Substitutability of Savings by Sectors : OECD Experiences

Yoichi Matsubayashi[*] Takao Fujii[†]

This version: August 21, 2012

Abstract

This paper investigates empirically the substitutability of savings among the household, corporate and government sectors in OECD countries. First, theoretical micro-foundations are constructed, wherein, each sector behaves under intertemporal optimization. Second, empirical investigations are conducted based on this theoretical formation. Optimal consumptions is then derived based on the theoretical relationship between household consumption and corporate and government savings. Empirical results indicate that changes in corporate savings marginally offset household savings in OECD countries. This empirical evidence somewhat supports the assertion that households partly pierce the corporate veil and that other factors, such as fluctuations in disposable income and precautionary motives, contribute to the relation between household and corporate savings. However, substitutability of savings between the households and the government is not clearly evident.

Keywords: Savings by Sectors, Pierce Corporate Veil, Ricardian Equivalence Theorem

JEL Classification: E21, E62, F01

[*]Graduate School of Economics, Kobe University. E-mail: myoichi@econ.kobe-u.ac.jp

[†]Graduate School of Economics, Kobe University. E-mail: fujii@econ.kobe-u.ac.jp

1 Introduction

Much attention has been focused on the trend of worldwide external imbalances 'global imbalances'. When taking medium and long-term views of these imbalances as they pertain to savings and expenditures, we must scrutinize savings trends for national economies. Unfortunately, doing so often causes arguments to centre upon household savings, and insufficient consideration is given to the relations among household, corporate and government saving. In the US and Japan, for example, declining household savings have been widely and fearfully discussed. However, the tilting of those discussions may have the redeeming feature of exposing alternative ways to view savings in other sectors and thereby promote multi-angled examinations of national savings, and not merely that of imbalances in saving and expenditure.

In today's market economy, households, firms, and governments save independently, e.g. personal savings by households, cash flows in firms and financial surpluses among governments[1]. However, sacrifice theories argue that households (shareholders) own corporations and governments are surrogates for households (citizens), therefore corporate and government savings are merely substitutes for household savings. From this notion emerges the question of whether savings by one sector of the economy suubstitute for savings in other sectors.

This paper will empirically examines these issues and shows the theoretical relationships of substitutability between sectors by focusing on dynamic decision-making by households, firms and governments. This paper is structured as follows. The next section reviews relevant research and summarizes the original characteristics of the present analysis. Section 3 constructs a theoretical model based on empirical analysis, while Section 4 examines savings trends, Section 5 and 6 offer a detailed empirical analysis. Section 7 elabourates upon further points and Section 8 summarizes the conclusions of the analyses.

[1]Government savings is the difference between revenues and government consumption, not net of government investment(in public capital formation). Accordingly, their levels are not the same as "fiscal balances". However, because fluctuation patterns in government savings and fiscal balances match, in this paper we treat both of these as essentially the same concept.

2 Overview

First let us review relevant previous research into this topics. Denison (1958) obserbed post-war US data and concluded that fluctuations in private savings were smaller than fluctuations in household and corporate savings. Now known as the Denison's Law, his report was the first to imply substitutability between household and corporate savings.[2] Few scant attempts at computational analysis followed Denison (1958). Using UK data from 1946 to 1968, Feldstein and Fane (1973) concluded that corporate savings have effect on household savings. Other papers sceptical about substitutability include Feldstein (1973, 1978), David and Scadding (1974), von Furstenberg (1981), and Pitelis (1987). On the other hand, using US data from 1948 to 1986, Poterba (1987) reported that household savings could, to an extent, substitute for corporate savings. Thornton (1998) obtains similar results with annual panel data from 1980 to 1993 for five OECD countries: Canada, France, Japan, the UK and the US. Bhatia (1979) and Hendershott and Peek (1987) hint at the possibility of substitutability.[3] Using aggregate and microeconomic data, Iwaisako and Okada (2010, 2012) suggest that Japan's declining savings rate, particularly a nonlinear movement, cannot be attributed solely to population aging and productivity shocks and underscore the importance of income distribution. Examining corporate saving, they cite the substitution between household and corporate saving as evidence of a shift in income distribution from labour to shareholders after Japan's financial crisis in the 1990s. Jongwanich (2010) investigates determinants of household and private savings in Thailand and finds that corporate savings is one of the important determinant of household savings and suggests substitutability between corporate and household savings.

The relation between household and government savings, which we elabourate later, helps explain how the Ricardian Equivalence Theorem can be possible when as-

[2]However, Keynes (1936), in his eighth chapter, has already acutely noted that household savings cannot substitute for corporate savings.

[3]Chapter 4 of Sachs and Larrain (1993) contains a simple explanation of substitutability between household and corporate savings.

sessing the effectiveness of government policy. Beginning with Barro (1974), scholars have analysed the theorem and drawn many conclusions.[4] Jongwanich (2010) empirically investigates the relation between household and public saving, and finds that household saving does not fully crowded out by public saving, suggesting that Ricardian equivalence does not hold. Monogios and Pitelis (2004) find that the prefect substitution between household savings and government savings, corporate savings, or both cannot be supported. They conclude that each agent's rational behaviour is not satisfied.

Several implications arise from previous research. First, evidence of substitutability between household and corporate savings is undeniable among primary advanced economies, including Japan. Second, substitutability between household and government savings cannot be clearly observed. However, research either relies on simple observations of data or employs orthodox regression aanalyses. None have closely scrutinized the time-series data from a strictly theoretical basis.

3 Model

In this section, we show theoretical substitutability among sectors by considering intertemporal decision-making by households, corporations and governments.

3.1 Household

Based on budgetary constraints at different times, households choose a period-specific consumption profile that maximizes the discounted present value of a utility stream as shown in Equation (1). Their budgetary constraints can be expressed by Equation (2).

[4]For example, research by Brittle (2010), Cohn and Kolluri (2003) and Kessler et al. (1993) partially supports the theorem, whereas Cebula et al. (1996), Eisner (1994), Jaeger (1993), Domenech et al. (2000) and Drakos (2001) dispute it. For developing countries, refer Leiderman and Razin (1988), Gupta (1992) and Khalid (1996). See Buiter and Tobin (1979), Bernheim (1987), Leiderman and Blejer (1988), Barro (1989), Seater (1993), Elmendorf and Mankiw (1999), Ricciuti (2003) and Adji (2007) for overviews of theory and empirical analysis.

$$E_t \sum_{s=t}^{\infty} \beta^{s-t} U(C_s) \tag{1}$$
$$\beta = \frac{1}{1+\mu}$$

$$A_{t+1} + V_t \chi_{t+1} = (1+r)A_t + V_t \chi_t + d_t \chi_t + WL_t - C_t \tag{2}$$
$$WL_t = YL_t - TH_t$$
$$A_t = B_t^g + B_t^p$$

In Equation (2), A_t is the non-stock financial wealth at the beginning of period t, V_t is a corporation's market value at beginning of period t and χ_t is the share ownership ratio at the beginning of period t. In addition, r is the rate of return on financial wealth, d_t is total dividends at period t and μ is the discount rate ($0 < \mu < 1$). YL_t is labour income before taxes and WL_t is labour income after taxes. TH_t denotes household tax payments and C_t denotes household consumption. Households' non-stock financial wealth is assumed to be held as government bond(B_t^g) and other safe assets(B_t^p), and their rate of return is assumed to be identical.[5] All variables are expressed in real terms. After considering optimization of the necessary conditions and by substituting Equation (2) successively, the budgetary constraints can be rewritten as Equation (3).

$$E_t \sum_{s=t}^{\infty} \Big(\frac{1}{1+r}\Big)^{s-t} C_s = (1+r)A_t + V_t \chi_t + d_t \chi_t + E_t \sum_{s=t}^{\infty} \Big(\frac{1}{1+r}\Big)^{s-t} WL_s \tag{3}$$

Equation (3) can be interpreted as future consumption being determined by the total equity and financial wealth held in the current period (non-human capital) and future labour income after taxes(factor endowments). In regards to consumption expenditure and labour income after taxes, it is impossible, in the present, to observe

[5] In Equation(2), market value in period t, V_t, does not change. It is assumed that the ownership balance of equity can be altered by adjusting household income via the ownership ratio (χ). Obstfeld and Rogoff (1996) (2-5-1) share this assumption.

future flows, but it can be assumed as a stochastic variable. In Equation (3), the conditional expected value (E_t) appears based on the information set established for period t.

If we specify a utility function, we can derive an optimal decision function as shown below.[6]

$$C_t = \alpha\Big[(1+r)A_t + V_t\chi_t + d_t\chi_t + E_t\sum_{s=t}^{\infty}\Big(\frac{1}{1+r}\Big)^{s-t}WL_s\Big] \tag{4}$$

$$\alpha > 0$$

Equation (5) is a formulation of the Permanent Income Hypothesis, which argues that household consumption for each period embodies expectations of its permanent income, the sum of human and non-human capital.

3.2 Firms

Firms maximize market value, and adjust current period production inputs (employment, materials, etc.) and actual capital stock. In this paper, market value refers to the income flow of future discounted present value of utility. In a perfect capital markets, this value would match firms' equity value. Miller and Modigliani (1958) prove that would be the case in ideal capital markets, regardless of corporate value and capital structure. Their proof is known as the Modigliani-Miller Theorem(MMT).

Whenever MMT applies, a corporation's value (market value) as shown by the issuances of stock essentially would be the same as the present value of future flows of internal reserves. This relation is expressed in Equation (5).

$$V_t = E_t\sum_{s=t}^{\infty}\Big(\frac{1}{1+r}\Big)^{s-t}cash_s \tag{5}$$

$$cash_s = \pi_s - d_s$$

[6]If we specify a utility function as a constant relative risk aversion$\big(u(C) = \frac{C^{1-1/\sigma}}{1-1/\sigma}\big)$, we fulfill $a > 0$ in Equation (3) based on $\alpha = \big\{(1+r) - (1+r)^{\sigma}\beta^{\sigma}\big\}/(1+r)$ where $(1+r)^{\sigma-1}\beta^{\sigma} < 1$

In this equation, V_t is the market value of a corporation's equity during period t. $Cash_s$ is cash flow corporate savings defined as post-tax income (π_s) net of dividends (d_s).[7] Cash flow is a corporation's savings, and in situations where MMT strictly applies, Equation (5) indicates that a firm's current market value equals the present value of future corporate savings under the indicated discounted rate.

3.3 Government

Governments accommodate for the gap between revenues and expenditures by issuing bonds, and budget constraints materialize between periods, as shown in Equation (6).

$$\begin{aligned} B^g_{t+1} &= (1+r)B^g_t + G_t - T_t \\ T_t &= TH_t + TO_t \end{aligned} \tag{6}$$

G_t represents expenditures for period t, T_t represents revenues, TH_t represents tax revenues from households, and TO_t represents other revenues. By substituteing Equation (6) successively, we can express budget constraints as

$$(1+r)B^g_t = E_t \sum_{s=t}^{\infty} \Big(\frac{1}{1+r}\Big)^{s-t} (T_s - G_s) \tag{7}$$

We interpret equation (7) as the outstanding balance of government bonds in the present that must be redeemed by future budget surpluses and government savings.

[7] In the standard corporate finance model, a firm's market value (V_t), is the discounted present value of dividends by assuming arbitrage conditions of stock and safe assets. In this case, discounted present values of future flows can be interpreted as corporate value because dividends, which are included in the income of each reporting period, are distributed to shareholders. Intuitively, we say that share prices rise as dividends increase. However, in this model, not all profit (π_t) is distributed to shareholders. In other words, dividends (d_t) in this model are not income but deductions from income. Accordingly, we see that as dividends decrease, a corporate profit increases after net distribution of deductions and thus corporate value increases. Additionally, in this analysis, share value (V_t), which is a corporate market value, is determined by Equation (5). In other words, this equation can be expressed as a corporation's market value that is the discounted present value of a corporation's cash flow (profit less dividends).

Thus, it presents an indication of budget constraints over time in the public sector. Future expenditures and revenue flows cannot be observed; we calculate the expected conditional value (E_t) based on the information set at t as we did for the household sector.

3.4 Substitutability of Saving by Sectors

Based on the previous settings, we define the saving functions for households, firms, and governments, we then show the relation among these sectors. Household saving for period t(S_t^h) is the total disposable income net of consumption, as is conventionally defined by Equation (9).

$$S_t^h = YD_t - C_t \tag{8}$$

$$YD_t = YL_t + d_t\chi_t - TH_t \tag{9}$$

$$\begin{aligned} C_t = \alpha\Big[&(1+r)B_t^p + E_t\sum_{s=t}^{\infty}\beta^{s-t}(TH_s + TO_s - G_s) + d_t\chi_t \\ &+ E_t\sum_{s=t}^{\infty}\beta^{s-t}(\pi_s - d_s)\chi_s + E_t\sum_{s=t}^{\infty}\beta^{s-t}(YL_s - TH_s)\Big] \end{aligned} \tag{10}$$

In our model, disposable income (YD_t) is defined as the sum of labour income and dividends less taxes (Equation (9)). Also, the consumption expenditure standards for each period (Equation (10)) are provided after considering Equations (4), (5), and (7). We define corporate savings (S_t^f) and government savings (S_t^g) as shown below[8].

$$S_t^f = \pi_t - d_t \tag{11}$$

$$S_t^g = T_t - G_t \tag{12}$$

$$T_t = TH_t + TO_t \tag{13}$$

[8] To abbreviate, we standardize as $\chi_s = 1$ below.

First, we observe the relationship between household and corporate saving. Assume that a corporation decreases its dividend (d_t) to shareholders (households) in period t. According to Equation (11) and barring a change in income, corporate savings increase by the amount of the unpaid dividend in period t. The effect of the dividend reduction on the household sector will be two-fold, assuming no change in the share ownership ratio (χ_t). First, disposable income (as specified in (9)) decreases. Second, permanent income and consumption are affected. As we see in Equation (10), dividend reductions reduce permanent income directly. However, when MMT is strictly in effect (Equation (5)), dividend reductions increases in corporate savings increase the value of households 'equity holdings through increases in prices (V_t). In other words, permanent income on the right side of Equation (10) remains unaffected and consumption expenditures do not change[9]. Expressed differently, we observe only a decrease in dividends equal to disposable income, or, consequently, household savings. Private savings remains unchanged. This is the outcome of households 'rational response to changes in corporate saving policies and could be expressed as households unveiling firms.

Let's review the conditions under which corporate and household savings are substitutes: 1) dividends and corporate savings are negatively correlated; 2) the efficient stock market reflect changes in cash flow in the stock prices (or divi- dends); 3) households hold a significant amount of a corporation's assets in stock as financial wealth; 4) households regard equity as permanent income on which they base consumption and savings.

Next we observe the relationship between household and government saving. We assume that the government implements taxcut whereby it reduces its tax revenues (TH_t) from households in period t. From Equation (12), and assuming no changes in expenditures, government savings decrease by the amount of the tax cuts in period t.

[9] By writing the permanent income part on the right side of Equation (10),
$(1+r)B_t^p + E_t\sum_{s=t}^{\infty}\beta^{s-t}(TH_s + TO_s - G_s) + d_t\chi_t + (\pi_t - d_t)\chi_t + E_t\sum_{s=t}^{\infty}\beta^{s-t}(\pi_t - d_t)\chi_t + E_t\sum_{s=t}^{\infty}\beta^{s-t}(YL_s - TH_s)$
it is easily confirmed that dividend reductions in the current period (d_t) does not impact permanent income.

The household sector's disposable income rises due to the tax decrease. On the other hand, as Equation (10) indicates, the single-period decrease in TH_t does not affect permanent income, on the right side of Equation (10), and has no apparent effect on consumption[10]. A reduction in government savings by tax reductiones increased the household's disposable income and savings by an amount equal to the tax of perfect substitutability. It is known in government policy circles, as the Ricardian Equivalence Theorem or Neutrality Theorem of Debt Burden.

4 Data

Annual unbalanced panel data of 10 OECD countries for 1980-2009:[11] Canada(1980-2009), Finland(1995-2009), France(1995-2009), Germany(1991-2009), Italy(1980-2009), Japan(1980-2009), Norway(1995-2009), Sweden(1980-2009), the UK(1980-2009) and the US(1980-2009). Data availability and structural similarities among countries were the criteria for sample selection[12]. Data is sourced primarily from OECD national accounts. The data appendix provides a detailed documentation. We use two samples: Sample I is composed of G7 countries and Sample II is the G7 plus Sweden, Norway and Finland.

Figure 1 presents sector-wise savings as a percentage of GDP for each of the 10

[10]The fact that permanent income is not affected by a reduction in taxes for that period can be easily confirmed by the expression in footnote 9.

[11]As Haque et al. (1999) point out, to assume parameter homogeneity across countries neglects heterogeneity and may cause misleading interpretations of results. But it is also true that our empirical analysis provides the overall picture as stated by Bernheim (1987). Estimating country by country remains a task for future research.

[12]It is extremely difficult to find lengthy time series data for household financial net wealth. This variable is available only for few countries. Mello et al. (2004) also lament this point.

OECD countries.[13] The figure reveals several interesting properties.[14] This directionality of total savings is evident as upward trending(Norway, Sweden), downward trending(Italy, Japan, US), flat(France, Germany, UK) or erratic(Canada, Finland). Total saving rates in Norway and Sweden trend upward but trends in sectoral savings vary. Norway's household and corporate saving rates remain low but government saving shows an increase post the Nordic financial crisis.[15] Swedish corporate and household savings are more cyclical than in Norway, nor does Sweden's government saving witness an increase like Norway's.[16]

In contrast to those countries, total saving rates and household savings rates in Italy, Japan and the US trend downwards. Italy's household saving rate is higher than those of Japanese or the US, perhaps, reflecting the borrowing constraints on young Italians(Kirsanova and Sefton (2007)). Unlike in Italy, corporate saving rates negatively correlated with household saving rates in Japan. In Japan, government saving rates have declined rapidly in recent years unlike Italy which shows improvement in its fiscal condition. Moreover, in contrast to Italy and Japan, where trends in the total saving rates seem to accord with those of household saving, behaviour of the US tatal saving rate may be explained by the government saving behaviour.

Total saving rates in France, Germany and the UK are relatively flat across the sample period. France's household saving rate seems negatively correlated with the corporate saving rate, wherein movements in the government saving rate seem to dominate the total saving rate. The UK is almost at par in this regard, although

[13] Edwards (1996) states that "Most empirical studies have associated private savings to household savings. This is not strictly correct, since in a number of countries corporate savings are an important component of the aggregate." An exception is Kirsanova and Sefton (2007), who decompose national savings into household, corporate and public sectors in the UK, US and Italy. Among lesser developed countries, as mentioned before, Jongwanich (2010) investigates determinants of household and private savings in Thailand and finds that corporate savings is an important determinat of household savings.

[14] We should, however, bear in mind that we conduct the retroaction of data to the past by using the growth rate of the older data sets.

[15] For more on the Nordic financial crisis, see Jonung et al. (2009).

[16] Swedish government saving declined drastically in 1993 during the Nordic financial crisis. For details see Bi and Leeper (2010).

it has a relatively cyclical flow compared with France and Germany. Germany's household saving rate is stable compared with other G7 countries(Hufner and Koske (2010)).[17]

Total saving rates are erratic in Canada and Finland, mainly because they are dominated by the corporate saving rate that reflects the business cycle. [18][19]

Causal examination of Figure 1 indicates that the household saving rate in many countries correlates negatively with the corporate saving rate, which influences the total saving rate. We examine these facts statitically. Table 1 presents the coefficient of variation in rates of savings by sectors. The sixth and seventh columns of the table almost support the above fact known as Denison's Law(Denison (1958)).

However, the above findings are based on a casual glance, and an initial descriptive statistics requires further scrutiny through panel cointegration analysis.[20] As a prerequisite to testing for cointegration, a panel unit root test is conducted per Im et al. (2003).

As Table 2 shows, the Im et al. (2003) test fails to reject the null hypothesis for levels except corporate saving per GDP, and rejects it for first differences. These

[17]They suggest that this fact may be what Borsch-Supan et al. (2001) and Borsch-Supan (2002) term the German savings puzzle.

[18]For Canada, Carroll and Summers's(1987) important paper differs from the analysis here by sample period and purpose of analysis. They seek to explain the divergence between movements of Canadian and US private savings rates. They suggest that macroeconomic variables such as inflation and unemployment do not sufficiently explain the divergence and the importance of fiscal policy differences. Their empirical results show that the increase in budget deficit is offset almost one for one by increases in private saving. They, however, warn against interpreting the results as the evidence of Ricardian equivalence. For details, see Carroll and Summers((1987), p.272). Moreover, they indicate that corporate saving is not important in explaining the divergence in movements of the two countries' private saving rates.

[19]During the mid-1990s, the saving rate of Canada's government rapidly improved followed by economic expansion. Krugman (2012), however, suggests that this experience does not offer evidence of expansionary fiscal consolidations.

[20]Previous studies of saving behaviour using panel cointegration analysis include Bandiera et al. (2000), Sarantis and Stewart (2001) and Hondroyiannis (2006). Their concern is with determinants of aggregate private saving. See Berube and Cote (2000) and Hufner and Koske (2010).

results suggest that the panel data series are I(1).[21]

Table 3 reports cointegration test results using the panel cointegration tests of Kao (1999) and Pedroni (1999, 2004).[22] Although it is desirable to use Pedroni's test because it allows for heterogeneity in slope coefficients across all units, Gutierrez (2003) argues that Kao's(1999) tests outperform Pedroni's if the time series dimension of the panel is small from his Monte Carlo results. We therefore use both tests.

Generally, test results support a cointegration relation among any pair of series except for the pairing of household and corporate savings. These results indicate an apparent long-run equilibrium among household, corporate and government series. The Kao and Pedroni tests, however, rely on the assumption of cross-sectional independence and accordingly suffer from size distortions(Banerjee et al. (2004); Gengenbach et al. (2006)). We therefore implement the Westerlund (2007) panel cointegration test. Table 5 shows these results. After considering cross-sectional dependence, the cointegration relation still exists, but is less powerful.

To summarize, the analyses indicate only a slight connection among savings by sectors. However, a cointegaration test merely investigtes whether a long-run equilibrium exists among variables.[23] We therefore proceed to the next step by estimating the equation based on structural models.[24]

[21] A careful interpretation of panel unit root tests should be performed. "In IPS, the alternative is that at least one of the individual series in the panel is stationary"(Karlsson and Lothgren (2000)).

[22] Pedroni (1999) proposes seven tests for panel coitegration: the panel ν-statistic, panel ρ-statistic, panel t-statistic(non-parametric), panel t-statistic(parametric), group ρ-statistic, group t-statistic(non-parametric) and group t-statistic(parametric). From among these, we adopt panel t-statistic(parametric) and group t-statistic(parametric) because a Monte Carlo study by Pedroni (2004) shows that these two statistics are more robust for small samples. We also use the unweighted statistic as panel t-statistic as per his statement: "In Monte Carlo simulations, we found that the unweighted statistics consistently outperformed the weighted statistics in terms of the small sample size properties."(Pedroni (2004),p.619)

[23] Gutierrez (2003) warns about inference based only on panel cointegration tests.

[24] Mello et al. (2004) indicate the strengths and weaknesses of reduced-form and structural-form equations.

5 Empirical Analysis

5.1 Estimating Method

We focus on the substitutability of savings by sectors, whereas previous studies investigate the determinants of household and private savings. As Loayza et al. (2000) point out, however, the use of reduced-form saving equations does not necessarily have a micro foundation. Here, we use the estimation equation based on a micro foundation.[25] Equation (10) is the basis for our analysis, as we set our estimation equation having accommodated the following four points: First, we set households' rational recognitions for future corporate savings $\left(E_t \sum_{s=t}^{\infty} \beta^{s-t}(\pi_s - d_s)\right)$ as $\theta(0 \leq \theta \leq 1)$, and for future government savings $\left(E_t \sum_{s=t}^{\infty} \beta^{s-t}(TH_s + TO_s - G_s)\right)$ as $\gamma(0 \leq \gamma \leq 1)$. If both θ and γ are 1, households are correctly recognizing corporate and government savings trends; if both are 0, households are oblivious to the changes in savings in those sectors'. Second, households confront liquidity constraints, and their consumption is thought to depend not only on perceptions of permanent income, but also on each period's disposable income (YD_t). This rate is shown as λ $(0 \leq \lambda \leq 1)$. Third, the share ownership ration (χ_t) is assumed to be 1. Giver these three points, we rewrite the consumption function of Equation (10) as

$$\begin{aligned} C_t = \alpha \Big[&(1+r)B_t^p + \gamma E_t \sum_{s=t}^{\infty} \beta^{s-t}(TH_s + TO_s - G_s) + d_t \\ &+ \theta E_t \sum_{s=t}^{\infty} \beta^{s-t}(\pi_s - d_s) + E_t \sum_{s=t}^{\infty} \beta^{s-t}(YL_s - TH_s) \Big] + \lambda YD_t \end{aligned} \tag{14}$$

$$\alpha > 0, \beta = \frac{1}{1+\mu}$$

The right side of Equation (14) shows government savings, corporate savings, and future values for human wealth. Because it is impossible to observe future values

[25] Although Lopez et al. (2000), Malengier and Pozzi (2004) and Pozzi and Malengier (2007) are technically similar to ours in adopting a nonlinear generalized method of moments (GMM) estimator using panel data, they do not account separately for corporate savings and our analysis has a different purpose. Although not a panel data analysis, Pozzi (2003) estimates a consumption function for Belgium by a nonlinear instrumental variables method.

in the present, we cannot directly estimate Equation (14). We use Hayashi's(1982) methodology as a fourth modification of Equation (14) to allow making these estimations.

$$
\begin{aligned}
C_{it} &= (1+\mu)C_{it-1} + \alpha[W_{it} - (1+\mu)(W_{it-1} + WL_{it-1})] - \alpha\gamma(1+\mu)S^{g}_{it-1} \\
&- \alpha\theta(1+\mu)S^{f}_{it-1} + \lambda[YD_{it} - (1+\mu)YD_{it-1}] + \eta_i + \epsilon_{it} \qquad (15)
\end{aligned}
$$

where C denotes consumption, W nonhuman wealth, WL after tax labour income, S^g government saving, S^f corporate saving and YD disposable income. Subscripts i and t denote countries and time periods respectively. All variables are real per capita values.

Within Equation (15), parameters to be estimated are μ, α, λ, θ, and γ, and our parameter space is theoretically constrained. However, Equation (15) specifies a complex non-linear shape for these parameters. Also, these parameters express their representative agents 'behaviours that we validate using macro data. Accordingly, it is not easy to reach reasonable estimations for all parameters within an appropriate space range. To amend this situation, we fix the valuee of μ in advance, in estimating parameters α, λ, θ, and γ as explained below.

5.2 Estimation

Equation (15) using OECD countries' panel dataset is a dynamic panel data model because it includes a lagged dependent variable, C_{it-1}. Thus, the fixed effects model generates inconsistent estimates under normal conditions(Baltagi (2008)). Therefore, we use a GMM procedure proposed by Arellano and Bond (1991). As Arellano and Bond (1991) state, it is preferable to use all lagged values as instruments of explanatory variables, but practically this preference does not always work well. For examples, see Tauchen (1986), Alonso-Borrego and Arellano (1999) and Ahn and Schmidt (1999).

In fact, the Monte Carlo work of Ahn and Schmidt (1999) shows that GMM estimation using subset of the moment conditions often performs better than that using of the moment conditions in finite samples. We therefore use only dependent variables lagged two or more periods as instruments, following Dahlberg and Johansson (2000).[26]

Moreover, as the equation includes μ, α, λ, θ and γ as estimated parameters in nolinear form, it is difficult to get reasonable estimates for all parameters. So, we exogenously set three values for μ, our variable of less interest(0.05, 0.01 and 0.001).[27]

Table 6 reports estimation results. First, we examine λ, representing the proportion of households facing liquidity constraints. This parameter is important as a prerequisite for Ricardian equivalence and is the key to the fiscal policy puzzle,[28] so it has been researched considerably. Studies employing panel data analysis include Evans and Karras (1998), Lopez et al. (2000), Malengier and Pozzi (2004) and Pozzi and Malengier (2007).

Evans and Karras (1998) investigate the severity of liquidity constraints using annual data for 66 countries between 1970 and 1989. They obtain a robust estimates of 0.25 for λ. Using annual data from 1975 to 1992 for 41 industrial and developing countries, Lopez et al. (2000) get approximately 0.40 as their estimate for the subsample of 19 industrialized economies and about 0.60 for the 22 developing economies. Malengier and Pozzi (2004) use panel data for 19 OECD countries spanning 1980 to 1997 and conclude that approximately 25% of consumers are rule-of-thumb households. Moreover, detailed analysis by Pozzi and Malengier (2007) provides a reliable estimate of λ by estimating a panel data model for 17 OECD countries over 1981–2003. Their estimate is 0.369.

Our estimates are in line with the above research. In addition, Table 7 indicates

[26] We do not use the lagged difference but the lagged level as instruments(Arellano (1989))

[27] A similar approach is taken by Lopez et al. (2000), Malengier and Pozzi (2004) and Reitschuler (2008).

[28] As well known, the Ricardian Equivalence Theorem holds under specified assumptions: no liquidity constraints, identical planning horizons between private and government sectors, nondistortionary taxes and certainty. In addition to these, the theorem does not hold if households have hyperbolic discounting(Laibson (1997)). See footnote 4 for the REP and Gali et al. (2007) for the fiscal policy puzzle.

that our estimates in Sample I are roughly in line with the average value of country-specific values given by Evans and Karras (1996) and Evans and Karras (1998). Although our estimation results in Sample II is different from the average of their results, our estimate, about 20%, is nearly identical to Malengier and Pozzi's(2004). Moreover, it is interesting that estimates of λ in Sample II are lower than for Sample I. Pozzi et al. (2004) show that a higher government debt ratio causes excess sensitivity, partly explained by liquidity constraints. As Table 8 reveals, the average government debt ratio for the three Nordic countries in Sample II is below the G7 average(Sample I). That is, the lower estimates of λ in Sample II are consistent with the empirical results of Pozzi et al. (2004).

Further we discuss the parameters of our primary interest γ and θ. Unfortunately, no previous research concerns these parameters, but most of our estimation results are statistically significant. In other words, household saving substitutes for corporate and government saving. Note, however, the values are very small, suggesting an extremely low degree of substitutability. These results support Edwards (1996).

6 Robustness Check

This study primarily focuses on the estimates of γ and θ. To check the robustness of our results, we repeated the analysis along three dimensions. First, we vary the value of μ from 0.002 to 0.05 by increments of 0.002 and repeat the analysis. As we conducted an empirical analysis by setting the value of μ exogenously in the previous section, it is important for us to reestimate Equation 15 by changing the the value of μ. Second, we also estimate Equation 15 using households' final consumption expenditures as an alternate measure of consumption. As Graham (1992) mentions, choosing the consumption measure is important because of its influence on the estimation results. Thsu, we exclusively adopt household's final consumption expenditures in place of households' final consumption expenditure as well as expenditures by non profit institutions serving households.[29] Third, we use all explanatory variables lagged two and three years as instruments. As mentioned, it is preferable to use all lagged values as instruments of explanatory variables, but in practice it causes finite sample bias. Therefore, as done previously, we dopt only deppendent variables lagged two or more periods as instruments, following Dahlberg and Johansson (2000). However, this way of dealing with the issue also presents the problem that the lagged variables of the all explanatory variables are not used. So, we use all explanatory variables lagged two and three years as instruments following Pozzi et al. (2004).

Tables 9, 10 and 11 show the results. Although some estimates take a negative values, these results further detail the degree of substitutability between household, corporate and government savings. In particular, estimates of θ, the coefficient of corporate saving, tends to be larger than those of γ, representing the coefficient of government saving. In other words, the degree of substitutability between household and corporate saving exceeds that between household and government saving. In addition, the degree of substitutability between household and government saving is extremely low. As Romer (2011) says, "the important question on Ricardian Equivalence Theorem is whether there are large departures from it." Our results suggest that the Ricardian equivalence attracts less support than is indicated inthe previous research, notably Bernheim (1987) and Masson et al. (1998).

7 Discussions

Based on the theoretical model in Section 3 and empirical results obtained in Section 5, we now further consider the relationships among savings by sectors in OECD countries.

[29] Although Graham (1992) indicates the importance of the consumption measure, his argument is not about the choice between household only or household plus non profit institutions but rather about the handling of the service flow from consumer durables. Checking the robustness on this point remains another important future task due to data availability.

7.1 Substitutability of Household and Corporate Savings

First, we re-examine the feasibility of the theoretical model with regard to the substitutability of household and corporate savings. The impact of corporate savings on household consumption (savings) is not large, but is significant in both cases. In other words, there is a slight possibility that in OECD countries it might present the theoretical model mechanism. Further in this paper, we deepen this discussion about the investigation of the economic environment that the theoretical model as well as factors other than the theoretical model.

For household and corporate savings to be substitutable, it is prerequisite that dividends and corporate savings correlate negatively.

Figure 2 shows the movements of dividend income(DIV) and corporate savings (both given as ratios of GDP) obtained by household sectors in the US, UK and Japan (it was difficult for other countries to obtain dividend series for the same periods). In the US, until the mid 1990s, high corporate savings were accumulated against the backdrop of a booming economy, and an increasing trend in dividends was maintained, reflecting strong corporate performance. However, in the latter half of the 1990s, dividend trends correlated negatively with corporate savings. Then, 2000s onwards, a positive correlation reappeared. In the UK, the two variables showed a negative correlation(-0.625) for the sample period. In Japan, where dividends to households were weak through the 1990s and early 2000s, corporate savings steadily increased, producing a negative correlation between the two variables(-0.100). However, from the early, from the early to the late 2000s, dividends and corporate savings showed roughly identical trends. Data from these three countries thus confirms the negative correlation between dividends and corporate savings assumed by the theoretical model, however, confirmation depends on the periods observed.

An effective stock market is also an important condition for establishment of the theoretical model. Determining stock market efficiency is an empirical problem, for which there are various empirical methods. The most typical is the use of time series analysis (unit root tests) to determine whether prices follow a random walk.

Narayan and Prasad (2007), and Narayan and Narayan (2007) conducted panel unit root tests, using samples from 17 European countries (January 1988–March 2003), and samples from the G7 (January 1975–April 2003) respectively, which supported the efficient market hypothesis. Narayan and Smyth (2005) further used daily data (1991–2003) of 22 OECD nations (including the G7), and performed unit root tests taking into account a one time structural change, and supported the random walk hypothesis for stock prices.

The mechanism that generates the negative correlation between corporate and household savings does not necessarily depend on rational long term behaviour of each economic agent, as shown above. For example, the suppression of wage growth can result, simultaneously, in both lower household disposable income and higher corporate profits that could cause negative correlation between corporate and household savings. The empirical analysis in Section 5 confirms that the impact of the liquidity constraint (λ) is significant. This means that disposable income and wages act on consumption and savings in the current fiscal period, thus requiring further attention to the significance of this effect.

Figure 3 shows the rate of change in nominal wages of households and corporate savings for OECD nations, as shown in Figure 1. As Figure 3 depicts, Canada, France, Japan and the US showing number of periods of negative correlation between household and corporate savings, but it is possible that the changes in nominal wages play an important role in this. For example, the growth rate of wages in France declined during the 1980s. During this period, household savings fell significantly while corporate savings recovered rapidly. No significant variations were observed in wage growth through the 1990s and 2000s, as a result, there has been no major movement in household and corporate savings. A similar trend can be observed in the US during the 1980s, and in Japan during the 1990s. On the other hand, Sweden, Norway and Finland witnessed no notable decrease in the growth rate of wages since the 1990s, rendering the effect of changes in wages on corporate savings and household savings unclear.

Besides mechanisms based on wage changes, factors generating a negative correlation between corporate and household savings can include economic agents' reactions to the economy's rapid deterioration. For example, corporate savings decline during a worsening recession, reflecting the decline in earnings. At the same time, economic uncertainty among households may stimulate precautionary savings. Finland and Sweden entered a deep recession during the early 1990s after the economic bubble collapsed in the late 1980s. As seen in Figure 3, corporate savings during this period stagnated and household savings increased rapidly, presumably for precautionary reasons, resulting in a negative relation between savings of these two sectors. This short term fluctuation functions as a substitute mechanism for savings by sectors.

7.2 Substitutability of Household and Government Savings

Estimated results in Section 5 assertain that the substitutability of household and government savings was extremely low.[30]

As discussed, the possibility of substitutability of savings by these two sectors relates closely to the formation of the Ricardian Equivalence Theorem. Extended empirical analysis has produced multiple results concerning that possibility, but analysis in recent years has been scattered, showing scepticism about formation of the theorem. For example, Rohn (2010) conduct panel and individual estimates for 16 OECD countries and six countries (Denmark, France, Germany, Italy, Japan and the US), and Hufner and Koske (2010) find no support to the Ricardian Equivalence Theorem in OECD countries other than the US and France. Generally, these empirical results support ours. In the event that government savings influence household consumption and savings, it is important to consider factors such as the current level of government savings and how to assess households' diachronic view of changes in tax policy. Even if cutting taxes reduces government savings, households' consumption for the period will increase because their disposal income increases if they do not anticipate future tax increases. Also, provided government savings do not sustain major deficits, it is unlikely that future tax increases or spending cuts will be

[30] Although not in panel context, Mukhopadhyay (1994) investigates the Ricardian Equivalence Theorem directly using self-reports of residents in Halifax, Canada. The results show that most hoseholds do not consider government budget deficits in deciding how much they save, concluding that the Ricardian Equivalence Theorem is not supported. Our extremely low estimates are consistent with his result.

expected. This issue thus requires further investigation.

8 Conclusion

This paper quantitatively analysed the substitutability of savings by sectors using panel data from OECD countries, producing two significant findings. First, household and corporate saving correlated negatively in most sampled OECD countries. We surmise that the negative correlation was somewhat explained by short-term and medium-term intertemporal rational behaviour by households and corporations, along with changes in wages and disposal income, but its effects were marginal. Second, there is no evident, clear relation between the substitutability of household and government saving. Our analysis suggested that the Ricardian Equivalence Theorem held to a degree, dependent on country specificity and observed time period, but analysis of the OECD countries as a whole indicated that prospects for the theorem to hold as being low. Most developed countries currently experience declining birthrate and ageing populations. The savings trend in every sector in such countries, particularly the down trend in household and government saving has drawn sholarly attention to its medium-term and long-term consequences. Most discussions are preoccupied with saving trends in individual sectors. If future analysis of substitutability between sectors proceeds in directions suggested by this article, more research will involve multifaceted angles. Further study is required to assess the impact of deteriorating government savings on private sector saving. For example, study of additional long-term issues such as the substitutability of saving by sectors and economic growth could revise and extend the theoretical framework of this analysis.

Based on results of this analysis, chances are high that decreased household saving, through numerous routes, is somewhat offset by corporate saving in OECD countries. Therefore, it is difficult to paint a scenario involving a large decrease in the saving rate for the overall private economy. However, developed countries' burgeoning government deficits and deteriorating budget balances are worrisome. National saving could decline if household or private saving does not offset government deficits. Extrapolating this trend suggests sustained budget deficits or lack of funds for saving or investing. This problem is serious, particularly for the US and Southern Europe. This problem cannot be ignored, especially when global imbalances show no indications of setting down. Further, for an in depth understanding of the global economy research into the substitutability of saving by sectors in emerging economies is essential. The mechanism of substitutability of saving by sectors may be critical in the macro performance of the global economy.

Data Appendix

We use annual data for 10 selected OECD countries: Canada, Finland, France, Germany, Italy, Japan, Norway, Sweden, the UK and the USA. Our sample period is 1980-2009. For some of the countries the sample period is shorter, so the panel is unbalanced. Recent data series are primarily taken from the OECD database(OECD.Stat). We cannot, however, find some past series of the variables. Therefore we also use the previous version of OECD books: National Accounts of OECD Countries Volume IIIa(Financial Accounts Flows 1995-2006), IIIb(Financial Balance Sheets Stocks 1995-2006), Detailed tables Volume II 1980-1992 and Detailed tables Volume II 1984-1996, etc. The retroaction of data to the past is conducted by using the growth rate of the older data sets. Consumer price index(CPI) is used to construct real values.

- Savings(S)
  Household saving(S^h), Corporation saving(S^f) and Government saving(S^g) are corresponding to household saving,net, corporation saving,net and government saving,net in OECD Annual National Accounts, respectively.

- Consumption(C)
  Final consumption expenditure of households and non profit institutions serving households

- labour Income after tax(WL)
  labour income after tax = compensation of employees minus personal current taxes. Personal current taxes are retrieved from OECD tax statistics.

- Household Disposal Income(YD)
  Dates are retrieved from Economic Outlook No.73 and No.86. The retroaction of data to the past is conducted by using the growth rate of the net national disposal income only for UK.

- Net Financial Wealth(W)
  While dates are mainly retrieved from OECD Financial Accounts, we use the other sources: Bonci and Coletta (2008) for Italy , Statistics Sweden for Sweden and The Blue Book for UK.

- Household dividend income(DIV)
  Japanese household dividend income is retrieved from the Cabinet Office web site. For the UK, distributed income of corporations from The Blue Book is used. For the USA, we use personal dividend income from National Income and Product Accounts(NIPA).

References

Adji, Artidiatun (2007) "Essays on Ricardian Equivalence," economics dissertations, Georgia State University.

Ahn, S.C. and Peter Schmidt (1999) "Modified Generalized Instrumental Variables Estimation of Panel Data Models with Strictly Exogenous Instrumental Variables," in Hsiao, Cheng, M. Hashem Pesaran, Kajal Lahiri, and Lung Fei Lee eds. *Analysis of Panels and Limited Dependent Variable Models*: Cambridge University Press, Chap. 7, pp. 171-198.

Alonso-Borrego, Cesar and Manuel Arellano (1999) "Symmetrically Normalized Instrumental-Variable Estimation Using Panel Data," *Jourrnal of Business and Economic Statistics*, Vol. 17, No. 1, pp. 36-49.

Arellano, Manuel (1989) "A Note on the Anderson-Hsiao Estimator for Panel Data," *Economics Letters*, Vol. 31, No. 4, pp. 337-341.

Arellano, Manuel and Stephen Roy Bond (1991) "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, Vol. 58, No. 2, pp. 277-297.

Baltagi, Badi H. (2008) *Econometric Analysis of Panel Data*: Wiley, 4th edition.

Bandiera, Oriana, Gerard Caprio, Patrick Honohan, and Fabio Schiantarelli (2000) "Does Financial Reform Raise or Reduce Saving?" *The Review of Economics and Statistics*, Vol. 82, No. 2, pp. 239-263.

Banerjee, Anindya, Massimiliano Marcellino, and Chiara Osbat (2004) "Some Cautions on the Use of Panel Methods for Integrated Series of Macroeconomic Data," *Econometrics Journal*, Vol. 7, No. 2, pp. 322-340.

Barro, Robert J. (1974) "Are Government Bonds Net Wealth?" *Journal of Political Economy*, Vol. 82, No. 6, pp. 1095-1117.

——— (1989) "The Ricardian Approach to Budget Deficits," *Journal of Economic Perspectives*, Vol. 3, No. 2, pp. 37-54.

Bernheim, B. Douglas (1987) "Ricardian Equivalence: An Evaluation of Theory and Evidence," in *NBER Macroeconomics Annual 1987, Volume 2*: National Bureau of Economic Research, Inc, pp. 263-316.

Berube, Gilles and Denise Cote (2000) "Long-Term Determinants of the Personal Savings Rate: Literature Review and Some Empirical Results for Canada," working papers, Bank of Canada.

Bhatia, Kul B. (1979) "Corporate taxation, retained earnings, and capital formation," *Journal of Public Economics*, Vol. 11, No. 1, pp. 123-134.

Bi, Huixin and Eric Leeper (2010) "Sovereign Debt Risk Premia and Fiscal Policy in Sweden," NBER Working Papers 15810, National Bureau of Economic Research, Inc.

Bonci, Ricardo and Massimo Coletta (2008) "Italy's Financial Accounts since 1950," in *Financial Accounts: History, Methods, the Case of Italy and International Comparisons*: Bank of Italy, Chap. 2, pp. 63-115.

Borsch-Supan, Axel (2002) "International Comparison of Household Savings Behaviour: The German Savings Puzzle," MEA discussion paper series 02006, Munich Center for the Economics of Aging (MEA) at the Max Planck Institute for Social Law and Social Policy.

Borsch-Supan, Axel, Anette Reil-Held, Ralf Rodepeter, Reinhold Schnabel, and Joachim Klaus Winter (2001) "The German Savings Puzzle," *Research in Economics*, Vol. 55, No. 1, pp. 15-38.

Brittle, Shane (2010) "Ricardian Equivalence and the Efficacy of Fiscal Policy in Australia," *Australian Economic Review*, Vol. 43, No. 3, pp. 254-269.

Buiter, Willem Hendrik and James Tobin (1979) "Debt Neutrality: A Brief Review of Doctrine and Evidence," in von Furstenberg, George M. ed. *Social security versus private saving*: Cambridge, Mass. : Ballinger Pub. Co. Chap. 2, pp. 39-63.

Carroll, Christopher and Lawrence H. Summers (1987) "Why have private savings rates in the United States and Canada diverged?" *Journal of Monetary Economics*, Vol. 20, No. 2, pp. 249-279.

Cebula, Richard J., Chao-Shun Hung, and Neela Manage (1996) "Ricardian equivalence, budget deficits, and saving in the United States, 1955:1-1991:4," *Applied Economics Letters*, Vol. 3, No. 8, pp. 525-528.

Cohn, Richard and Bharat R. Kolluri (2003) "Determinants of household saving in the G-7 countries: recent evidence," *Applied Economics*, Vol. 35, No. 10, pp. 1199-1208.

Dahlberg, Matz and Eva Johansson (2000) "An examination of the dynamic behaviour of local governments using GMM bootstrapping methods," *Journal of Applied Econometrics*, Vol. 15, No. 4, pp. 401-416.

David, Paul A. and John L Scadding (1974) "Private Savings: Ultrarationality, Aggregation, and "Denison's Law."," *Journal of Political Economy*, Vol. 82, No. 2, pp. 225-49.

Denison, Edward F. (1958) "A Note on Private Saving," *Review of Economics and Statistics*, Vol. 40, No. 3, pp. 261-267.

Domenech, Rafael, David Taguas, and Juan Varela (2000) "The Effects of Budget Deficit on National Saving in the OECD," *Economics Letters*, Vol. 69, No. 3, pp. 377-383.

Drakos, Kostas (2001) "Testing the Ricardian Equivalence Theorem: Time Series Evidence from Greece," *Journal of Economic Development*, Vol. 26, No. 1, pp. 149-160.

Edwards, Sebastian (1996) "Why are Latin America's savings rates so low? An international comparative analysis," *Journal of Development Economics*, Vol. 51, No. 1, pp. 5-44.

Eisner, Robert (1994) "National Saving and Budget Deficits," *The Review of Economics and Statistics*, Vol. 76, No. 1, pp. 181-86.

Elmendorf, Douglas W. and N. Gregory Mankiw (1999) "Government Debt," in Taylor, John B. and Michael Woodford eds. *Handbook of Macroeconomics (Handbooks in Economics, Vol 1c)*: North Holland, Chap. 25, pp. 1615-1669.

Evans, Paul and Georgios Karras (1996) "Private and Government Consumption with Liquidity Constraints," *Journal of International Money and Finance*, Vol. 15, No. 2, pp. 255-266.

——— (1998) "Liquidity Constraints and the Substitutability between Private and Government Consumption: The Role of Military and Non-military Spending," *Economic Inquiry*, Vol. 36, No. 2, pp. 203-214.

Feldstein, Martin S. (1973) "Tax incentives, corporate saving, and capital accumulation in the United States," *Journal of Public Economics*, Vol. 2, No. 2, pp. 159-171.

——— (1978) "Do private pensions increase national savings?" *Journal of Public Economics*, Vol. 10, No. 3, pp. 277-293.

Feldstein, Martin S. and George Fane (1973) "Taxes, Corporate Dividend Policy and Personal Savings: The British Postwar Experience," *The Review of Economics and Statistics*, Vol. 55, No. 4, pp. 399-411.

von Furstenberg, George M. (1981) "Saving," in Aaron, Henry J. ed. *How Taxes Affect Economic Behavior (Studies in Government Finance)*: Brookings Inst Pr, pp. 327-390.

Gali, Jordi, David Lopez-Salido, and Javier Valles (2007) "Understanding the Effects of Government Spending on Consumption," *Journal of the European Economic Association*, Vol. 5, No. 1, pp. 227-270.

Gengenbach, Christian, Franz C. Palm, and Jean-Pierre Urbain (2006) "Cointegration Testing in Panels with Common Factors," *Oxford Bulletin of Economics and Statistics*, Vol. 68, pp. 683-719.

Graham, Fred C. (1992) "On the importance of the measurement of consumption in tests of Ricardian equivalence," *Economics Letters*, Vol. 38, No. 4, pp. 431-434.

Gupta, Kanhaya L (1992) "Ricardian Equivalence and Crowding out in Asia," *Applied Economics*, Vol. 24, pp. 19-25.

Gutierrez, Luciano (2003) "On the Power of Panel Cointegration Tests: a Monte Carlo Comparison," *Economics Lettters*, Vol. 80, pp. 105-111.

Haque, Nadeem, Sunil Sharma, and M Hashem Pesaran (1999) "Neglected Heterogeneity and Dynamics in Cross-Country Savings Regressions," IMF Working Papers 99/128, International Monetary Fund.

Hayashi, Fumio (1982) "The Permanent Income Hypothesis: Estimation and Testing by Instrumental Variables," *Journal of Political Economy*, Vol. 90, No. 5, pp. 895-916.

Hendershott, Patric H. and Joe Peek (1987) "Private Saving in the United States: 1950-85," NBER Working Papers 2294, National Bureau of Economic Research, Inc.

Hondroyiannis, George (2006) "Private Saving Determinants in European Countries: A Panel Cointegration Approach," *Social Science Journal*, Vol. 43, pp. 553-569.

Hufner, Felix and Isabell Koske (2010) "Explaining Household Saving Rates in G7 Countries: Implications for Germany," OECD Economics Department Working Papers 754, OECD Publishing.

Im, Kyung So, M Hashem Pesaran, and Yongcheol Shin (2003) "Testing for Unit Roots in Heterogeneous Panels," *Journal of Econometrics*, Vol. 115, No. 1, pp. 53-74.

Iwaisako, Tokuo and Keiko Okada (2010) "Understanding the Decline in Japan's Saving Rate in the New Millennium," macroeconomics working papers, East Asian Bureau of Economic Research.

——— (2012) "Understanding the Decline in Japan's Saving Rate in the New Millennium," *Japan and the World Economy*, Vol. 24, pp. 163-173.

Jaeger, Albert (1993) "Debt, Finite Horizons, and Private Savings Behavior," in Verbon, Harrie A. A. ed. *The Political Economy of Government Debt*: Emerald Group Publishing, Chap. 9, pp. 195-205.

Jongwanich, Juthathip (2010) "The Determinants of Household and Private Savings in Thailand," *Applied Economics*, Vol. 42, No. 8, pp. 965-976.

Jonung, Lars, Jaakko Kiander, and Pentti Vartia eds. (2009) *The Great Financial Crisis in Finland and Sweden: The Nordic Experience of Financial Liberalization*: Edward Elgar Pub.

Kao, Chihwa (1999) "Spurious Regression and Residual-based Tests for Cointegration in Panel Data," *Journal of Econometrics*, Vol. 90, No. 1, pp. 1-44.

Karlsson, Sune and Mickael Lothgren (2000) "On the power and interpretation of panel unit root tests," *Economics Letters*, Vol. 66, No. 3, pp. 249-255.

Kessler, Denis, Sergio Perelman, and Pierre Pestieau (1993) "Savings Behavior in 17 OECD Countries," *Review of Income and Wealth*, Vol. 39, No. 1, pp. 37-49.

Keynes, John Maynard (1936) *The General Theory of Employment, Interest, and Money*: Prometheus Books, reprint edition.

Khalid, Ahmed M. (1996) "Ricardian equivalence: Empirical evidence from developing economies," *Journal of Development Economics*, Vol. 51, No. 2, pp. 413-432.

Kirsanova, Tatiana and James Sefton (2007) "A Comparison of National Saving Rates in the UK, US and Italy," *European Economic Review*, Vol. 51, No. 8, pp. 1998-2028.

Krugman, Paul R. (2012) *End This Depression Now!*: W W Norton & Co Inc.

Laibson, David Isaac (1997) "Golden Eggs and Hyperbolic Discounting," *The Quarterly Journal of Economics*, Vol. 112, No. 2, pp. 443-77.

Leiderman, Leonardo and Mario I. Blejer (1988) "Modeling and Testing Ricardian Equivalence: A Survey," *IMF Staff Papers*, Vol. 35, No. 1, pp. 1-35.

Leiderman, Leonardo and Assaf Razin (1988) "Testing Ricardian Neutrality with an Intertemporal Stochastic Model," *Journal of Money, Credit and Banking*, Vol. 20, pp. 1-21.

Loayza, Norman V., Klaus Schmidt-Hebbel, and Luis Serven (2000) "What Drives Private Saving Across the World?" *The Review of Economics and Statistics*, Vol. 82, No. 2, pp. 165-181.

Lopez, Humberto, Klaus Schmidt-Hebbel, and Luis Serven (2000) "How Effective is Fiscal Policy in Raising National Saving?" *The Review of Economics and Statistics*, Vol. 82, No. 2, pp. 226-238.

Malengier, G. and L. Pozzi (2004) "Examining Ricardian Equivalence by estimating and bootstrapping a nonlinear dynamic panel model," working papers of faculty of economics and business administration, ghent university, belgium, Ghent University, Faculty of Economics and Business Administration.

Masson, Paul Robert, Tamim A Bayoumi, and Hossein Samiei (1998) "International Evidence on the Determinants of Private Saving," *World Bank Economic Review*, Vol. 12, No. 3, pp. 483-501.

de Mello, Luiz, Per Mathis Kongsrud, and Robert Price (2004) "Saving Behaviour and the Effectiveness of Fiscal Policy," OECD Economics Department Working Papers 397, OECD Publishing.

Miller, Merton H. and Franco Modigliani (1958) "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, Vol. 48, No. 3, pp. 261-297.

Monogios, Yannis A. and Christos Pitelis (2004) "On (Ultra) rationality and the corporate and government veils," *Manchester School*, Vol. 72, No. 3, pp. 382-402.

Mukhopadhyay, Arun K. (1994) "Are Haligonians Ricardian? A survey of households' saving response to the government's budget deficits," *The Journal of Socio-Economics*, Vol. 23, No. 4, pp. 457-477.

Narayan, Paresh Kumar and Seema Narayan (2007) "Mean reversion in stock prices: new evidence from panel unit root tests," *Studies in Economics and Finance*, Vol. 24, No. 3, pp. 233-244.

Narayan, Paresh Kumar and Arti Prasad (2007) "Mean Reversion in Stock Prices: New Evidence from Panel Unit Root Tests for Seventeen European Countries," *Economics Bulletin*, Vol. 3, No. 34, pp. 1-6.

Narayan, Paresh Kumar and Russell Smyth (2005) "Are OECD stock prices characterized by a random walk? Evidence from sequential trend break and panel data models," *Applied Financial Economics*, Vol. 15, No. 8, pp. 547-556.

Obstfeld, Maurice and Kenneth S. Rogoff (1996) *Foundations of International Macroeconomics*: The MIT Press.

Pedroni, Peter (1999) "Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors," *Oxford Bulletin of Economics and Statistics*, Vol. 61, No. 0, pp. 653-70.

——— (2004) "Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis," *Econometric Theory*, Vol. 20, pp. 597-625.

Persyn, Damiaan and Joakim Westerlund (2008) "Error-Correction-Based Cointegration Tests for Panel Data," *Stata Journal*, Vol. 8, No. 2, pp. 232-241.

Pitelis, Christos (1987) "Corporate Retained Earnings and Personal Sector Saving: A Test of the Life-Cycle Hypothesis of Saving," *Applied Economics*, Vol. 19, pp. 907-913.

Poterba, James (1987) "Tax Policy and Corporate Saving," *Brookings Papers on Economic Activity*, Vol. 18, No. 2, pp. 455-516.

Pozzi, Lorenzo (2003) "Tax Discounting in a High-debt Economy," *Oxford Bulletin of Economics and Statistics*, Vol. 65, No. 3, pp. 261-282.

Pozzi, Lorenzo, Freddy Heylen, and Maarten Dossche (2004) "Government Debt and Excess Sensitivity of Private Consumption: Estimates from OECD Countries," *Economic Inquiry*, Vol. 42, No. 4, pp. 618-633.

Pozzi, Lorenzo and Griet Malengier (2007) "Certainty Equivalence and the Excess Sensitivity of Private Consumption," *Journal of Money, Credit and Banking*, Vol. 39, No. 7, pp. 1839-1848.

Reitschuler, Gerhard (2008) "Assessing Ricardian equivalence for the New Member States: Does debt-neutrality matter?" *Economic Systems*, Vol. 32, No. 2, pp. 119-128.

Ricciuti, Roberto (2003) "Assessing Ricardian Equivalence," *Journal of Economic Surveys*, Vol. 17, No. 1, pp. 55-78.

Rohn, Oliver (2010) "New Evidence on the Private Saving Offset and Ricardian Equivalence," OECD Economics Department Working Papers 762, OECD Publishing.

Romer, David (2011) *Advanced Macroeconomics (The Mcgraw-Hill Series in Economics)*: McGraw-Hill/Irwin, 4th edition.

Sachs, Jeffrey D. and Felipe B. Larrain (1993) *Macroeconomics in the Global Economy*: Prentice Hall.

Sarantis, Nicholas and Chris Stewart (2001) "Saving Behaviour in OECD Countries: Evidence from Panel Cointegration Tests," *Manchester School*, Vol. 69, No. 0, pp. 22-41.

Seater, John J. (1993) "Ricardian Equivalence," *Journal of Economic Literature*, Vol. 31, No. 1, pp. 142-90.

Tauchen, George (1986) "Statistical Properties of Generalized Method-of-Moments Estimators of Structural Parameters Obtained from Financial Market Data: Reply," *Journal of Business & Economic Statistics*, Vol. 4, No. 4, pp. 397-416.

Thornton, John (1998) "Corporate Taxes and Household Saving: Panel Evidence From Five OECD Countries," *Economia Internazionale / International Economics*, Vol. 51, No. 2, pp. 279-283.

Westerlund, Joakim (2007) "Testing for Error Correction in Panel Data," *Oxford Bulletin of Economics and Statistics*, Vol. 69, No. 6, pp. 709-748.

Windmeijer, Frank (2005) "A finite sample correction for the variance of linear efficient two-step GMM estimators," *Journal of Econometrics*, Vol. 126, No. 1, pp. 25-51.

Table 1: Coefficients of Variation in Savings by Sectors(as % of GDP)

Country	Period	(1) Household	(2) Corporation	(3) Private	(3)/(1)	(3)/(2)	(4) Government
Canada	1980-2009	0.625	0.636	0.268	0.429	0.421	1.537
Finland	1980-2009	1.347	1.136	0.686	0.509	0.604	1.351
France	1980-2009	0.174	1.480	0.155	0.891	0.105	0.927
Germany	1991-2009	0.094	0.953	0.175	1.862	0.184	0.872
Italy	1980-2009	0.500	1.735	0.521	1.042	0.300	0.680
Japan	1980-2009	0.504	0.453	0.205	0.407	0.453	78.026
Norway	1980-2009	0.885	0.334	0.356	0.402	1.066	0.651
Sweden	1980-2009	0.908	0.446	0.395	0.435	0.886	39.153
UK	1980-2009	1.062	0.741	0.346	0.326	0.467	1.538
USA	1980-2009	0.436	0.262	0.262	0.601	1.000	0.886

Notes: Source: SourceOECD.

Table 2: Panel Unit root tests for Savings by Sectors-Im, Pesaran and Shin(IPS)

Variable	Country Group							
	Sample I				Sample II			
	Level		First difference		Level		First difference	
	Statistics	p-value	Statistics	p-value	Statistics	p-value	Statistics	p-value
per GDP								
Government	0.1823	0.5723	-3.6669^{**}	0.0001	-0.2125	0.4158	-4.4659^{**}	0.0000
Household	-0.7924	0.2141	-2.2933^{*}	0.0109	-1.2162	0.1120	-4.0426^{**}	0.0000
Corporation	-2.0744^{*}	0.0190	-3.4694^{**}	0.0003	-2.5568^{**}	0.0053	-4.7663^{**}	0.0000
per capita, nominal								
Government	2.1881	0.9857	-2.7065^{**}	0.0034	1.9057	0.9717	-3.5650^{**}	0.0002
Household	0.3663	0.6429	-2.0470^{*}	0.0203	0.6630	0.7463	-4.3979^{**}	0.0000
Corporation	-0.0082	0.4967	-3.2061^{**}	0.0007	0.3229	0.6266	-4.8890^{**}	0.0000
per capita, real								
Government	1.0664	0.8569	-3.2625^{**}	0.0006	0.7200	0.7642	-4.1138^{**}	0.0000
Household	0.5601	0.7123	-2.0071^{*}	0.0224	0.4345	0.6680	-4.0178^{**}	0.0000
Corporation	-0.9779	0.1641	-3.2307^{**}	0.0006	-0.9703	0.1659	-4.6302^{**}	0.0000

1. $*$, $**$ indicate 5% and 1% significance, respectively.
2. A constant is included for variables in levels and in first differences. In all these tests, the lag length is set to 3.

Table 3: Kao and Pedroni Panel Cointegration Tests for Savings by Sectors

(No intercept no trend)

	Sample I						Sample II					
	Kao		Pedroni				Kao		Pedroni			
			No intercept no trend						No intercept no trend			
			Within dimension		Between dimension				Within dimension		Between dimension	
Series	ADF	p-value	ADF	p-value	ADF	p-value	ADF	p-value	ADF	p-value	ADF	p-value
per GDP												
(Government, Household)	-0.8146	0.2077	$-1.2830^{\dagger}$	0.0997	-2.3974^{**}	0.0083	-2.7251^{**}	0.0032	-2.7869^{**}	0.0027	-3.3126^{**}	0.0005
(Household, Corporation)	-1.1819	0.1186	-1.0911	0.1376	-1.2174	0.1117	-2.2465^{*}	0.0123	$-1.4129^{\dagger}$	0.0788	-2.1779^{*}	0.0147
(Government, Corporation)	-1.2407	0.1074	-1.4366^{**}	0.0754	-1.8365^{*}	0.0331	-2.6722^{**}	0.0038	-2.4672^{**}	0.0068	-2.9926^{**}	0.0014
(Government, Household, Corporation)	-0.3656	0.3573	-2.6007^{**}	0.0047	-3.5290^{**}	0.0002	-2.8580^{**}	0.0021	-1.7995^{*}	0.0360	-3.3797^{**}	0.0004
per capita, nominal												
(Government, Household)	-4.2886^{**}	0.0000	2.6117	0.9955	$-1.4327^{\dagger}$	0.0760	-4.9677^{**}	0.0000	2.3186	0.9898	-2.9694^{**}	0.0015
(Household, Corporation)	-2.5748^{**}	0.0050	-0.8856	0.1879	-0.0016	0.4994	-1.7233^{*}	0.0424	-1.0548	0.1457	-1.1522	0.1248
(Government, Corporation)	-3.8001^{**}	0.0001	1.6491	0.9504	$-1.2908^{\dagger}$	0.0984	-3.3537^{**}	0.0004	1.7577	0.9606	-2.5158^{**}	0.0059
(Government, Household, Corporation)	-4.5042^{**}	0.0000	-2.4068^{**}	0.0080	-2.3907^{**}	0.0084	-4.9817^{**}	0.0000	-2.8306^{**}	0.0023	-2.8846^{**}	0.0020
per capita, real												
(Government, Household)	-4.7113^{**}	0.0000	2.5728	0.9950	-1.7831^{*}	0.0373	-5.4798^{**}	0.0000	2.3288	0.9901	-3.1039^{**}	0.0010
(Household, Corporation)	-3.6084^{**}	0.0002	-1.0035	0.1578	-0.5082	0.3057	-2.2568^{*}	0.0120	-1.1950	0.1161	$-1.5781^{\dagger}$	0.0573
(Government, Corporation)	-3.4308^{**}	0.0003	0.7906	0.7854	$-1.4409^{\dagger}$	0.0748	-3.3220^{**}	0.0004	0.7912	0.7856	-2.4940^{**}	0.0063
(Government, Household, Corporation)	-4.4991^{**}	0.0000	-2.2403^{*}	0.0125	-3.0670^{**}	0.0011	-3.4836^{**}	0.0002	-2.6046^{**}	0.0046	-3.2360^{**}	0.0006

Notes: $\dagger$, $*$ and $**$ indicate 10%, 5% and 1% significance, respectively.

Table 4: Kao and Pedroni Panel Cointegration Tests for Savings by Sectors

(Intercept no trend)

	Sample I						Sample II					
	Kao		Pedroni				Kao		Pedroni			
			Intercept no trend						Intercept no trend			
			Within dimension		Between dimension				Within dimension		Between dimension	
Series	ADF	p-value	ADF	p-value	ADF	p-value	ADF	p-value	ADF	p-value	ADF	p-value
per GDP												
(Government, Household)	-0.8146	0.2077	-1.8301^{*}	0.0336	-2.4424^{**}	0.0073	-2.7251^{**}	0.0032	-0.8398	0.2005	-2.0823^{*}	0.0187
(Household, Corporation)	-1.1819	0.1186	-0.1763	0.4300	-0.7051	0.2404	-2.2465^{*}	0.0123	-0.6585	0.2551	$-1.6417^{\dagger}$	0.0503
(Government, Corporation)	-1.2407	0.1074	$-1.3321^{\dagger}$	0.0914	-2.0582^{*}	0.0198	-2.6722^{**}	0.0038	-1.8156^{*}	0.0347	-2.6180^{**}	0.0044
(Government, Household, Corporation)	-0.3656	0.3573	-1.7936^{*}	0.0364	-1.8539^{*}	0.0319	-2.8580^{**}	0.0021	-0.6894	0.2453	-1.6660^{*}	0.0479
per capita, nominal												
(Government, Household)	-4.2886^{**}	0.0000	-1.2571	0.1044	-1.9431^{*}	0.0260	-4.9677^{**}	0.0000	$-1.4737^{\dagger}$	0.0703	-2.5622^{**}	0.0052
(Household, Corporation)	-2.5748^{**}	0.0050	-3.3019^{**}	0.0005	-0.3921	0.3475	-1.7233^{*}	0.0424	-3.8989^{**}	0.0000	-0.8456	0.1989
(Government, Corporation)	-3.8001^{**}	0.0001	-2.0486^{*}	0.0203	-2.4215^{**}	0.0077	-3.3537^{**}	0.0004	-2.6102^{**}	0.0045	-3.2076^{**}	0.0007
(Government, Household, Corporation)	-4.5042^{**}	0.0000	$-1.4695^{\dagger}$	0.0709	-1.7615^{*}	0.0391	-4.9817^{**}	0.0000	-1.8135^{*}	0.0349	-2.0658^{*}	0.0194
per capita, real												
(Government, Household)	-4.7113^{**}	0.0000	$-1.5083^{\dagger}$	0.0657	-2.0025^{*}	0.0226	-5.4798^{**}	0.0000	$-1.6200^{\dagger}$	0.0526	-2.3325^{**}	0.0098
(Household, Corporation)	-3.6084^{**}	0.0002	-5.5801^{**}	0.0000	0.4102	0.6592	-2.2568^{*}	0.0120	-6.4527^{**}	0.0000	-0.2927	0.3849
(Government, Corporation)	-3.4308^{**}	0.0003	-1.7078^{*}	0.0438	-1.9408^{*}	0.0261	-3.3220^{**}	0.0004	-2.1974^{*}	0.0140	-2.8944^{**}	0.0019
(Government, Household, Corporation)	-4.4991^{**}	0.0000	$-1.4539^{\dagger}$	0.0730	-2.5580^{**}	0.0053	-3.4836^{**}	0.0002	-1.7844^{*}	0.0372	-2.6947^{**}	0.0035

Notes: $\dagger$, $*$ and $**$ indicate 10%, 5% and 1% significance, respectively. The Kao (1999) test results are the same as those in Figure 3

Table 5: Westerlund Panel Cointegration Tests for Savings by Sectors

	Sample I				Sample II			
Series	G_τ	G_α	P_τ	P_α	G_τ	G_α	P_τ	P_α
per GDP								
(Government, Household)	-2.561^{*}	-6.972	-6.337^{*}	$-6.321^{\dagger}$	-2.280^{*}	-6.117	-4.680	-3.978
p-value	(0.011)	(0.533)	(0.006)	(0.106)	(0.039)	(0.724)	(0.459)	(0.571)
Robust p-value	(0.015)	(0.168)	(0.013)	(0.058)	(0.025)	(0.258)	(0.443)	(0.338)
(Household, Corporation)	-1.716	-7.107	-4.815	-6.050	-1.901	$-7.749^{\dagger}$	-6.037	$-5.986^{\dagger}$
p-value	(0.572)	(0.507)	(0.161)	(0.139)	(0.331)	(0.362)	(0.071)	(0.106)
Robust p-value	(0.478)	(0.180)	(0.248)	(0.128)	(0.235)	(0.085)	(0.163)	(0.095)
(Government, Corporation)	-2.169	-6.351	$-5.475^{\dagger}$	$-5.710^{\dagger}$	-1.882	-5.856	-4.789	-4.629
p-value	(0.125)	(0.650)	(0.049)	(0.189)	(0.357)	(0.773)	(0.416)	(0.388)
Robust p-value	(0.145)	(0.208)	(0.090)	(0.085)	(0.218)	(0.233)	(0.385)	(0.168)
(Government, Household, Corporation)	-1.759	-7.709	-5.117	-7.055	-1.756	-8.224	-4.582	-4.962
p-value	(0.786)	(0.725)	(0.286)	(0.287)	(0.831)	(0.675)	(0.791)	(0.695)
Robust p-value	(0.570)	(0.225)	(0.265)	(0.128)	(0.545)	(0.135)	(0.603)	(0.373)
per capita, nominal								
(Government, Household)	-3.004^{**}	-10.546^{*}	-6.381	$-9.590^{\dagger}$	-2.400^{*}	-8.026^{*}	-6.332	-7.432
p-value	(0.000)	(0.049)	(0.005)	(0.001)	(0.014)	(0.304)	(0.039)	(0.011)
Robust p-value	(0.003)	(0.010)	(0.203)	(0.088)	(0.023)	(0.043)	(0.348)	(0.170)
(Household, Corporation)	-1.058	-2.844	-5.138	-6.310	-1.269	-3.247	-6.252	-6.383
p-value	(0.983)	(0.982)	(0.094)	(0.108)	(0.963)	(0.988)	(0.046)	(0.063)
Robust p-value	(0.910)	(0.945)	(0.385)	(0.418)	(0.880)	(0.948)	(0.333)	(0.385)
(Government, Corporation)	-2.574	-7.617	-3.357	-4.804	-2.381	-8.110	-4.097	-4.996
p-value	(0.009)	(0.409)	(0.683)	(0.366)	(0.017)	(0.287)	(0.686)	(0.293)
Robust p-value	(0.013)	(0.058)	(0.620)	(0.340)	(0.023)	(0.030)	(0.610)	(0.323)
(Government, Household, Corporation)	-0.972	-1.864	-3.069	-2.717	-1.146	-3.302	-3.780	-2.846
p-value	(0.999)	(0.999)	(0.922)	(0.932)	(0.999)	(0.998)	(0.944)	(0.956)
Robust p-value	(0.958)	(0.993)	(0.718)	(0.780)	(0.965)	(0.980)	(0.748)	(0.815)
per capita, real								
(Government, Household)	-2.808^{*}	$-8.260^{\dagger}$	-6.782	-8.224	-2.422^{**}	-6.876	-7.088	-7.002
p-value	(0.001)	(0.294)	(0.002)	(0.009)	(0.012)	(0.561)	(0.006)	(0.024)
Robust p-value	(0.010)	(0.050)	(0.168)	(0.140)	(0.018)	(0.148)	(0.208)	(0.190)
(Household, Corporation)	-1.507	-7.497	-5.477	$-14.768^{\dagger}$	-1.557	-6.711	-6.539	-13.468^{*}
p-value	(0.787)	(0.432)	(0.049)	(0.000)	(0.781)	(0.599)	(0.024)	(0.000)
Robust p-value	(0.662)	(0.143)	(0.280)	(0.055)	(0.598)	(0.225)	(0.268)	(0.035)
(Government, Corporation)	$-2.387^{\dagger}$	-7.126	-2.348	-3.604	-2.282^{*}	-7.507^{*}	-2.986	-3.865
p-value	(0.036)	(0.503)	(0.932)	(0.646)	(0.038)	(0.416)	(0.945)	(0.603)
Robust p-value	(0.053)	(0.105)	(0.740)	(0.483)	(0.020)	(0.043)	(0.723)	(0.438)
(Government, Household, Corporation)	-2.052	$-9.159^{\dagger}$	-10.478^{*}	$-16.589^{\dagger}$	-1.926	$-9.048^{\dagger}$	-12.361^{*}	$-16.655^{\dagger}$
p-value	(0.481)	(0.494)	(0.000)	(0.000)	(0.646)	(0.515)	(0.000)	(0.000)
Robust p-value	(0.323)	(0.063)	(0.028)	(0.083)	(0.415)	(0.050)	(0.018)	(0.063)

Notes: Westerlund (2007) investigates panel cointegration tests for the null hypothesis that there is no cointegration. The tests are implemented with a constant. The lag length and the Bartlett kernel window width are set to one. All calculations are done using the STATA command 'xtwest'(see Persyn and Westerlund (2008)). The robust p-values, which are robust against cross-sectional dependence, are based on 400 bootstrap replications. $\dagger$, $*$ and $**$ indicate 10%, 5% and 1% significance based on the robust p-value, respectively.

Table 6: Estimated Parameters of the Model

Sample	Sample I						Sample II					
Parameter	$\mu = 0.05$		$\mu = 0.01$		$\mu = 0.001$		$\mu = 0.05$		$\mu = 0.01$		$\mu = 0.001$	
α	0.0175**	0.0199**	0.0137**	0.0106**	0.0121**	0.0132**	0.0061**	0.0050**	0.0084**	0.0065**	0.0063**	0.0049**
	(0.0001)	(0.0027)	(0.0004)	(0.0002)	(0.0002)	(0.0006)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0011)	(0.0002)
λ	0.4682**	0.4991**	0.4905**	0.4547**	0.4697**	0.4674**	0.1931**	0.1697**	0.2078**	0.2203**	0.2159**	0.2202**
	(0.0014)	(0.0145)	(0.0108)	(0.0019)	(0.0004)	(0.0041)	(0.0003)	(0.0011)	(0.0001)	(0.0001)	(0.0039)	(0.0006)
γ		0.0037**		0.0152**		0.0024		0.0332**		0.0110**		0.0288**
		(0.0036)		(0.0024)		(0.0061)		(0.0015)		(0.0002)		(0.0024)
θ	0.0377**	0.0186**	0.0406**	0.0106**	0.0061**	0.0419**	0.0215**	0.0104**	0.0352**	0.0183**	0.0096	0.0250**
	(0.0052)	(0.0064)	(0.0107)	(0.0003)	(0.0010)	(0.0125)	(0.0001)	(0.0017)	(0.0013)	(0.0014)	(0.0083)	(0.0010)
Sargan	187.5340	98.6945	196.0871	107.7829	147.8678	165.8652	229.3874†	153.5458	229.7976†	213.1332	221.3138	154.6683
p-value	0.3348	0.9999	0.1952	0.9999	0.9616	0.7506	0.0986	0.9953	0.0953	0.2819	0.1798	0.9943

Notes: This table reports the two-step GMM point estimates. †, $*$ and $**$ indicate 10%, 5% and 1% significance, respectively. Standard errors are in parentheses. As is well known, the asymptotic standard errors of the two-stemp GMM estimator are underestimated in small samples. Therefore, we usually use the corrected standard errors proposed by Windmeijer (2005). However, as stated by Pozzi and Malengier (2007), the method proposed by Windmeijer (2005) is only available for linear model. As a result, we report the uncorrected standard errors.

Table 7: The Proportion of Liquidity-Constrained Households by Evans and Karras(1996,1998)

	Evans and Karras (1996)	Evans and Karras (1998)
	sample period	
country	1950-1990	1970-1989
Canda	0.32	0.44
France	0.27	0.40
Germany	0.35	0.39
Italy	0.46	0.43
Japan	0.49	0.23
UK	0.79	0.58
USA	0.52	0.54
Finland	0.24	0.30
Norway	0.66	0.22
Sweden	-0.20	0.49
corresponding to our	mean	
Sample I	0.46	0.39
Sample II	0.39	0.43

Notes: This table summarizes the estimation results by Evans and Karras(1996,1998). We caluclate the mean values. Sample I includes Canada, France, Germany, Italy, Japan, UK and USA. Sample II includes those in Sample I plus Finland, Norway and Sweden.

Table 8: Average Government Debt(as % of GDP)

country	Net	Gross
Canda	41.37	76.79
France	43.02	47.59
Germany	42.20	59.17
Italy	94.93	107.42
Japan	42.61	110.66
UK	38.15	43.59
USA	44.06	62.49
Finland	-105.48	33.36
Norway	-54.96	41.02
Sweden	6.50	57.34
	mean	
G7(Sample I)	49.48	72.53
Three Nordic countries	-51.31	43.91

Source: IMF World Economic Outlook Database.

Notes: Average value was calculated over 1980-2009 for Canada, France, Japan, UK, US, Finland and Norwy, 1991-2009 for Germany, 1988-2009 for Italy and 1992-2009 for Sweden.

Table 9: The Robustness Check on Estimates of γ and θ

	Sample I				Sample II			
μ	γ		θ		γ		θ	
0.002	-0.0091	(0.0081)	0.0415**	(0.0070)	0.0295**	(0.0000)	0.0248**	(0.0001)
0.004	0.0410**	(0.0004)	0.0068**	(0.0000)	0.0061	(0.0068)	0.0415**	(0.0156)
0.006	0.0027	(0.0093)	0.0422**	(0.0132)	0.0194**	(0.0006)	0.0144*	(0.0061)
0.008	0.0137**	(0.0001)	0.0341**	(0.0024)	0.0177**	(0.0010)	0.0201**	(0.0013)
0.010	0.0152**	(0.0024)	0.0106**	(0.0003)	0.0110**	(0.0002)	0.0183**	(0.0015)
0.012	0.0126**	(0.0005)	0.0417**	(0.0020)	0.0068**	(0.0001)	0.0179**	(0.0001)
0.014	0.0278**	(0.0066)	0.0115**	(0.0039)	0.0002	(0.0007)	0.0156*	(0.0066)
0.016	0.0026	(0.0038)	0.0412**	(0.0087)	-0.0015	(0.0019)	0.0137**	(0.0009)
0.018	0.0164**	(0.0009)	0.0517**	(0.0180)	-0.0030	(0.0026)	0.0132**	(0.0005)
0.020	0.0180**	(0.0000)	0.0106**	(0.0002)	0.0102†	(0.0054)	0.0141**	(0.0009)
0.022	0.0064†	(0.0035)	0.0469**	(0.0007)	0.0094	(0.0059)	0.0147**	(0.0006)
0.024	0.0062**	(0.0000)	0.0430**	(0.0076)	0.0182**	(0.0000)	-0.0124^{**}	(0.0000)
0.026	0.0149**	(0.0000)	0.0550**	(0.0006)	0.0162**	(0.0005)	0.0146	(0.0128)
0.028	0.0067**	(0.0023)	0.0515**	(0.0015)	0.0123**	(0.0002)	0.0146**	(0.0001)
0.030	0.0121**	(0.0005)	0.0345**	(0.0088)	0.0269**	(0.0066)	0.0377*	(0.0151)
0.032	0.0052**	(0.0006)	0.0480**	(0.0000)	0.0046	(0.0097)	0.0445*	(0.0176)
0.034	0.0136**	(0.0002)	0.0522**	(0.0001)	0.0394	(0.0631)	0.0659	(0.0654)
0.036	0.0079**	(0.0001)	0.0399**	(0.0001)	0.1288	(0.1451)	0.1475**	(0.0000)
0.038	0.0134**	(0.0000)	0.0495**	(0.0002)	0.0344**	(0.0012)	-0.0133^{**}	(0.0001)
0.040	0.0105**	(0.0021)	0.0459**	(0.0013)	0.0045	(0.0095)	0.0443**	(0.0157)
0.042	0.0026	(0.0062)	0.0416**	(0.0000)	0.0020**	(0.0000)	0.0112**	(0.0000)
0.044	0.0115**	(0.0007)	0.0451**	(0.0009)	0.0349**	(0.0063)	0.0530**	(0.0142)
0.046	0.0119**	(0.0000)	0.0451**	(0.0000)	0.0277**	(0.0000)	0.0483**	(0.0006)
0.048	0.0145**	(0.0001)	0.0137**	(0.0024)	0.0321**	(0.0000)	0.0193**	(0.0002)
0.050	0.0037	(0.0036)	0.0186**	(0.0064)	0.0332**	(0.0015)	0.0104**	(0.0018)

Notes: This table reports the estimates of γ and θ when the value of μ is set from 0.002 to 0.050.

Table 10: Estimated Parameters of the Model for Final Consumption Expenditure of Households

Sample	Sample I						Sample II					
Parameter	$\mu = 0.05$		$\mu = 0.01$		$\mu = 0.001$		$\mu = 0.05$		$\mu = 0.01$		$\mu = 0.001$	
α	0.0199**	0.0217**	0.0144**	0.0114**	0.0124**	0.0117**	0.0092**	0.0062*	0.0160**	0.0175**	0.0173**	0.0164**
	(0.0003)	(0.0008)	(0.0000)	(0.0014)	(0.0000)	(0.0001)	(0.0012)	(0.0026)	(0.0000)	(0.0003)	(0.0042)	(0.0000)
λ	0.4413**	0.4335**	0.4492**	0.4628**	0.4069**	0.4733**	0.1731**	0.2433**	0.2140**	0.1834**	0.2205**	0.1896**
	(0.0014)	(0.0038)	(0.0022)	(0.0055)	(0.0001)	(0.0040)	(0.0055)	(0.0124)	(0.0000)	(0.0003)	(0.0042)	(0.0000)
γ		0.0091**		0.0027		0.0173**		0.0031		0.0058**		0.0062**
		(0.0015)		(0.0103)		(0.0000)		(0.0184)		(0.0000)		(0.0000)
θ	0.0331**	0.0111**	0.0114**	0.0430*	0.0055**	0.0048**	0.0429**	0.0447†	0.0467**	0.0414**	0.0430**	0.0525**
	(0.0020)	(0.0023)	(0.0002)	(0.0169)	(0.0000)	(0.0002)	(0.0146)	(0.0242)	(0.0000)	(0.0003)	(0.0015)	(0.0001)
Sargan	144.7836	147.3170	197.7251*	111.6396	116.6281	232.4780**	179.4825	172.0175	80.3643	263.5456†	111.6258	157.4928
p-value	0.7487	0.9599	0.0153	1.0000	0.9933	0.0044	0.9956	0.9986	1.0000	0.0696	1.0000	0.9999

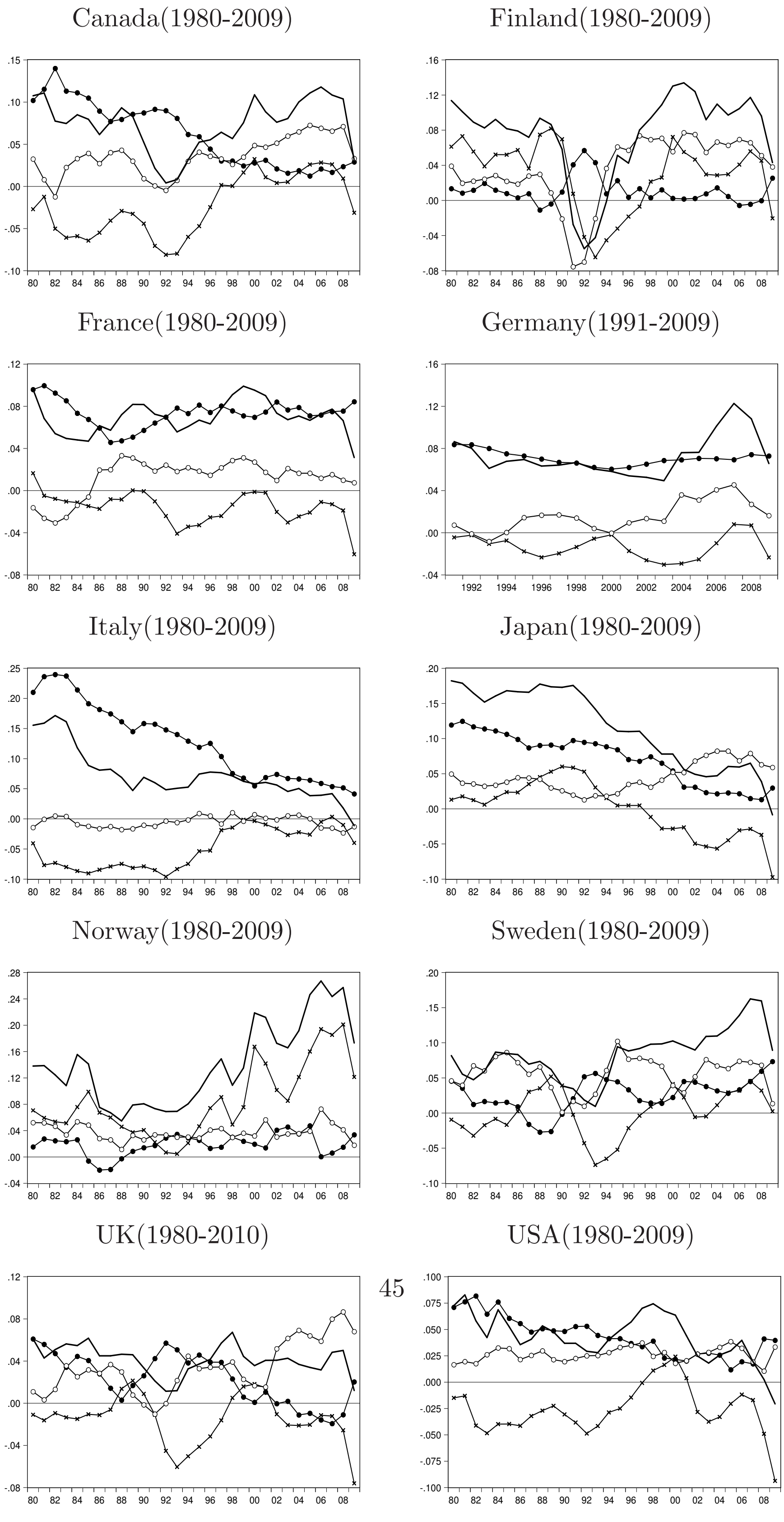
Notes: This table reports the two-step GMM point estimates. †, $*$ and $**$ indicate 10%, 5% and 1% significance, respectively. Standard errors are in parentheses. As is well known, the asymptotic standard errors of the two-stemp GMM estimator are underestimated in small samples. Therefore, we usually use the corrected standard errors proposed by Windmeijer (2005). However, as stated by Pozzi and Malengier (2007), the method proposed by Windmeijer (2005) is only available for linear model. As a result, we report the uncorrected standard errors.

Table 11: Estimated Parameters of the Model Using Additional Instrumental Variables

Sample	Sample I						Sample II					
Parameter	$\mu = 0.05$		$\mu = 0.01$		$\mu = 0.001$		$\mu = 0.05$		$\mu = 0.01$		$\mu = 0.001$	
α	0.0509**	0.0445**	-0.0202	0.0974**	0.0168**	0.0630**	0.0068**	0.0142**	0.0024**	0.0030**	0.0064**	0.0018**
	(0.0000)	(0.0020)	(0.0000)	(0.0000)	(0.0007)	(0.0004)	(0.0009)	(0.0000)	(0.0002)	(0.0006)	(0.0002)	(0.0001)
λ	0.6790**	0.7797**	0.3147**	0.3904**	0.5697**	0.5773**	0.2501**	0.2644**	0.2250**	0.2165**	0.2114**	0.1696**
	(0.0001)	(0.0115)	(0.0003)	(0.0000)	(0.0014)	(0.0055)	(0.0108)	(0.0001)	(0.0052)	(0.0025)	(0.0008)	(0.0006)
γ		0.0073*		0.0097*		0.0010*		0.0053*		0.0491*		0.0769*
		(0.0029)		(0.0000)		(0.0000)		(0.0003)		(0.0151)		(0.0029)
θ	0.0031*	0.0465*	0.0227*	0.0244*	0.0235*	0.0387*	0.0453*	0.0465*	0.0522*	0.0400*	0.0204	0.0614*
	(0.0000)	(0.0070)	(0.0005)	(0.0000)	(0.0046)	(0.0021)	(0.0172)	(0.0001)	(0.0037)	(0.0083)	(0.0129)	(0.0063)
Sargan	133.3125	154.5000	26.5918	171.4293	144.1128	212.5000	203.0251	212.0081	201.3700	123.2791	153.6372	194.3924
p-value	0.9999	0.9915	1.0000	0.9219	0.9989	0.2435	0.9896	0.9648	0.9917	1.0000	1.0000	0.9967

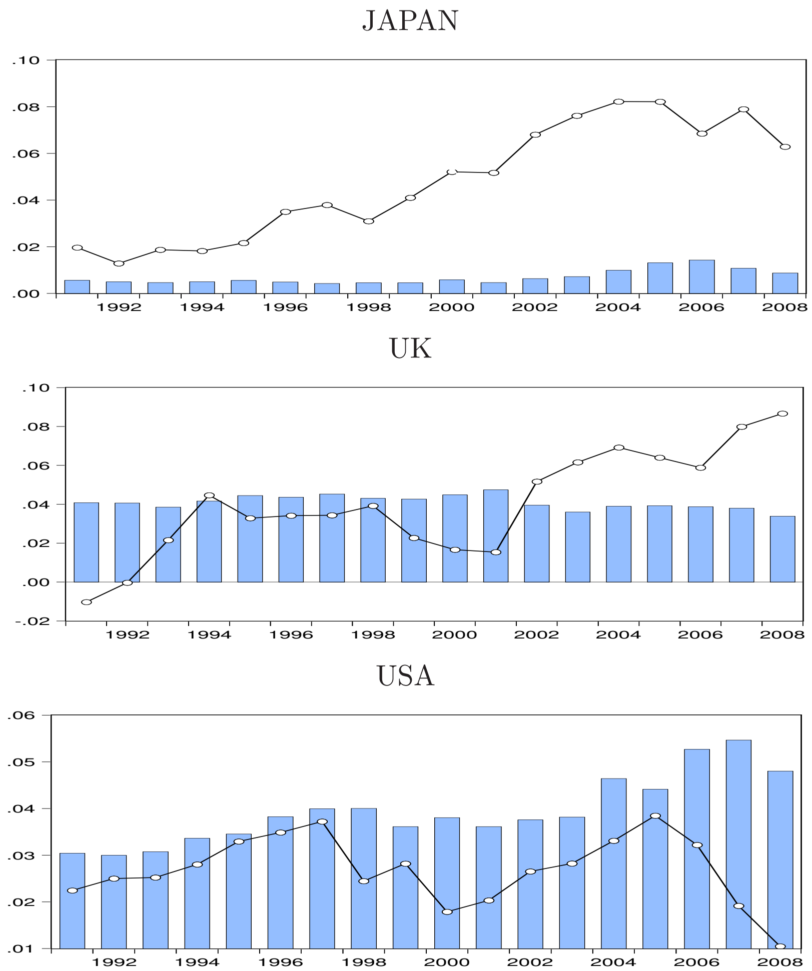
Notes: This table reports the two-step GMM point estimates. †, $*$ and $**$ indicate 10%, 5% and 1% significance, respectively. Standard errors are in parentheses. As is well known, the asymptotic standard errors of the two-stemp GMM estimator are underestimated in small samples. Therefore, we usually use the corrected standard errors proposed by Windmeijer (2005). However, as stated by Pozzi and Malengier (2007), the method proposed by Windmeijer (2005) is only available for linear model. As a result, we report the uncorrected standard errors.

Figure 1: Savings by Sectors(as % of GDP)



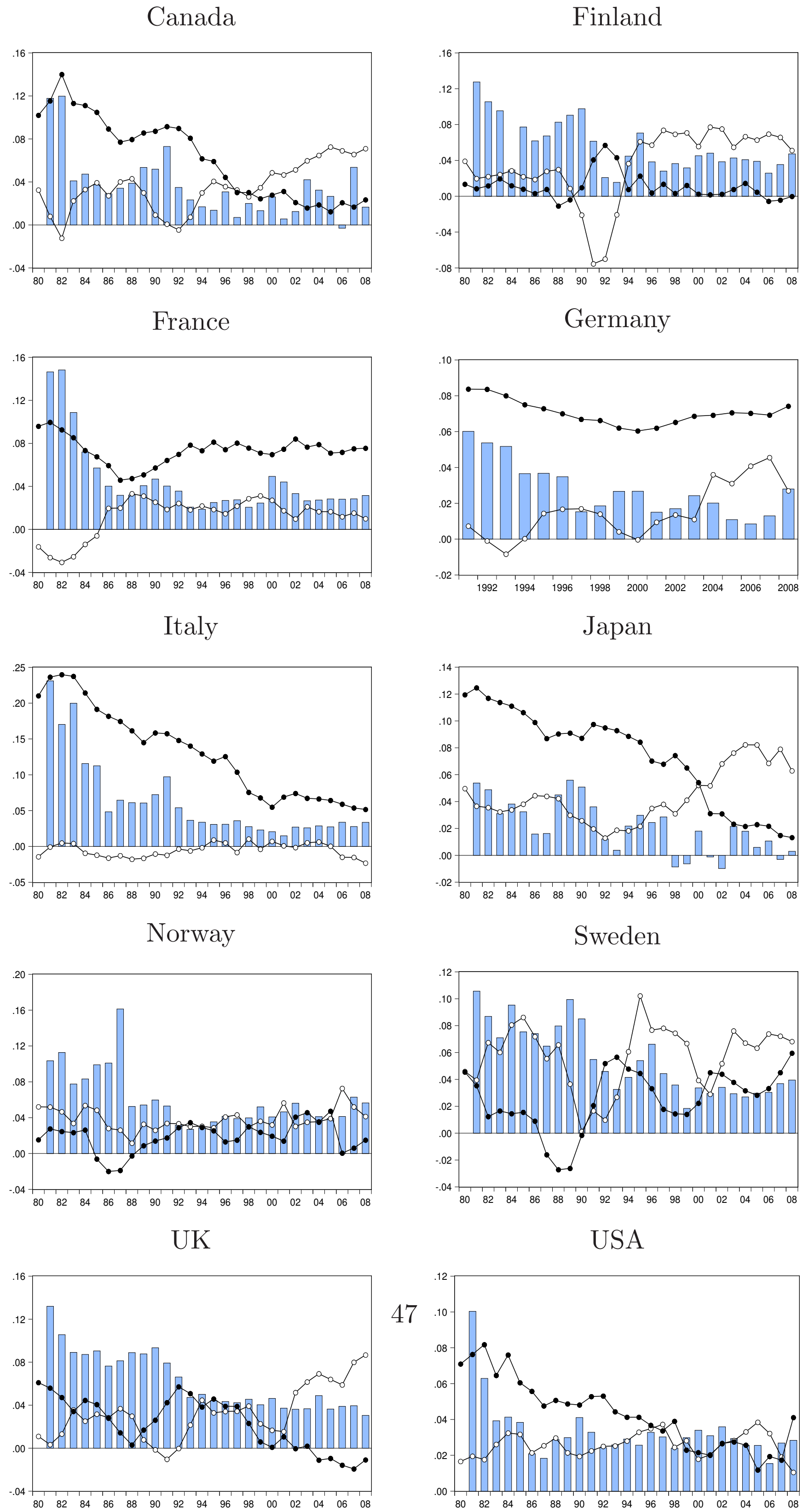
Notes: – : total, ∘ : corporation, • : household, × : government

Figure 2: Household and Corporate Saving and Household distributed income(as % of GDP)



Notes: ○ : corporation, ■ : household distributed income

Figure 3: Household and Corporate Saving and Wage(as % of GDP)



Notes: ○ : corporation, ● : household, ■ : wage