency and bank deposits	v28368740		Short-term instruments, liabilities
Deposits at other institutions	v28368741		
Trade accounts payable	v28368743	v28368692	
Other short-term paper	v28368746	v28368695	
Mortgages	v28368747	v28368696	Mortgages, liabilities
Bank loans	v28368744		Bonds, liabilities
Other loans	v28368745	v28368694	
Provincial bonds	v28368748	v28368697	
Municipal bonds		v28368698	
Other Canadian bonds	v28368749	v28368699	
Government claims	v28368752	v28368701	
Other liabilities	v28368754	v28368703	
Pensions and life insurance	v28368750		Pensions, liabilities
Foreign currency deposits	v28368742		Real liabilities

[†] Components of foreign investment have been assigned to the short-term, bond and real categories as explained in Section B.1.

- **pensions** include "life insurance and pensions" as reported in the NBSA;[19]

- **mortgages** include first, second, and third mortgages but exclude mortgage bonds and loans intended to finance residential improvements;

- the **bonds** category captures those long-term instruments, like loans, bonds, and government claims, that do not fall in the other categories.[20]

Note that shares and corporate claims as reported in the NBSA are not assigned to any of these instrument categories.[21] We treat them as equity.

In assigning NBSA positions to instrument categories, positions in "foreign investments" are treated specially. These investments are marketable securities issued by foreigners and held by Canadians and are thus reported as a liability of the foreign sector in the NBSA. This liability has three components, which are reported at market value in CANSIM Table 376-0055 as part of Statistics Canada's International Investment Position Program (IIP): stocks (series v28257658), bonds (v28257655), and short-term paper (v30615508). We divide the liability between these components, each of which is then assigned to the appropriate instrument category.[22] The bond and short-term paper components, which we refer to as "foreign bonds" and "foreign paper," are respectively assigned to the bond and short-term instrument categories. The stock component in foreign investment, which we refer to as "foreign stock," is assigned to the real instrument category, as in Doepke and Schneider (2006).

We also calculate the fraction of the foreign sector's foreign investment liabilities for which the stock, bond, and short-term paper components account on a market value basis. These fractions are reported in Table A3. The foreign investment assets that the household, business, and government sectors report in the NBSA are divided between instruments using these fractions.[23] Table A3 also reports instrument shares in the foreign sector's foreign investment liabilities on a book value basis from IIP data. We apply to NBSA data on the book value of sectoral positions in foreign investments (CANSIM table 378-0007) to compute at book value each sector's positions in foreign paper, bonds, and stocks specifically.[24] Table A3 shows that equity accounts for most Canadian investment in

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[19]This NBSA category includes employer-sponsored pensions plans, like Registered Pension Plans, but not plans in which households invest directly, like Registered Retirement Savings Plans. The household sector's holdings in various instrument categories, as reported in the NBSA, already take into account any assets held within RRSPs and other plans in which households invest directly.

[20]Government claims are securities passing between government business enterprises or between these enterprises and the government itself.

[21]Corporate claims cover loans and securities traded between firms and their parents, subsidiaries, and partners.

[22]There is a small subset of foreign investments that have not been categorised as stocks, bonds, or paper. Data on this subset have been withheld by Statistics Canada for confidentiality reasons. Within this subset, we assume that stocks, bonds, and paper are represented in proportion to the corresponding series from CANSIM Table 376-0055 (v28257658, v28257655 and v30615508 respectively). In 2005, this subset accounted for less than 1% of the foreign sector's foreign investment liabilities on a market value basis.

[23]Data on the short-term paper component in foreign investment prior to 2002Q1 are unavailable. Therefore, in earlier quarters, we use the average 2002 fractions. We also apply these fraction to the foreign sector's foreign investment liabilities in quarters 2001Q4 and earlier.

[24]v20683942 from CANSIM table 378-0007 gives the book value of the foreign sector's foreign investment liability while v30615505, v20862968, and v20862971 from CANSIM table 376-0055 give the book value of the stock, bond,

Table A3: Foreign Paper, Bonds, and Stock as a Percentage of Foreign Investment at Market and Book Value in 2005

	Short-term paper	Bonds	Stocks
Market value	2.40	15.61	81.99
Book value	4.31	25.94	69.74

marketable securities issued by non-residents.

B.2 Adjusting sectoral positions for foreign currencies

Several NBSA positions, as defined in Statistics Canada (1989), include both foreign and domestic currency-denominated instruments without details as to how large the currency-specific components are. In this section, we identify these positions and use supplementary data to separate their domestic and foreign currency components.

Bank loan, other loans, and consumer credit. We use data from the Tri-Agency Database System (TDS), which stores data provided by federally regulated financial institutions in several returns that they are required to file with government agencies. We focus on the quarterly A2 return, which reports an institution's non-mortgage loan balances. Table A4 summarizes the data reported in this return. It shows that we can calculate the total amount extended to domestic businesses, government, and households, as well as non-residents. We can also calculate the amount extended to these sectors in foreign currencies specifically.

"Consumer credit", as defined in Statistics Canada (1989), covers all loans extended to households except for mortgages, trade credit, business loans, and loans intended to finance renovations, mobile home purchases, or investments in securities. The definition applies regardless of the financial institution that serves as creditor. Using TDS data, we compute the total balance of loans meeting this definition at federally regulated institutions. We then calculate the fraction of this total for which foreign currencies account, which is reported in Table A5.[25] This fraction is applied to all consumer credit positions reported in the NBSA to estimate their foreign currency components. Not surprisingly, this approach finds that almost all of the household sector's consumer credit liabilities are denominated in Canadian dollars. For example, in 2005, Table A5 shows that only 0.37% of these liabilities were denominated in foreign currencies.

The "bank loan" category in the NBSA captures all instances in which banks extend loans that do not qualify as mortgages or consumer credit. The government, business, and foreign sectors report liabilities in this category. We have estimated their liabilities in foreign currencies specifically using

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and paper components respectively. In 2005, these components together accounted for about 99% of the total foreign investment liability. The remainder has been distributed between stocks, bonds, and paper in proportion to the corresponding series in CANSIM table 376-0055.

[25]No TDS data are available prior to 1994Q2. For earlier quarters we use the 1994Q2 foreign currency fractions. This is also true in our approach to bank loans and other loans.

TDS data on the foreign currency fractions in the balances that they owe to federally chartered banks. We have also applied these fractions to their liabilities in the "other loan" category, which captures non-bank loans that do not count as mortgages, consumer credit, or trade credit. Households also report liabilities in the bank loan and "other loan" categories, to which we apply a foreign currency fraction computed from TDS data on non-consumer credit loans that banks have extended to this sector.

In the bank loan category, we know that the business sector holds all foreign currency bank loans as assets since only financial institutions report bank loan assets in the NBSA. In the other bank loan category, assets are recorded for the business, government, and foreign sectors. We distribute foreign currency assets between these three sectors in proportion to their total assets in the "other loan" category.

Bonds. Table K8 of the Bank of Canada's Banking and Financial Statistics (BFS) reports the book value of bonds issued in domestic and foreign currencies by the federal, provincial, and municipal governments.[26] We use these data to calculate the fraction of the government sector's federal, provincial and municipal bond liabilities that are denominated in foreign currencies, which we show in Table A5. We also apply these fractions to the small liabilities that businesses report in the provincial and municipal bond categories, which arise when government business enterprises issue bonds.

Table K8 also records the book value of domestic and foreign currency bond issues by corporations, with which we compute the foreign currency fraction to be applied to the business sector's liabilities in the "other bond" category.[27] We also apply this fraction to the small liability that government reports in the "other bond" category, which arises when hospitals and universities issue bonds.

For the most part, Canadian issuers have sold their foreign currency bonds outside Canada. For example, in the 2006-2007 fiscal year, 98% of the Ontario provincial government's outstanding foreign currency bonds had been issued outside Canada, according to data from pages 3-24 through 3-29 of Ontario Ministry of Finance (2007). For this reason, we have assumed that the foreign sector holds all foreign currency bonds as assets, leaving any bond assets in the other sectors denominated in Canadian dollars only. This places a large share of the foreign sector's bond holdings in foreign currencies. For example, in 2005, we find that 98.22% of provincial bonds held by foreigners were denominated in foreign currencies. In some cases, outstanding foreign currency liabilities exceed the foreign sector's assets as reported in the NBSA. The 2005 "other bond" category is an example. In these cases, we assume that all the foreign sector's assets are denominated in foreign currencies, then calculate the proportion of assets outside the foreign sector that must be denominated in foreign currencies to ensure that all foreign currency liabilities have counterparts. This fraction is applied

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[26]These data are also available in CANSIM Table 176-0071. Foreign currency issues by the municipal, provincial, and federal governments are series v31185534, v31185511, and v31185509 respectively. The corresponding sources for total issues outstanding are v31185445, v31185468, and the sum v31185443 plus v31185444.

[27]These data are also in CANSIM Table 176-0071. Foreign currency issues are given by the sum v31185535 plus v31249397 while total issues, regardless of the denominating currency, are given by v31185469 plus v31185472

Table A4: TDS Data on Loan Liabilities Facing Various Sectors

Sector	TDS series		TDS definition
	Foreign currencies	All currencies	
Business (Financial institutions only)	v8807	v8816	Loans to resident financial institutions
Business (Non-financial corporations only)	v9316	v9317	Loans to resident public (non-financial) businesses
	v4048	v4115	
	v4051	v4118	
	v4054	v4121	
	v8933	v8937	
	v9015	v9022	
	v9017	v9024	Loans to resident private (non-financial) businesses in various industries
	v9080	v9084	
	v9081	v9085	
	v9082	v9086	
	v9144	v9148	
	v9145	v9149	
Government	v8849	v8858	Loans to Canadian governments
Household (excluding consumer credit)	v8856	v8865	Non-business loans to resident individuals to purchase or carry securities
	v4012	v4078	Consumer loans to resident individuals to purchase mobile homes
	v4015	v4081	Consumer loans to resident individuals to renovate residential property
Household (consumer credit only)	v8931	v4089	Credit card balances owed by resident individuals
	v8866	v8872	Consumer loans to resident individuals
	(v4012)	(v4078)	Consumer loans to resident individuals to purchase mobile homes
	(v4015)	(v4081)	Consumer loans to resident individuals to renovate residential property
Foreign	v8827	v8835	Loans to non-resident financial institutions
	v8881	v8895	Loans to foreign governments
	v8957	v8972	Loans to non-resident individuals
	v8958	v8973	Loans to non-resident (non-financial) public businesses
	v8959	v8974	
	v8960	v8975	
	v8961	v8976	
	v8965	v980	
	v9037	v9051	
	v9042	v9056	Loans to non-resident (non-financial) private businesses in various industries
	v9094	v9109	
	v9097	v9112	
	v9104	v9119	
	v9162	v9169	
	v9163	v9170	

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Table A5: Share of Sectoral Assets and Liabilities Denominated in Foreign Currencies for Various Instruments in Percent: 1999 and 2005

		2005				1999			
		Households	Businesses	Government	Foreigners	HH	BUS	GOV	FOR
Consumer credit	Assets	0.37	0.37			1.00	1.00		
	Liabilities	0.37				1.00			
Bank loans	Assets		15.34				20.08		
	Liabilities	6.91	13.28	1.46	96.03	8.28	18.82	4.75	94.90
Other loans	Assets		21.45	21.45	21.45		27.75	27.75	27.75
	Liabilities	6.91	13.60	1.46	96.03	8.28	20.50	4.75	94.90
Canada short-term paper	Assets	0.00	0.00	0.00	28.90	0.00	0.00	0.00	49.18
	Liabilities			1.93				7.50	
Other short-term paper	Assets	0.00	0.00	0.00	93.48	0.00	0.00	0.00	78.26
	Liabilities		5.23	5.23			7.40	7.40	
Canada bonds	Assets	0.00	0.00	0.00	23.51	0.00	0.00	0.00	30.11
	Liabilities			3.92				7.18	
Provincial bonds	Assets	0.00	0.00	0.00	98.22	5.09	5.09	5.09	100.00
	Liabilities		28.91	28.91			43.13	43.13	
Municipal bonds	Assets	0.00	0.00	0.00	48.65	0.00	0.00	0.00	77.67
	Liabilities		4.39	4.39			11.48	11.48	
Other bonds	Assets	13.24	13.24	13.24	100.00	22.50	22.50	22.50	100.00
	Liabilities		44.95	44.95			56.46	56.46	
Foreign paper	Assets	38.54	38.54			93.00	93.00	93.00	
	Liabilities				38.54				93.00
Foreign bonds	Assets	85.26	85.26	85.26		98.14	98.14	98.14	
	Liabilities				85.26				98.14

† A cell is blank if there is no corresponding position in the NBSA.

uniformly to the asset positions reported for the government, business, and household sectors in the NBSA.

Short-term paper. In the NBSA short-term paper is divided between federal government issues, which fall in the "Canada short-term paper" category, and everything else, which fall in the "other short-term paper" category. BFS Table G6 reports the book value of the federal government's outstanding paper issues in Canadian dollars and foreign currencies, which we use to compute the fraction of the government sector's liabilities in Canada short-term paper that is denominated in foreign currencies.[28] This fraction is reported in Table A5. We take a similar approach to the fraction of the business sector's liabilities in the "other short-term paper" category, using data on corporate paper issues in BFS Table F2, which reports the book value of foreign currency issues and all issues outstanding, regardless of the denominating currency.[29] We apply the same fraction to the small liability that the government sector reports in the "other short-term paper" category, which arises on account of provincial and municipal issues.[30] As we did for bonds, we assume that all short-term paper issues in foreign currencies are held by non-residents. This leaves the other sectors' asset positions denominated entirely in Canadian dollars.

Foreign investments. The variable foreign investments covers marketable securities issued by non-residents. It was divided between foreign equity, bonds, and paper in Section B.1. Foreign equity was assumed to be real in Section B.1, but foreign paper and bonds can have real and nominal parts depending on denominating currencies. The real parts arise from Canadian portfolio investment abroad, which is almost entirely denominated in foreign currencies, while the nominal parts arise from instances in which foreigners have issued Canadian-dollar securities to residents.

Bonds that foreigners issue in Canadian dollars on Canadian markets are called maple bonds and for our purposes represent a nominal position in foreign bonds. Market value data on these bonds are not available but the book value of the maple bond market is recorded in BFS Table K8. Dividing this total by the book value of the foreign sector's liability in foreign bonds, as computed in Section B.1, gives the share of total Canadian holdings in foreign bonds for which domestic currency denominations account. We apply this fraction to each sector's foreign bond position to estimate the position in domestic currency bonds specifically. The remainder is assumed to be in foreign currencies. We take a similar approach to foreign paper, using data from the Dominion Bond Rating Service on the book value of short-term paper that foreigners have issued to residents in Canadian dollars.

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[28]These data are also in CANSIM Table 176-0022. Series v37331 and v37323 cover Canadian dollar and foreign currency issues specifically respectively.

[29]These data are also available in CANSIM Table 176-0039. We get the total for all issues from v122258 and foreign currency issues from v122255. However, v122255 only covers US-dollar denominations. This is also true for v37323 in CANSIM table 176-0022, which we used for the federal government's outstanding liabilities in foreign currency-denominated short-term paper. However, US dollars account for the vast majority of Canadian issues in foreign currencies. For example, over our sample period the Canadian government did not issue short-term paper in any other foreign currency. This can be confirmed using Bank of Canada (1990-2007).

[30]These data only go back to 1996Q4. Therefore, for earlier quarters, we use the 1996Q4 foreign currency fraction.

Table A6: Number of Households in Different Age and Income Groups in 1999 and 2005

Age group	< 36	36 - 45	46 - 55	56 - 65	66 - 75	> 75
Benchmark year 2005						
All classes	3,614,435	2,932,977	2,705,181	1,817,712	1,272,242	997,551
Rich	356,856	290,887	269,082	180,820	126,678	99,166
Middle-class	2,531,032	2,053,994	1,892,920	1,271,933	888,744	697,851
Poor	726,547	588,096	543,179	364,959	256,820	200,535
Benchmark year 1999						
All classes	3,404,301	2,962,354	2,296,602	1,390,733	1,251,110	866,203
Rich	334,863	294,910	228,033	136,728	124,224	84,628
Middle-class	2,385,571	2,073,925	1,610,330	973,341	876,060	607,737
Poor	683,867	593,519	458,239	280,664	250,826	173,838

Table A7: Mean Household Income in 1999 and 2005

Age group	< 36	36 - 45	46 - 55	56 - 65	66 - 75	> 75
Benchmark year 2005						
All classes	51,174	107,707	107,773	106,745	86,865	60,422
Rich	115,516	321,651	280,375	284,064	296,450	198,120
Middle-class	50,215	75,812	83,708	69,896	44,653	37,594
Poor	8,676	16,644	14,518	11,857	14,424	14,842
Benchmark year 1999						
All classes	42,200	66,642	82,139	67,042	48,718	34,454
Rich	90,670	156,960	200,556	188,517	146,499	102,548
Middle-class	43,194	61,742	74,134	56,232	36,007	27,622
Poor	7,469	13,892	15,610	9,258	12,922	12,379

C Household-level positions

Household-level data come from the 1999 and 2005 Surveys of Financial Security (SFS), which provide a comprehensive picture of Canadian household finances. We divide households into six age groups based on the age of the household head as reported in the SFS: < 36, 36-45, 46-55, 56-65, 66-75, > 75. We also divide households by class using SFS data on income and net worth. Within each age group, *rich* households constitute the top ten percent of the net worth distribution. Non-rich households are then divided purely on the basis of income between the *poor*, who account for the bottom 20% of each age group, and the *middle class*, who account for the remaining 70%. Table A6 reports the number of households in each age/income group using sample weights reported in the SFS. Tables A7 and A8 respectively give each group's average income and net worth. The tables show that rich households have considerably higher income than the other classes. For example, their average 2005 income was more than five times that of the middle class. Young households are poorer on average. Mean 2005 net worth among households under 36 was less than a third of the average in the 36-45 age bracket. Tables A9 and A10 report the direct and indirect nominal positions that we have computed for each age/income group in 2005 and 1999 respectively.

Table A8: Mean Household Net Worth in 1999 and 2005

Age group	< 36	36 - 45	46 - 55	56 - 65	66 - 75	> 75
Benchmark year 2005						
All classes	87,374	324,120	496,814	649,193	521,666	409,374
Rich	538,541	1,712,583	2,241,762	2,739,799	1,988,294	1,599,722
Middle-class	46,882	207,981	358,494	502,349	428,040	334,419
Poor	6,838	42,983	114,429	125,168	122,241	81,581
Benchmark year 1999						
All classes	85,359	217,434	377,395	457,597	359,566	275,416
Rich	510,403	1,019,883	1,605,384	1,838,668	1,392,934	1,186,190
Middle-class	48,686	152,343	281,612	368,675	293,910	207,953
Poor	5,158	46,158	102,910	93,179	77,098	67,881

C.1 Classification of household-level positions

As shown in Tables A11 and A12, we identify SFS positions in nominal and real instruments, then divide the nominal positions between the four categories introduced in Section B.1. Some SFS variables are distributed between multiple categories. For example, a household's position in mutual funds (*wamutual*) is divided between stocks, bonds, and short-term paper, and each component is assigned to the appropriate instrument category. In this section we identify all such variables and explain how they are treated.

Table A9: Direct and Indirect Nominal Positions as a Percentage of Each Age/Income Group's Mean Net Worth in 2005

Age Cohort

All households

	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	4.83	-1.01	1.48	2.40	9.00	12.27
Direct	*8.51*	*4.20*	*6.90*	*7.70*	*11.85*	*14.61*
Indirect	*-3.67*	*-5.21*	*-5.42*	*-5.30*	*-2.85*	*-2.34*
Mortgages	-37.95	-13.57	0.07	4.48	3.55	3.29
Direct	*-44.21*	*-22.43*	*-9.15*	*-4.54*	*-1.30*	*-0.70*
Indirect	*6.25*	*8.86*	*9.23*	*9.02*	*4.85*	*3.99*
Bonds	-2.63	4.70	6.50	7.90	6.70	7.68
Direct	*-5.91*	*0.05*	*1.66*	*3.17*	*4.16*	*5.59*
Indirect	*3.28*	*4.65*	*4.84*	*4.73*	*2.54*	*2.09*
DB pensions, non-indexed	-0.14	-1.41	4.63	7.22	8.55	8.59
Direct	*5.86*	*7.10*	*13.49*	*15.88*	*13.21*	*12.41*
Indirect	*-6.00*	*-8.51*	*-8.86*	*-8.66*	*-4.66*	*-3.83*
DC pensions	0.09	0.09	0.37	0.14	0.13	0.07
Direct	*0.39*	*0.52*	*0.82*	*0.57*	*0.37*	*0.26*
Indirect	*-0.30*	*-0.42*	*-0.44*	*-0.43*	*-0.23*	*-0.19*
NNP	**-35.80**	**-11.19**	**13.06**	**22.14**	**27.93**	**31.89**

Middle-class households

	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	5.83	2.24	4.40	5.49	9.06	14.91
Direct	*8.67*	*4.78*	*6.78*	*7.86*	*10.94*	*16.56*
Indirect	*-2.83*	*-2.54*	*-2.38*	*-2.37*	*-1.87*	*-1.65*
Mortgages	-81.62	-35.43	-11.11	-2.91	1.62	1.70
Direct	*-86.44*	*-39.76*	*-15.17*	*-6.94*	*-1.57*	*-1.11*
Indirect	*4.82*	*4.33*	*4.05*	*4.03*	*3.19*	*2.81*
Bonds	-18.11	-0.90	2.16	4.10	4.56	4.56
Direct	*-20.64*	*-3.17*	*0.04*	*1.99*	*2.89*	*3.09*
Indirect	*2.53*	*2.27*	*2.12*	*2.11*	*1.67*	*1.47*
DB pensions, non-indexed	3.96	6.89	14.86	18.50	13.72	12.49
Direct	*8.59*	*11.04*	*18.75*	*22.37*	*16.78*	*15.19*
Indirect	*-4.63*	*-4.15*	*-3.89*	*-3.87*	*-3.06*	*-2.70*
DC pensions	0.50	0.74	1.09	0.85	0.40	0.22
Direct	*0.73*	*0.95*	*1.29*	*1.04*	*0.55*	*0.35*
Indirect	*-0.23*	*-0.21*	*-0.19*	*-0.19*	*-0.15*	*-0.13*
NNP	**-89.44**	**-26.47**	**11.40**	**26.04**	**29.36**	**33.88**

Age Cohort

Rich households

	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	3.86	-3.73	-1.97	-2.36	8.48	8.57
Direct	*8.07*	*3.71*	*6.85*	*6.72*	*12.91*	*11.94*
Indirect	*-4.21*	*-7.44*	*-8.82*	*-9.08*	*-4.44*	*-3.38*
Mortgages	-11.31	4.71	12.92	13.66	7.15	5.71
Direct	*-18.48*	*-7.96*	*-2.10*	*-1.79*	*-0.40*	*-0.04*
Indirect	*7.17*	*12.67*	*15.01*	*15.46*	*7.55*	*5.75*
Bonds	7.71	9.72	11.73	13.00	10.50	12.37
Direct	*3.96*	*3.08*	*3.86*	*4.89*	*6.54*	*9.36*
Indirect	*3.76*	*6.64*	*7.87*	*8.10*	*3.96*	*3.01*
DB pensions, non-indexed	-2.77	-8.08	-5.91	-6.06	1.61	3.33
Direct	*4.11*	*4.08*	*8.50*	*8.77*	*8.86*	*8.84*
Indirect	*-6.88*	*-12.16*	*-14.41*	*-14.84*	*-7.25*	*-5.52*
DC pensions	-0.16	-0.45	-0.34	-0.71	-0.24	-0.15
Direct	*0.19*	*0.15*	*0.38*	*0.03*	*0.13*	*0.13*
Indirect	*-0.34*	*-0.61*	*-0.72*	*-0.74*	*-0.36*	*-0.27*
NNP	**-2.66**	**2.16**	**16.43**	**17.53**	**27.51**	**29.82**

Poor households

	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	18.90	-0.06	5.04	13.84	12.58	10.95
Direct	*21.69*	*4.28*	*8.79*	*16.74*	*14.26*	*12.97*
Indirect	*-2.79*	*-4.34*	*-3.75*	*-2.90*	*-1.68*	*-2.02*
Mortgages	-37.77	-19.44	-9.39	2.35	-2.56	2.10
Direct	*-42.52*	*-26.82*	*-15.78*	*-2.58*	*-5.42*	*-1.34*
Indirect	*4.75*	*7.39*	*6.39*	*4.94*	*2.87*	*3.44*
Bonds	-37.66	-3.53	0.17	2.59	1.40	6.06
Direct	*-40.15*	*-7.40*	*-3.18*	*0.00*	*-0.10*	*4.26*
Indirect	*2.49*	*3.87*	*3.35*	*2.59*	*1.50*	*1.80*
DB pensions, non-indexed	4.59	-4.51	1.13	2.08	2.76	4.60
Direct	*9.14*	*2.57*	*7.26*	*6.82*	*5.51*	*7.90*
Indirect	*-4.55*	*-7.09*	*-6.13*	*-4.74*	*-2.75*	*-3.30*
DC pensions	-0.16	0.42	-0.21	-0.13	-0.03	0.03
Direct	*0.06*	*0.77*	*0.10*	*0.10*	*0.11*	*0.20*
Indirect	*-0.23*	*-0.35*	*-0.31*	*-0.24*	*-0.14*	*-0.16*
NNP	**-52.11**	**-27.13**	**-3.26**	**20.73**	**14.15**	**23.75**

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Table A10: Direct and Indirect Nominal Positions as a Percentage of Each Age/Income Group's Mean Net Worth in 1999

All households

			Age Cohort			
	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	1.16	0.01	1.06	3.59	7.79	13.42
Direct	6.91	6.13	6.67	8.36	11.51	16.59
Indirect	-5.75	-6.12	-5.60	-4.77	-3.72	-3.17
Mortgages	-24.01	-8.13	-0.39	3.39	4.21	4.23
Direct	-32.57	-17.23	-8.73	-3.72	-1.34	-0.49
Indirect	8.56	9.11	8.34	7.11	5.54	4.71
Bonds	2.03	7.36	8.03	9.61	9.13	8.26
Direct	-3.88	1.07	2.26	4.70	5.30	5.00
Indirect	5.91	6.29	5.76	4.91	3.83	3.26
DB pensions, non-indexed	-1.09	0.98	5.74	7.16	6.77	3.84
Direct	7.21	9.80	13.82	14.05	12.15	8.41
Indirect	-8.29	-8.83	-8.09	-6.89	-5.37	-4.57
DC pensions	0.16	0.17	0.12	0.09	-0.04	-0.05
Direct	0.40	0.43	0.35	0.29	0.12	0.08
Indirect	-0.24	-0.26	-0.24	-0.20	-0.16	-0.13
NNP	-21.74	0.39	14.55	26.20	27.87	29.70

Rich households

			Age Cohort			
	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	-2.02	-3.77	-2.81	0.57	5.29	9.13
Direct	5.82	5.73	6.12	8.34	11.73	14.82
Indirect	-7.84	-9.50	-8.92	-7.77	-6.43	-5.69
Mortgages	-0.81	9.83	10.09	10.87	8.88	8.43
Direct	-12.48	-4.31	-3.19	-0.70	-0.70	-0.05
Indirect	11.67	14.14	13.28	11.56	9.58	8.48
Bonds	9.66	12.49	12.77	14.01	13.50	11.82
Direct	1.60	2.72	3.59	6.02	6.89	5.96
Indirect	8.07	9.77	9.18	7.99	6.62	5.86
DB pensions, non-indexed	-5.96	-8.50	-5.75	-3.66	1.59	-2.80
Direct	5.35	5.21	7.13	7.55	10.87	5.42
Indirect	-11.32	-13.71	-12.88	-11.21	-9.28	-8.22
DC pensions	-0.07	-0.13	-0.15	-0.17	-0.19	-0.20
Direct	0.26	0.27	0.22	0.15	0.08	0.04
Indirect	-0.33	-0.40	-0.37	-0.33	-0.27	-0.24
NNP	0.80	9.92	14.16	21.61	29.07	26.38

Middle-class households

			Age Cohort			
	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	6.11	4.01	4.25	5.75	9.38	16.68
Direct	8.42	6.59	6.95	8.28	11.24	17.88
Indirect	-2.32	-2.59	-2.69	-2.53	-1.86	-1.20
Mortgages	-62.06	-26.86	-9.47	-2.23	1.07	0.89
Direct	-65.50	-30.71	-13.47	-5.99	-1.69	-0.89
Indirect	3.45	3.85	4.01	3.77	2.76	1.78
Bonds	-8.42	2.11	3.79	6.31	6.18	5.61
Direct	-10.80	-0.55	1.03	3.71	4.27	4.38
Indirect	2.38	2.66	2.77	2.60	1.91	1.23
DB pensions, non-indexed	7.05	11.65	16.98	16.06	11.08	9.90
Direct	10.40	15.39	20.86	19.71	13.76	11.63
Indirect	-3.34	-3.73	-3.88	-3.65	-2.68	-1.73
DC pensions	0.56	0.53	0.39	0.31	0.07	0.07
Direct	0.65	0.64	0.50	0.42	0.15	0.12
Indirect	-0.10	-0.11	-0.11	-0.11	-0.08	-0.05
NNP	-56.76	-8.57	15.95	26.20	27.78	33.15

Poor households

			Age Cohort			
	≤ 35	36-45	46-55	56-65	66-75	> 75
Short-term instruments	10.40	1.82	4.44	6.22	11.11	18.56
Direct	15.64	5.82	8.75	9.77	13.15	19.29
Indirect	-5.24	-4.00	-4.31	-3.55	-2.03	-0.73
Mortgages	-30.22	-19.48	-5.61	0.52	0.14	0.85
Direct	-38.02	-25.44	-12.03	-4.77	-2.89	-0.23
Indirect	7.80	5.96	6.42	5.29	3.03	1.08
Bonds	-63.63	2.90	6.87	7.78	5.66	3.46
Direct	-69.01	-1.21	2.43	4.13	3.57	2.71
Indirect	5.39	4.11	4.44	3.65	2.09	0.75
DB pensions, non-indexed	-4.49	-1.88	-0.64	0.90	0.34	0.71
Direct	3.07	3.90	5.59	6.02	3.27	1.76
Indirect	-7.56	-5.77	-6.22	-5.13	-2.94	-1.05
DC pensions	-0.15	-0.06	-0.09	-0.06	-0.05	0.01
Direct	0.07	0.11	0.09	0.09	0.03	0.04
Indirect	-0.22	-0.17	-0.18	-0.15	-0.09	-0.03
NNP	-88.08	-16.70	4.97	15.35	17.20	23.59

Holdings in mutual funds and trust funds. We suppose that the portfolio of marketable securities held by financial institutions provides a reasonable proxy for the distribution of mutual fund investments (SFS variables *wamutual* and *v3total*) across instrument categories. We take the same approach to trust funds (*watrust*).

We construct the portfolio of marketable securities held by financial institutions by combining NBSA and IIP data on its six components: domestic bond, stock, and short-term paper issues, all reported directly in the NBSA (CANSIM table 378-0009), and foreign issues of these three instruments, computed in Section B.1. Variables like *wamutual* are then divided between these components based on their portfolio weights, and the components are assigned to the appropriate instrument categories. During assignment, we take into account our results in Section B.2 regarding foreign currencies. For example, by combining NBSA data on the holdings of financial institutions in federal, provincial, municipal and "other" bonds with our results in Table A5 regarding the business sector's foreign currency fractions in each of these bond categories, we find that 5.6% of the domestic bond holdings of financial institutions are denominated in foreign currencies. Thus only 94.4% of the domestic bond component is assigned to the bond category, while the remainder goes to real instruments.

We take a similar approach to **other financial investments**, captured by the SFS variable *wafinot*, which we distribute between instrument categories based on the portfolio of marketable securities held by the NBSA household sector. For **pension supplements** (*waotpen*), we use the portfolio of marketable securities held by trusteed pension plans, whose holdings in domestic issues are reported at market value in the NBSA (CANSIM Table 378-0004), along with their total asset in foreign investments, which we have distributed between foreign stocks, bonds, and paper using the market value fractions in Table A3. After using the portfolio weights to divide trusteed pension plan holdings between domestic and foreign bond, stock, and paper issues, we identify foreign currency positions in each component using the foreign currency fractions identified for financial institutions in Section B.2. This is because trusteed plans are included among these institutions.

For 2005, **holdings in registered plans** are reported as *v1total* through *v8total*, with each variable recording investments in a specific instrument, except for *v8total*, which covers investments by registered plans in other registered plans. For 1999, these details are not reported and total holdings are simply given by the sum *warrspl* + *warrif* + *waresp*. We construct the average household's 2005 registered plan portfolio by aggregating the variables *v1total* through *v7total*, each of which has been assigned to their appropriate instrument categories, then compute the portfolio shares for which each instrument category accounts. These shares are used to distribute *v8total*, *warrspl*, *warrif*, and *waresp* across instrument categories. For simplicity, we have thus assumed that the 1999 composition of the average household's registered plan portfolio is the same in 2005.

C.2   Adjusting household-level positions for foreign currencies

As in the NBSA, some SFS positions include instruments denominated in Canadian dollars and foreign currencies. Since currency-specific positions are not reported, we use supplementary data to separate the domestic and foreign currency components. For each SFS variable, our approach

Table A11: Classification of household SFS Variables by Instrument Category (Part 1)

SFS definition	SFS variables	Instrument category
Deposits outside registered plans.	$wastdept$	
Investments in Treasury bill funds held outside registered plans.	$watbill$	
Investments in mutual funds outside registered plans.	$wamutual^{\dagger}$	
Holdings in trust funds outside registered plans.	$watrust^{\dagger}$	
Pension supplements.	$waotpen^{\star}$	
Investments in other funds outside registered plans.	$wafinot^{\ddagger}$	Short-term
Term deposits and GICs held in registered plans (2005 only).	$v1total$	instruments,
Mutual funds held in registered plans (2005 only).	$v3total^{\dagger}$	assets
Treasury bills held in registered plans (2005 only).	$v7total$	
Investments by registered plans in other registered plans (2005 only).	$v8total^{\S}$	
Investments in registered retirement savings plans (1999 only).	$warrspl^{\S}$	
Investments in registered retirement income funds (1999 only).	$warrif^{\S}$	
Investments in registered education savings plans (1999 only).	$waresp^{\S}$	
Mortgage loans outside registered saving plans.	$wamowed$	Mortgages, assets
Non-mortgage loans.	$waowed$	
Bonds held outside registered plans.	$wastbond$	
Investments in mutual funds outside registered plans.	$wamutual^{\dagger}$	
Holdings in trust funds outside registered plans.	$watrust^{\dagger}$	
Pension supplements.	$waotpen^{\star}$	
Investments in other funds outside registered plans.	$wafinot^{\ddagger}$	Bonds,
Savings bonds held in registered plans (2005 only).	$v2total$	assets
Mutual funds held in registered plans (2005 only).	$v3total^{\ddagger}$	
Bonds and debentures held in registered plans (2005 only).	$v6total$	
Investments by registered plans in other registered plans (2005 only).	$v8total^{\S}$	
Investments in registered retirement savings plans (1999 only).	$warrspl^{\S}$	
Investments in registered retirement income funds (1999 only).	$warrif^{\S}$	
Investments in registered education savings plans (1999 only).	$waresp^{\S}$	
Employer-sponsored pension plans.	$warppg$	Pensions, assets
Non-financial assets.	$wastnfin$	Real assets

[†] We approximate the distribution of mutual and trust fund investments across instrument categories using the portfolio of marketable securities held by financial institutions, as recorded in the NBSA.

[‡] We distribute *wafinot* across instrument categories according to the portfolio of marketable securities held by the household sector in the NBSA.

[§] We construct the average household's registered plan portfolio by aggregating the 2005 variables *v1total* through *v7total*, each of which have been assigned to their appropriate instrument categories. We then compute portfolio weights in each category, and distribute *v8total*, *warrspl*, *warrif* and *waresp* according to these weights.

[⋆] We distribute *waotpen* across instruments based on the portfolio of marketable securities held by trusteed pension plans, as recorded in the NBSA. *waotpen* includes executive pensions, annuities, and foreign pensions.

Table A12: Classification of Household SFS Variables by Instrument Category (Part 2)

SFS definition	SFS variables	Instrument category
Publicly traded stocks held outside registered plans.	*wastock*	
Shares in closely held stock held outside registered plans.	*washare*	
Value of all family businesses.	*wbuseq*	
Investments in income trusts outside registered plans.	*wainctru*	
Investments in mutual funds outside registered plans.	*wamutual*[†]	
Holdings in trust funds outside registered plans.	*watrust*[†]	
Pension supplements.	*waotpen*[⋆]	Equity, assets
Investments in other funds outside registered plans.	*wafinot*[‡]	
Mutual funds held in registered plans (2005 only).	*v3total*[†]	
Income trusts held in registered plans (2005 only).	*v4total*	
Publicly traded stocks held in registered plans (2005 only).	*v5total*	
Investments by registered plans in other registered plans (2005 only).	*v8total*[§]	
Investments in registered retirement savings plans (1999 only).	*warrspl*[§]	
Investments in registered retirement income funds (1999 only).	*warrif*[§]	
Investments in registered education savings plans (1999 only).	*waresp*[§]	
Debt on major credit cards.	*wdccard*	Short-term instruments, liabilities
Debt on other credit cards.	*wdoccrd*	
Student loans.	*wdsloan*	
Car, truck and van loans.	*wdvehln*	
Other vehicle loans.	*wdovehl*	
Debt on home equity lines of credit.	*wdloche*	Bonds, liabilities
Debt on other lines of credit.	*wdlocot*	
Other loans from financial institutions.	*wdothln*	
Deferred payment and installment plan obligations.	*wddefpy*	
Other loans.	*wdowed*	
Mortgage on principal residence.	*wdprmor*	Mortgages, liabilities
Mortgage on other Canadian real estate.	*wdocmor*	

[†] We approximate the distribution of mutual and trust fund investments across instrument categories using the portfolio of marketable securities held by financial institutions, as recorded in the NBSA.

[‡] We distribute *wafinot* across instrument categories according to the portfolio of marketable securities held by the household sector in the NBSA.

[§] We construct the average household's registered plan portfolio by aggregating the 2005 variables *v1total* through *v7total*, each of which have been assigned to their appropriate instrument categories. We then compute portfolio weights in each category, and distribute *v8total*, *warrspl*, *warrif* and *waresp* according to these weights.

[⋆] We distribute *waotpen* across instruments based on the portfolio of marketable securities held by trusteed pension plans, as recorded in the NBSA. *waotpen* includes executive pensions, annuities, and foreign pensions.

Table A13: Share of Household Positions in Various SFS Variables Denominated in Foreign Currencies, percent: 1999 and 2005

	2005				1999		
Variable	FC share, percent	Variable	FC share, percent	Variable	FC share, percent	Variable	FC share, percent
wamutual	21.68	wddefpy	2.22	wamutual	23.16	wddefpy	2.91
watrust	21.68	waowed	2.22	watrust	23.16	waowed	2.91
v3total	21.68	wdccard	0.37	v3total	23.16	wdccard	1.00
waotpen	31.38	wdoccrd	0.37	waotpen	20.67	wdoccrd	1.00
wafinot	3.48	wdofmor	100.00	wafinot	5.67	wdofmor	100.00
wdsloan	2.22	wastdept	0.35	wdsloan	2.91	wastdept	4.96
wdvehln	2.22	wastock	2.92	wdvehln	2.91	wastock	4.57
wdovehl	2.22	v5total	2.92	wdovehl	2.91	v5total	4.57
wdloche	2.22	wastbond	9.91	wdloche	2.91	wastbond	12.35
wdlocot	2.22	v6total	9.91	wdlocot	2.91	v6total	12.35
wdothln	2.22	v8total	12.21	wdothln	2.91	v8total	13.82

identifies comparable variables in the sectoral data. The foreign currency fractions for the sectoral data, as computed in Section B.2, are then applied to the SFS variables. For example, the share of the household sector's total consumer credit liabilities for which foreign currencies account was calculated using TDS data in Section B.2 and is now applied to the SFS variables dealing with credit card debt (*wdccard* and *wdoccrd*). Other variables are treated as follows:

Investments in mutual and trust funds. They are represented by the variables *wamutual*, *v3total*, and *watrust* and they were split up between their components in domestic and foreign bond, stock, and paper issues based on portfolios constructed from NBSA and IIP data in Section C.1. We did the same for **other financial investments** (*wafinot*) and **pension supplements** (*waotpen*). In Section B.2, foreign currency shares for each component were computed. Using these data, we can identify the foreign currency components in each of these SFS variables. The results are summarized in Table A13, which gives the portion of each variable for which foreign currencies account. For example, in 2005, the table indicates that 21.68% of the average household's position in mutual funds (*wamutual* and *v3total*) was denominated in foreign currencies.

Loans and Mortgages. In Section B.2, we used TDS data to compute the household sector's foreign currency liabilities in bank loans and loans from other institutions. We combine these results to compute the fraction of the household sector's total loan liabilities for which foreign currencies account, which we report in Table A13. The fraction is applied to the SFS variables dealing with non-mortgage loan liabilities: *wdsloan, wdvehln, wdovehl, wdloche, wdlocot, wdothln, wddefpy,* and *wdowed*. We also apply this fraction to non-mortgage loan assets (*waowed*) under the assumption that these are all loans to other households and have a currency mix similar to *wdowed*. Mortgaes are assumed to be denominated in Canadian dollars (*wamowed, wdprmor, wdocmor*).

Deposits. Data on household assets in three deposit categories are reported in the NBSA: bank deposits, deposits at other institutions, and foreign currency deposits. As defined in Statistics Canada (1989), bank deposits are denominated only in Canadian dollars while deposits at other institutions

can include foreign currencies. We abstract from the latter possibility and assume that all foreign currencies are captured in foreign currency deposits. Under this assumption, we compute the fraction of the household sector's total deposits denominated in foreign currencies, which we report in Table A13. The fraction is then applied to *wastdept.*

Stocks. SFS variables like *wastock* and *v5total* include shares in both Canadian and foreign firms. The household sector's position in domestic equity is reported directly in the NBSA (CANSIM Table 378-0009), while holdings in foreign stock were computed in Section B.1. We combine these data to calculate the share of the sector's total equity holdings for which foreign issues account, which we show in Table A13, and apply to *wastock* and *v5total*. The foreign equity components in these variables are assigned to the real instrument category while the remainder goes to equity. *washare* and *wabuseq*, which respectively focus on closely held and unincorporated businesses, are assumed to be denominated in Canadian dollars only. We make the same assumption for income trusts (*wainctru* and *v4total*), since these instruments are a unique feature of the Canadian financial environment.

Bonds. SFS variables like *wastbond* and *v6total* include both domestic and foreign bond issues, and among foreign issues do not distinguish between maple bonds and bonds denominated in foreign currencies. In Section B.1, we calculated the household sector's position in foreign bonds. Then, in Section B.2, we calculated the proportion of these holdings for which maple bonds account specifically. The household sector's holdings in domestic bonds come directly from the NBSA (CANSIM Table 378-0009), while the fraction of these holdings for which foreign currencies account was calculated in Section B.2. Combining all these results, we are able to estimate the total fraction of the sector's bond holdings tied up in foreign currency denominations, which we report in Table A13 and apply to *wastbond* and *v6total*. *v2total*, which covers savings bond issued by the federal and provincial governments, is assumed to be denominated in Canadian dollars since our analysis in Section B.2 found that all of the household sector's holdings in federal and provincial bond issues are denominated in Canadian dollars.

Our results regarding foreign currency denominations in household bond, stock, and mutual fund investments give foreign currency fractions for *v2total*, *v5total*, and *v3total*, which in 2005 record the **holdings of registered plans** in various instruments. All other *vtotal* variables are assumed to be denominated in Canadian dollars only, except *v8total*, which covers the investments of registered plans in other registered plans. We aggregate the domestic and foreign components *v1total* through *v7total* to construct the average household's registered plan portfolio, then use the portfolio share in foreign currencies as the foreign currency fraction for *v8total*. We apply the same fraction to *warrspl*, *warrif*, and *waresp*, which together give total registered plan holdings in 1999.

D Reconciling the sectoral- and household-level data

When estimating the household sector's aggregate holdings in various instrument categories, our findings based on NBSA data are close to those based on SFS data. Antoniewicz *et al.* (2005) point

out that there are broad consistencies between the datasets, though some discrepancies do arise.

We correct these discrepancies by adjusting the NBSA household sector's net holdings in each instrument category to match the SFS aggregates. We then adjust other sectors' positions to ensure that assets and liabilities balance throughout the economy. More specifically, we identify the household sector's net counterparties in each category and assign offsetting adjustments to these sectors in proportion to their unadjusted net positions.[31]

E   Treatment of pensions

Nominal pension positions cannot be inferred directly from the NBSA for two reasons. First of all, some pension plans offer defined benefits which are fully indexed to inflation and thus are not affected by inflation. Secondly, some real assets are held in defined contribution pension plans. We adjust for each of these issues as follows.

E.1   Overall

In order to calculate the impacts on pensions, we require information on the allocation of pension assets and liabilities over these three plan types. For different household classes, we have calculated mean wealth in each EPP type from the SFS data. However, for the end-user sectors, the NBSA does not provide these values for the different types of pensions directly. It is possible to calculate from SFS data the proportion of total pension assets for which each of the three plan types accounts. We use these proportions, presented in Table A14, to estimate the household sector's assets in indexed and non-indexed defined benefit plans, as well as defined contribution plans. Furthermore, a sub-set of SFS respondents specified whether their plan sponsor was a public (i.e., government) or private sector employer. With this information we estimate the government's pension liabilities in each plan type. Since the foreign sector has no direct pension position, the business sector's liabilities are then calculated as residuals so as to ensure that pension assets and liabilities match throughout the economy.

For defined contribution EPPs, we assume that the average investment portfolio is approximated by the holdings of Trusteed Pension Plans. Trusteed Pension Plans hold approximately 70-75% of EPP assets.[32] The assets of Trusteed Pension Plans are given by NBSA data. In order to assign the assets in households' defined contribution EPPs to specific instruments, we have computed the proportion of Trusteed Pension Plans' asset holdings within each asset category for 2005 using NBSA data.

Table A14 summarizes the distribution of pension assets by plan type. EPPs in the public sector and the private sector differ significantly in type and indexation. Table A14 shows that in 2005 private registered pensions plans (RPPs) accounted for 84.56% of pension assets and that 92.79% of these private RRPs offer defined benefits. Overall, defined benefit plans accounted for nearly

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[31]Real instruments are an exception: we match the household sector's position to the SFS aggregate by adjusting the sector's non-financial assets. Since these assets have no counterparties, no adjustments are applied to other sectors.

[32]The numbers are from 2006 Canadian Retirement Income Program data set provided by Statistics Canada.

Table A14: Percentage of Pension Assets in Each Plan Type from the 1999 and 2005 Survey of Financial Security

Benchmark year	2005	1999
	All plans	
Public-sector plans	15.44	19.13
Private-sector plans	84.56	80.87
Indexed defined benefit	36.60	38.78
Public	*7.50*	*8.95*
Private	*29.10*	*29.82*
Non-indexed defined benefit	56.90	57.75
Public	*7.54*	*9.93*
Private	*49.36*	*47.82*
Defined contribution	6.50	3.48
Public	*0.40*	*0.25*
Private	*6.10*	*3.23*
	Public-sector plans	
Indexed defined benefit	48.60	46.80
Non-indexed defined benefit	48.80	51.90
Defined contribution	2.60	1.30
	Private-sector plans	
Indexed defined benefit	34.41	36.88
Non-indexed defined benefit	58.38	59.13
Defined contribution	7.21	3.99

93.50% of pension assets and indexed plans accounted for nearly 39.14% of defined benefit assets. Defined benefits also account for the majority of assets within the public and private subsets, though they are more popular in the public sector, where they account for about 97.40% of pension assets. Indexed defined benefits are also more popular in the public sector, accounting for 49.87% of all defined benefits and 48.60% of all pension assets. In the private sector, they only account for 37.08% of defined benefits and 34.41% of all pension assets. In comparison, defined contribution and non-indexed defined benefit plans are more popular, respectively accounting for 7.21% and 58.38% of private sector pension assets. Since substantial differences in the distribution of pension assets by type and indexation status are apparent in Table A14, we apply separate distributions for government and the business sector.

In the calculation of household direct impacts from an inflation shock, we apply the methodology described in Section 2 to pensions. The impact on defined contribution plans can be estimated directly by applying the formulas in Sections 2.1.1 and 2.1.2 to the portfolio of assets in which the contributions have been invested. For non-indexed defined benefit plans, we assume that their present values are the sum over a discounted stream of annual post-retirement payments. Since an inflation shock can have an effect on the real values of these payments, especially for non-indexed defined benefit pensions, the real value of the households' pension assets is subject to the shock. When calculating the present value gains and losses of pension assets, we have to take into account the stream of payments. We do so by using the formulas for the gains or losses (equations 2 and 4) for each payment and then sum all the gains or losses to construct the total gains or losses for the pension asset position.

As a result, for a specific age group, the calculation of gains and losses on non-indexed defined benefit pensions requires information on years to retirement and years to life expectancy, both of which depend on the current age of the agent. Furthermore, for a sector, we need a sense of how non-indexed defined benefit assets are distributed across age groups. This information is summarized in Table A15. From the SFS, we have calculated mean household age for each age group. Assuming that the typical household retires at 62 years, we then estimate mean years to retirement. Mean years to life expectancy has been estimated using life tables provided by the University of Montreal's Canadian Human Mortality Project.[33]

For the aggregate sectors where we only have information on the aggregate pension assets and liabilities of the sector, we compute the total effect of inflation on non-indexed defined benefit pension pans under IA as the sum of the impacts on each age group weighted by their respective proportion of non-indexed defined benefit pension assets.[34] Table A15 details the proportion of non-indexed defined benefit pension assets held by each age group, according to 2005 SFS data, and indicates that the distribution is weighted towards households that are retired or near retirement.

The treatment of the business sector's pension liabilities requires extra attention. Under PT, since the impact on defined benefit EPPs depends on the years to retirement and to life expectancy, the losses of different age groups will differ. The impact on each household type's own non-indexed

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[33]These tables are available at http://www.bdlc.umontreal.ca/chmd/prov/can/can.htm.

[34]Under FS, the age distribution turns out to be irrelevant for the impact on the aggregate pension as all age groups are affected proportionally.

Table A15: Mean Years to Retirement, Mean Years to Life Expectancy and Percentage of Non-Indexed Defined Benefits Registered Pension Plans Assets by Age Group in the 2005 SFS

	Mean years to retirement	Mean years to life expectancy	Fraction of non-indexed DB RPP assets (%)
Under 36	33.74	53.21	2.02
36-45	21.07	41.01	7.20
46-55	11.57	32.16	20.75
56-65	1.63	23.46	35.63
66-75†	–	15.61	21.58
Over 75†	–	8.37	12.82

"†" denotes age groups that are, on average, already retired.

defined benefit EPP assets depends on age. Therefore, each household type's losses through their own non-indexed defined benefit EPPs are computed based on years-to-retirement and years-to-life expectancy data specific to their particular age group. On the other hand, to assess the impact on the business sector's non-indexed defined benefit EPP liabilities we must consider the aggregate impact across a distribution of age groups of the plan holders. Therefore, within our experiments, we separately compute the business sector's gain from inflation that results from a reduction in its non-indexed defined benefit EPP liabilities. Households benefit indirectly from this reduction through their equities. Therefore the pension liabilities of the business sector are not assigned as indirect liabilities prior to performing the experiment as opposed to other nominal assets and liabilities of the sector. Rather, these gains are estimated, and then, based on household equity holdings, they are added as an indirect effect when computing the change in the NNP for each household type.

E.2 Defined benefit pension plans

From the SFS we compute the value of the household sector's total holdings in fully indexed defined benefit plans, non-indexed defined benefit plans, and defined contribution plans. To simplify our analysis, we assign partially indexed plans to the non-indexed group. We then calculate the proportion of the market value of the sector's total pension assets in each of these three plan types, denoted proportions β^I, β^N, and γ respectively.[35]

A subset of SFS respondents have indicated that their plan sponsor is a public-sector employer. Focusing on this subset only, we calculate the proportion of public-sector pension assets in the various plan types, which we denote β_G^I, β_G^N, and γ_G. The subscript G stands for government (public sector).

We now calculate the corresponding proportions for private-sector pension assets by noting that household assets in each pension category must match government and business sector liabilities. For example, suppose that households have a pension asset P_H. The government and business sectors

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[35]In our sample period, SFS data are only available for two years: 1999 and 2005. When proportions are needed for other years, we average the 1999 and 2005 figures.

Table A16: Trusteed Pension Plan Holdings and Net Non-Equity Positions for the Business Sector: Percent Shares in Various Instruments, 1999 and 2005

	Trusteed pension plan holdings (κ)		Net non-equity positions for the business sector (ρ)	
	2005	1999	2005	1999
Short-term instruments	4.86	5.88	-20.82	-18.27
Mortgages	1.16	1.92	35.62	27.58
Bonds	38.09	39.27	19.97	21.37
Pensions	–	–	-58.56	-45.22
Equity	27.33	33.49	–	–
Real instruments	28.57	19.44	123.80	114.53

have pension liabilities P_G and P_B respectively. β_B^I, the proportion of private-sector pension assets in fully indexed defined benefit plans, is given by:

$$\beta_B^I P_B = \beta^I P_H - \beta_G^I P_G. \tag{6}$$

We repeat for non-indexed defined benefit plans and defined contribution plans.

E.3 Defined contribution pension plans

Defined contribution plans can have both real and nominal components, depending on how contributions are invested. To address this issue, we turn to the NBSA, which records the holdings of trusteed pension plans at market value (CANSIM table 378-0004). Data on Statistics Canada's 2006 Canadian Retirement Income Program CD indicate that about 70% of pension plans are trusteed. We therefore approximate the average defined contribution pension portfolio using the trusteed pension portfolio, which is described in Table A16. We calculate the proportion of trusteed pension plan holdings in mortgages, equity, short-term instruments, bonds, and real instruments. Denote these proportions κ^M, κ^E, κ^S, κ^B, and κ^R respectively.

We continue using the NBSA to focus on the business sector. Our logic is that equity in the defined contribution portfolio represents a partial claim on the business sector's portfolio, which itself has real and nominal components. Therefore we calculate the proportion of the business sector's net non-equity positions in mortgages, short-term instruments, bonds, real instruments, and pensions: ρ^M, ρ^S, ρ^B, ρ^R, and ρ^P, respectively. These proportions are in Table A16.

Now we calculate the proportion of defined contribution holdings that is nominal, μ, by solving

$$\mu = \left[\begin{array}{c} \kappa^S + \kappa^M + \kappa^B \\ + \kappa^E \left(\rho^S + \rho^M + \rho^B + \rho^P (\beta_B^N + \mu \gamma_B) \right) \end{array} \right]. \tag{7}$$

A sector or household's total nominal position in pensions is the sum of its non-indexed defined benefit position and the nominal part of the defined contribution portfolio.