Fiscal Reform and Fiscal Sustainability: Evidence from Australia and Sweden

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This paper examines how the adoption of a fiscal rule affects the sustainability of fiscal policy in two OECD countries; Australia and Sweden. While recent fiscal reforms undertaken in both these countries are useful for ensuring the sustainability of government budgets, there are a few differences. In Australia, we show that government revenues are not necessarily growing at a faster rate than government expenditures, at least from the viewpoint of a statistical long-run relationship. In contrast, in Sweden, we show the reform is more beneficial for the attainment of a budget surplus.

*K*eywords: Fiscal reform; Sustainability of fiscal policy; Expenditure ceilings; Dynamic OLS

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1 Introduction

In the 1990s, many OECD countries undertook various approaches to fiscal reform. Three types of reforms were typically undertaken: (i) the introduction of numerical fiscal rules; (ii) the reform of budget procedures; and (iii) the introduction of independent fiscal institutions.

Of these three approaches, the introduction of numerical fiscal rules has been necessary and effective for consolidating government budgets. In terms of the outcomes of these approaches in the European Union (EU), Hallerberg et al. (2007) argued that the severity of fiscal rules appeared to restrain public debt regardless of the ideological distance between the ruling parties. Moreover, as Franco and Zotteri (2010) argued, even some countries where assigned strong powers to the finance minister or prime minister introduced expenditure rules in the 1990s. There is also the expectation that independent fiscal institutions provide policy advice through forecasts and fiscal analysis. However, as argued by Fatás (2010), independent fiscal institutions may be the appropriate authorities to complement numerical rules.

Incidentally, to meet balanced budget targets, governments may often prefer spending cuts to tax increases because of the relatively small macroeconomic trade-off. Furthermore, for the purpose of fiscal adjustment, Konishi (2006) and Alesina (2010) showed that governments tend to focus on expenditure restraint rather than on increasing taxes. Following this, we focus on the effect of budget expenditure rules (or ceilings). In this context, we define the introduction of an expenditure rule as a type of "fiscal reform".

Many countries introduced budget expenditure rules in the 1990s. For example, since 1996, Sweden has been implementing ceilings that set expenditure limits over a three-year period. Under the Swedish rule, expenditures are not allowed to increase over a three-year period. Australia has been setting limits on annual expenditures since 1996. The ceilings are legally enforced by the Charter of Budget Honesty Act, established in 1998. The Australian rule is linked to forward estimates of future economic growth and expected budget balances. However, although the level of expenditure is flexible, the rule functions as a limit on expenditures in certain years.[1] Australia and Sweden introduced fiscal rules following fiscal aggravation in the early and mid-1990s owing to the economic slowdown. With regard to other countries, as a condition for forming a coalition government in the Netherlands in 1994, the coalition parties also agreed on expenditure rules. Although Japan committed to decrease government expenditures through the Fiscal Structural Reform Act in 1997, the act was suspended in December 1998.[2]

Until the mid-1990s, both Australia and Sweden were typically categorized as countries without expenditure ceilings, and as countries in which there was little evidence that the prime minister or finance minister dominated budget negotiations, as shown by von Hargen and Harden (1995), De Haan et al. (1999), and Perotti and Kontopoulos (2002). By contrast, the Netherlands was seen as countries that did implement expenditure ceilings and in which the prime minister or finance minister dominated budget negotiations.[3] Thus, the recent fiscal reforms undertaken in these countries are evidence of the reinforcement of "existing" fiscal rules and of the reinforcement of the power of the fiscal authorities. Moreover, unlike the Japanese Fiscal Structural Reform Act, the reforms undertaken in both Australia and Sweden remain effective.

When compared with the reforms conducted in countries with only primitive expenditure ceilings or strong fiscal authorities, and compared with the Japanese experience, the reforms conducted in Australia and Sweden clearly altered their "fragile" public finance systems and should essentially be con-

[1]For details of the reforms conducted in Australia and Sweden, see Kennedy and Robbins (2003), Simes (2003), and Wehner (2007).

[2]For an appraisal of Japanese fiscal institutions and fiscal reform, see Tanaka (2003) and von Hagen (2006).

[3]von Hagen and Harden (1995) argued that the budget process in the Netherlands was governed by a firm commitment to the setting of a numerical target, even before the 1990s. On the basis of this and the agreements subsequently introduced in 1994, Perotti and Kontopoulos (2002) characterized the Netherlands as having expenditure ceilings from 1970 to 1995. The budget process in the UK relies heavily on the authority of the Treasury. Hallerberg et al. (2007) pointed out that the degree of commitment improved in Denmark between 1991 and 2004. However, Denmark can be classified as a country with primitive fiscal rules, at least according to surveys conducted from the 1980s to the mid-1990s.

sidered examples of the "permanent" introduction of fiscal rules.[4]

The Australian and Swedish reforms may contribute to fiscal policy sustainability when the government budget deficit has not been on a hitherto sustainable path. The mechanisms are as follows. First, the government may attempt to restrict spending based on the ceiling. Second, the rules may lead to a reduction in the government's deficit. Third, the government may achieve fiscal soundness through deficit reduction and, consequently, maintain the sustainability of fiscal policy.

Conversely, countries that do not adopt or apply the rules may not contribute to fiscal policy sustainability. For example, as mentioned earlier, the Japanese government abolished the Fiscal Structural Reform Act in 1998. The Japanese government has not since adopted a legal rule to consolidate the government budget. This may explain the continuous increase in the Japanese government's debt, and some existing researches show that fiscal policy in Japan may not be sustainable.[5] The fact that reforms in Australia and Sweden have been effective suggests that they, unlike Japan's reforms, may contribute to fiscal policy sustainability.

Some recent studies, such as those of Fatás (2010), Franco and Zotteri (2010), and Rose (2010), have identified a relationship between fiscal rules and the sustainability of fiscal policy. Franco and Zotteri (2010), in particular, discussed the relationship between fiscal reform and fiscal sustainability and emphasized that fiscal rules play an important role in ensuring the sustainability of fiscal policy, as we assume. However, these researchers did

[4]New Zealand also introduced a fiscal rule in the form of the Fiscal Responsibility Act in 1994. However, to our knowledge, unlike in the cases of Australia and Sweden, there has been no examination of the effect of fiscal rules or of the strength of the fiscal authorities in New Zealand's public financial system before the introduction of the Act. Therefore, we cannot investigate this case with confidence because it may be difficult to judge evenhandedly whether New Zealand's fiscal reform represents evidence of the introduction of "brand-new" fiscal rules or simply of the reinforcement of existing rules and procedures.

[5]For example, by using a dynamic stochastic general equilibrium model, Hosono and Sakuragawa (2010) and Hosono and Sakuragawa (2011) found that the debt–GDP ratio has gradually increased, thereby causing Japanese government debt to become unsustainable. A recent paper by Doi et al. (2011) demonstrated the unsustainability of Japanese fiscal policy by estimating a fiscal policy function with Markov switching.

not examine the issue by using econometric techniques. On the other hand, there exist many previous studies that consider the sustainability of fiscal policy in general, including those of Hakkio and Rush (1991), Trehan and Walsh (1991), Ahmed and Rogers (1995), Quintos (1995), Bohn (1998), Martin (2000), Bravo and Silvestre (2002), Afonso (2006), Uctum et al. (2006), Bohn (2007), Bohn (2008), Afonso and Rault (2009), and Legrenzi and Milas (2011). Olekalns (2000), Hatemi-J (2002a), and Hatemi-J (2002b) examined sustainability in the Australian and Swedish cases. However, to our knowledge, no empirical work has been undertaken on the sustainability of fiscal policy that incorporates fiscal reform.[6]

Hence, our objective is to analyze how the adoption of a "permanent" fiscal rule affects the sustainability of fiscal policy in Australia and Sweden. We focus on a numerical fiscal target and, in particular, we define the introduction of expenditure rules as a fiscal reform, which is assumed to be a structural change. This is why such an introduction changes the intertemporal relationship between revenues and expenditures and puts fiscal policy on a sustainable path. Furthermore, we use our empirical results to discuss the implications for EU countries that have experienced recent fiscal crises.

The process is as follows. First, we test for cointegration between government revenues and expenditures. Second, we estimate the cointegration vector in order to determine whether the introduction of a fiscal rule would contribute to making the government's budget sustainable. Third, to examine the influence of fiscal reform, we use the dynamic ordinary least squares (DOLS) approach developed by Stock and Watson (1993) to estimate the coefficient of the fiscal variable that exhibits a structural break.

The remainder of the paper is structured as follows. In Section 2, we describe the theoretical and empirical framework. In Section 3, we report our estimation results. Section 4 concludes the paper.

[6]Hatemi-J (2002b) examined the sustainability of Swedish fiscal policy incorporating structural breaks to confirm that it satisfied EMU criteria. However, Hatemi-J (2002b) did not examine the effects of the introduction in 1996 of the rules considered in this paper.

2 The Sustainability of Public Debt

2.1 Theoretical Framework

We assume that the government's one-period budget constraint is:

$$\Delta D_t = G_t + r_t D_{t-1} - R_t, \tag{1}$$

where G_t denotes government expenditure (excluding interest payments), r_t is the real interest rate, R_t is government revenues, and D_t is government debt. In our specification, following Hakkio and Rush (1991), Quintos (1995), Martin (2000), and Afonso (2006), we assume that r_t is stationary around its mean r.[7] Given this assumption, we define the following: ${G^*}_t = G_t + (r_t - r)D_{t-1}$. This expression is used to rewrite equation (1) as follows:

$${G^*}_t + (1+r)D_{t-1} = R_t + D_t. \tag{2}$$

Rewriting equation (2) for subsequent periods and expressing debt yields:

$$D_t = \frac{1}{(1+r)} S_{t+j+1} + \frac{1}{(1+r)} D_{t+j+1}, \tag{3}$$

where $S_{t+j+1} = R_{t+j+1} - {G^*}_{t+j+1}$. Then, solving the resulting equations recursively yields the following intertemporal budget constraint:

$$D_t = \sum_{j=0}^{\infty} \frac{1}{(1+r)^{j+1}} S_{t+j+1} + \lim_{j \to \infty} \frac{1}{(1+r)^{j+1}} D_{t+j+1}. \tag{4}$$

By taking conditional expectations, we can write equation (4) as:

$$D_t = \sum_{j=0}^{\infty} \frac{1}{(1+r)^{j+1}} E_t[S_{t+j+1}] + \lim_{j \to \infty} \frac{1}{(1+r)^{j+1}} E_t[D_{t+j+1}]. \tag{5}$$

From equation (5), the intertemporal budget balances if and only if the current value of outstanding government debt is equal to the expected present value of future budget balances. That is:

$$D_t = \sum_{j=0}^{\infty} \frac{1}{(1+r)^{j+1}} E_t[S_{t+j+1}] \tag{6}$$

[7] Treating the real interest rate as endogenous dramatically changes the restrictions that need to be tested. However, following existing studies on the sustainability of fiscal policy that incorporate structural change, we assume that r_t is stationary around its mean. Treating the real interest rate as endogenous awaits further research.

must be equivalent to the following:

$$\lim_{j\to\infty} \frac{1}{(1+r)^{j+1}} E_t[D_{t+j+1}] = 0. \tag{7}$$

Equation (7) is commonly known as the no-Ponzi game condition (hereafter, NPG condition).

2.2 The Econometric Model

To proceed from theory to empirical testing, we first difference equation (4) to obtain:

$$\Delta D_t = \sum_{j=0}^{\infty} \frac{1}{(1+r)^{j+1}} [\Delta S_{t+j+1}] + \lim_{j\to\infty} \frac{1}{(1+r)^{j+1}} [\Delta D_{t+j+1}]. \tag{8}$$

Given $\Delta D_t = D_t - D_{t-1}$, and using equation (1), equation (8) can be rewritten as:

$$\begin{aligned} G_t + r_t D_{t-1} - R_t &= \sum_{j=0}^{\infty} \frac{1}{(1+r)^{j+1}} [\Delta S_{t+j+1}] \\ &\quad + \lim_{j\to\infty} \frac{1}{(1+r)^{j+1}} [\Delta D_{t+j+1}]. \end{aligned}$$

Given the NPG condition, this equation can be written as:

$$G_t + r_t D_{t-1} - R_t = \sum_{j=0}^{\infty} \frac{1}{(1+r)^{j+1}} [\Delta S_{t+j+1}]. \tag{9}$$

To test the NPG condition (that is, whether equation (9) holds), we follow standard procedure of testing for the stationarity of $G_t + r_t D_{t-1} - R_t$ after imposing the cointegration vector (1,1,–1).[8] By defining $GG_t = G_t + r_t D_{t-1}$,

[8] As an alternative, Bohn (2007) proposes the policy reaction function approach, developed by Bohn (1998). However, Bohn's (1998) approach may not be applicable to the long-run relationship between government revenues and expenditures that is the focus of our research. Moreover, as pointed out by Li (2009), Bohn's (1998) reaction function cannot be identified because the equilibrium condition that the market value of debt equals the expected present value of primary surpluses may induce positive correlation between the value of debt today and future surpluses.

we can use the following equivalent procedure to test for cointegration in the regression equation:

$$R_t = \alpha + \beta GG_t + u_t. \tag{10}$$

To determine the sustainability of the budget deficit, we estimate equations for, and conduct tests on, public expenditures including net interest payments, as in the cointegration approach.[9] In this respect, some researchers, such as Quintos (1995) and Martin (2000), test the necessary and sufficient conditions for deficit sustainability by testing whether GG_t and R_t are cointegrated, with $\beta = 1$ in equation (10).

However, in the context of this approach, Bohn (2007) argued that if the revenue and with-interest spending series are stationary after any finite number of differencing operations, the intertemporal budget constraint is satisfied. Moreover, for the sustainability test developed by Quintos (1995), Bohn (2007) showed that it is misleading to determine whether the necessary or sufficient condition holds based on the coefficient of the cointegration vector. Bohn (2007) argued that all cointegrating conditions are merely "sufficient" for transversality. Given Bohn's (2007) argument, the cointegration approach for judging the sustainability of public debt allows us to examine only the sufficient condition. In addition, Bohn (2007) suggested that all of the sustainability conditions, be they strong, weak, or absurdly weak, imply that the transversality condition and the intertemporal government budget constraints are satisfied.[10] Therefore, we modify the scenarios for deficit sustainability suggested by Quintos (1995) and Martin (2000) as follows:

(1) The deficit is "sustainable" if there is a cointegration relationship between GG_t and R_t, with $0 < \beta \leq 1$.

[9]To determine whether the NPG condition is satisfied by using a unit-root test or cointegration test, we also test for the stationarity of the first difference of public debt. However, it is difficult to test for the "direction" of fiscal reform by examining the stationarity of public debt. Moreover, as suggested by Ahmed and Rogers (1995) and Bohn (1998), it seems appropriate to deal with sustainability in a stochastic environment. However, since our motivation is to examine not only the sustainability problem but also the "direction" of fiscal reform for the government budget, it is not necessarily important to assume a stochastic environment in deriving the NPG condition. For these reasons, we employ a simple cointegration approach.

[10]For details, see the arguments on pp. 1839–1843 of Bohn (2007).

(2) $\beta > 1$ is not consistent with a deficit because revenues are growing at a faster rate than expenditures, including interest payments.

Scenario (1) implies that only the sufficient condition (not the necessary and sufficient conditions) for deficit sustainability is satisfied.[11] Even if $\beta < 0$, a confirmed cointegration relationship between GG_t and R_t does not necessarily imply that the budget deficit is unsustainable, according to the arguments of Bohn (2007). Moreover, despite a confirmed cointegration relationship between revenues and expenditures, the estimated β could be positive but insignificant. In these cases, we simply report the existence of a confirmed cointegration relationship between GG_t and R_t.

To estimate β, we use the DOLS method developed by Stock and Watson (1993). Using DOLS gives a more efficient estimate of the coefficient of the cointegration vector than does straight OLS.

An estimated coefficient of between zero and unity on the variable GG_t multiplied by the dummy indicating fiscal reform implies that reform makes the government budget sustainable. Given the above arguments, an estimated coefficient exceeding unity implies that the reform enables the government to run budget surpluses.

[11] In a recent paper, Legrenzi and Milas (2011) assumed that the government's intertemporal budget constraint is satisfied if government revenues and expenditures are cointegrated and if the estimated $\beta = 1$, whereas fiscal policy might not be sustainable if $\beta < 1$, even if there is a cointegration relationship between government revenues and expenditures. However, we do not apply the scenarios suggested by these authors because, according to Bohn (2007), they could be misleading.

3 Empirical Results

3.1 Datasets

All datasets are from the OECD Economic Outlook database (No.82).[12] We use this database because, for comparing the influence of fiscal reform in two different countries, it seems appropriate to use country data from the same database, rather than using data from individual countries' governments. For both Australia and Sweden, our quarterly data cover the period 1980:Q1–2007:Q4.[13] GG_t is current general government disbursements (including interest payments) and R_t is current general government receipts.[14] All variables are measured in real terms, based on GDP deflators, and are seasonally adjusted, based on the X-12-ARIMA method.

3.2 Unit-root Tests for r_t, GG_t, and R_t

We report the results of the unit-root tests for each variable. To do this, we first check whether both GG_t and R_t are I(1) before we test for cointegration between GG_t and R_t.

In Section 2.1, we assumed that the interest rate r_t is stationary around its mean r. Thus, following Hatano (1999), before we perform the unit-root tests for the fiscal variables, we check whether this assumption holds.

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[12] The fiscal rules in two countries concern only the federal government budget, whereas the data from the OECD cover general government, including local government. However, the local government budget is hardly affected because the federal government exerts strong control over the local public financial system through the system of intergovernmental transfers.

[13] We choose 1980 as the start of the sample period to avoid incorporating the effects of the two oil crises of the 1970s.

[14] Property income received and paid by the government is excluded from both current disbursement and receipts because these items have a rather incomplete coverage in the OECD Economic outlook database and are typically very small, as indicated in Perotti and Kontopoulos (2002). The averages of the share of property income received by the government per current receipts in the sample periods are 6.184% in Australia and 7.628% in Sweden. The averages of the share of property income paid by the government per current disbursements are 9.621% in Australia and 8.243% in Sweden.

To check whether each variable is stationary, we use the Augmented Dickey–Fuller (1979) test (hereafter, ADF test). We also use the GLS-based Dickey–Fuller unit-root test (hereafter, DF-GLS test) developed by Elliott et al. (1996), and the Zivot and Andrews (1992) unit-root test. The reason underlying the use of the former is that the DF-GLS test is sufficiently powerful to detect a unit root in small samples. The Zivot and Andrews (1992) test is useful because it can detect a unit root in a time series with unknown structural change.[15] More specifically, we perform both the ADF and DF-GLS tests as benchmarks, and if we cannot confirm that the variable is I(1), we repeat the test by including a structural break. To be compatible with our theoretical arguments, and following standard practice, all our tests include only a constant.

Table 1 reports the results for the unit-root test for r_t (the real long-term interest rate). For both countries, both the ADF and DF-GLS tests cannot reject the null hypothesis that r_t is nonstationary. By contrast, the Zivot and Andrews (1992) unit-root test, including an unknown single structural break, rejects the null of nonstationarity. These results validate an important assumption underlying our model when a structural break is incorporated.

Table 2 shows the results for the fiscal variables. The results reveal that nearly all the level variables are nonstationary. The exceptions include R_t level, which is stationary for Australia according to the DF-GLS test, and for Sweden according to the Zivot and Andrews (1992) test. However, there are no rejections for the ADF test. Hence, we need to test the first differences of the series.

All tests strongly reject the null hypothesis of nonstationarity for the first differences. Therefore, all variables may be treated as single (I(1)) unit-root process.

[15] Economic circumstances within each country affect public expenditures, revenues, and the long-term interest rate. Moreover, changes in the deficit may result more from the government's own efforts than from the binding rules set by foreign countries or international organizations. Hence, the structural breaks evident in the variables we use may arise because of endogenous factors. Therefore, we use the unit-root test of Zivot and Andrews (1992) with an endogenous structural break.

3.3 On the Existence of Cointegration Relationships Between G_t, r_tD_{t-1}, and R_t

The results reported in Tables 1 and 2 validate the assumptions necessary for testing the sustainability of the budget deficit. In this subsection, we test for cointegration between R_t and GG_t.

We first perform Johansen's (1995) cointegration test for R_t and GG_t by employing the specification that there are no linear time trends in the levels of the data. The result in Table 3 shows that the null hypothesis of no cointegration vector (r = 0) is rejected in favor of at least one cointegration vector at the 1% level of significance for the two countries.

Second, we employ the unit-root test for the budget deficit $GG_t - R_t$. The unit-root test for $GG_t - R_t$ is equivalent to the test of the cointegration relationship among G_t, r_tD_{t-1}, and R_t. Especially, we implement the Zivot and Andrews (1992) test with a single unknown break. The results are reported in Table 4. Table 4 shows that the stationarity of $GG_t - R_t$ is confirmed when we assume a structural break.[16]

3.4 The DOLS Results and the Influence of Fiscal Reform

Based on the results of testing for cointegration between R_t and GG_t, we can confirm a cointegration relationship between G_t, r_tD_{t-1}, and R_t. In this subsection, we use the DOLS approach to estimate the cointegration vector and check whether the fiscal reform affects the sustainability of fiscal policy.

[16]A method developed by Gregory and Hansen (1996) is useful for performing a cointegration test when there is a single break. However, when using this test, we could only find evidence of a cointegration relationship among G_t, r_tD_{t-1}, and R_t by limiting the sample period. This suggests that there are multiple breaks during the sample period. Dealing with this problem would require testing for a unit root (cointegration) when there are multiple breaks, as did Martin (2000), Bai and Perron (2003), Arghyrou and Luintel (2007), and Kejriwal and Perron (2010). Although a variety of tests are proposed in these papers, there seems to be no established method for testing for cointegration when there are multiple breaks. Thus, we are limited to detecting single structural breaks and observing the data. Addressing this limitation awaits further research.

According to the results based on incorporating a break shown in Table 3, there may have been a structural change in the relationship between R_t and GG_t around 1984. In 1984, the fiscal condition in both two countries were gradually improving as shown in Figures 1 and 2. This perhaps reflects the economic recovery observed in the developed countries this year. Moreover, as discussed in Section 1, since 1996, Australia has set an expenditure ceiling by balancing the government budget across the business cycle. Likewise, the Swedish government introduced an expenditure ceiling in 1996. In this context, Figures 1 and 2 depict the trends in the budget balance ($R_t - GG_t$) in the two countries. According to Figure 1, although the Australian government ran deficits from 1991 to 1995, its budget balance has been positive since 1996. Further, as shown in Figure 2, the budget deficit in Sweden decreased between 1995 and 1997, but was positive between 1997:Q4 and 2002:Q1. This suggests that there may have been a structural change between R_t and GG_t before and after the introduction of the fiscal rules.[17] Alternatively, we observe a downward trend in the government budget balance around the early 2000s in both countries (2000–2002 in Australia and 2002–2003 in Sweden).[18] Based on these arguments, which are supported by the data as well as the statistical results, we can legitimately argue that a dummy variable representing a structural break should be included when estimating the DOLS equation.

For this purpose, we incorporate dummy variables identifying the periods in which the fiscal rules were introduced, which are represented as structural

[17]Furthermore, to examine how governments strive to restrict government expenditures and successfully reduce the budget deficit, we purify the "outcome" gained from the effort made to restrain expenditure. We do this to exploit the cyclically adjusted data or trend component in the original time-series data. These movements illustrate clearly that both governments have succeeded in restricting expenditures to be less than revenues in most periods since the introduction of the fiscal rule. These results also support the notion that there may have been a structural change before and after the introduction of the fiscal rules. Detailed arguments can be obtained from the former version of this paper, which is available from the author's website: https://sites.google.com/site/tomomisite/research/dp.

[18]The global economy entered a recessionary phase in 2000-2001 owing to the slowdown of the U.S. economy and bursting of so-called "information-technology bubble." Owing to the recession, the budget balance temporarlily worsend around the year 2000 in both the countries.

breaks, namely, D_f for Australia and $\tilde{D_f}$ for Sweden.[19] Initial testing detects a breakpoint in 1984:Q3 in Australia and one in 1984:Q2 in Sweden. To deal with these breaks, the dummy variable D_{84} for Australia takes a value of unity from 1984:Q3 to 1996:Q2, and the dummy variable $\tilde{D_{84}}$ for Sweden takes a value of unity from 1984:Q2 to 1995:Q4 (and both are zero otherwise). For the other dummy variables, D_f in Australia takes a value of unity for the period 1996:Q3–2000:Q4, and $\tilde{D_f}$ in Sweden takes a value of unity for the period 1996:Q1–2001:Q4 (zero otherwise). Based on the movements in R_t and GG_t shown in Figures 1 and 2, we propose to deal with possible breaks around 2000. Thus, for Australia, we construct a dummy variable D_{01} that takes a value of unity from 2001:Q1 (zero otherwise). For Sweden, the dummy variable D_{02} takes a value of unity from 2002:Q1 (zero otherwise). Clearly, we can determine the effects of the fiscal reforms based not only on the coefficients of D_f and $\tilde{D_f}$ but also on those of D_{01} and D_{02}. This is because the fiscal rules adopted in Australia and Sweden have been effective since being introduced.

We estimate equation (11) for Australia and equation (12) for Sweden as shown below:

$$\begin{aligned} R_t &= \alpha + D_f + D_{84} + D_{01} + \beta_1 GG_t + \beta_2(D_f * GG_t) \\ &\quad + \beta_3(D_{84} * GG_t) + \beta_4(D_{01} * GG_t) + \sum_{j=-p}^{p} \gamma_j GG_{t-j} \\ &\quad + \sum_{j=-p}^{p} \delta_j (D_f * GG_{t-j}) + \sum_{j=-p}^{p} \phi_j (D_{84} * GG_{t-j}) \\ &\quad + \sum_{j=-p}^{p} \psi_j (D_{01} * GG_{t-j}) + u_t^{AUS}, \end{aligned} \tag{11}$$

$$\begin{aligned} R_t &= \tilde{\alpha} + \tilde{D_f} + \tilde{D_{84}} + D_{02} + \tilde{\beta_1} GG_t + \tilde{\beta_2}(\tilde{D_f} * GG_t) \\ &\quad + \tilde{\beta_3}(\tilde{D_{84}} * GG_t) + \tilde{\beta_4}(D_{02} * GG_t) + \sum_{j=-p}^{p} \tilde{\gamma_j} GG_{t-j} \end{aligned}$$

[19] In Australia, the fiscal year is from July to the following June. In Sweden, the fiscal year corresponds to the calendar year. Our dummy variables for identifying the introduction of fiscal reform are consistent with these definitions.

$$+\sum_{j=-p}^{p}\tilde{\delta}_j(\tilde{D_f}*GG_{t-j})+\sum_{j=-p}^{p}\tilde{\phi}_j(\tilde{D_{84}}*GG_{t-j})$$
$$+\sum_{j=-p}^{p}\tilde{\psi}_j(D_{02}*GG_{t-j})+u_t^{SWE}, \tag{12}$$

where j is the number of leads and lags in the DOLS equation. We assume lag and lead lengths of unity.

Tables 5 and 6 report the results of the DOLS estimation. Table 5 reports the estimation results based on excluding the dummy variables. These results show that in the simplified model, the estimated β_1 is not significant. However, as shown in Table 6, the estimated coefficients for $D_f * GG_t$ (β_2 and $\tilde{\beta_2}$) are positive and significant, particularly in Sweden, where the estimate is greater than unity. This also applies to the estimates of β_4 and $\tilde{\beta_4}$. Moreover, we test the following null hypotheses: $\beta_2 = \beta_4 = D_f = D_{01} = 0$ (for Australia) and $\tilde{\beta_2} = \tilde{\beta_4} = \tilde{D_f} = D_{02} = 0$ (for Sweden). To test these hypotheses, we use a Wald test to check for structural change following the introduction of the expenditure rules. Because we reject the null hypothesis for both countries, we confirm that structural changes took place, both in the intercept and the slope parameters, following the introduction of fiscal reform.

To check the robustness of our DOLS estimates, we reestimate the model by increasing the lag length to three.[20] Table 7 reports the results. The estimates for both $\tilde{\beta_2}$ and $\tilde{\beta_4}$ are greater than unity and significant in all cases for Sweden. By contrast, in the Australian case, β_2 and β_4 in Table 7 range from 0.686 to 1.027. When two-period leads and lags are used, the estimate of β_2 exceeds unity, but β_4 is 0.812.

As shown in Tables 6 and 7, the estimates of β_1 ($\tilde{\beta_1}$) and β_3 ($\tilde{\beta_3}$) are neither positive nor significant in any case. These results suggest that fiscal policy may not have been sustainable in either Sweden or Australia before these countries introduced their respective fiscal rules. However, based on

[20] We set a maximum lag length of three because Stock and Watson (1993) showed that, unlike increasing the number of observations, increasing the number of lags and the kernel length does not appreciably improve the coverage rate. Nevertheless, because we were unable to draw on any established method for determining the lag and lead lengths for DOLS estimation, we could not identify specific values for lag and lead lengths.

these results and our discussion of the estimated β coefficient in Section 2.2, we conclude that the expenditure ceiling introduced in 1996 by the Swedish government allowed it to run a budget surplus, even after accounting for the structural break that followed the introduction of the fiscal rule. Conversely, although the Australian reform was also useful in ensuring the sustainability of the Australian government's budget, we cannot necessarily conclude that it helped yield a budget surplus, at least from the viewpoint of a statistical long-run relationship, according to the arguments presented in Section 2.2.

4 Conclusion

In this paper, we examined the influence of fiscal reform on the sustainability of fiscal policy. We analyzed Australia and Sweden because these two countries have been adopting fiscal rules since the mid-1990s. Based on the scenarios used to determine the sustainability of fiscal policy discussed in Section 2.2, although the Australian reform has been useful for ensuring the sustainability of fiscal policy, revenue has not necessarily grown at a faster rate than expenditure from the viewpoint of a statistical long-run relationship between the two variables. By contrast, for Sweden, we found that, in terms of the long-run relationship between revenue and expenditure, reform has been beneficial for running a budget surplus because, for the period following the reform, the estimated coefficients of GG_t, namely $\tilde{\beta}_2$ and $\tilde{\beta}_4$, exceed unity.

Although many existing empirical studies on the sustainability of fiscal policy have merely investigated whether the intertemporal government budget constraint holds in the long run, our results suggest that the introduction of a fiscal rule contributes to restoring the sustainability of fiscal policy.

Incidentally, the fiscal rules in both countries only cover the federal (central) government. However, if the fiscal rule also covers the local government budget, it may exert a stronger influence to suppress government expenditures within a country. The inclusion of local public sector in the coverage of the rule may be desired.

Putting this aside, government of most EU countries have adopted the fiscal rule in accordance with the Maastricht Treaty and the Stability and Growth Pact. Since we have focused on examining the reforms initiated in the wake of fiscal aggrevation in countries, we do not examine the post-EMU fiscal reforms. However, binding rules in the wake of pressure from foreign countries or international organizations may also affect the sustainability of fiscal policy. In that sense, post EMU fiscal reforms should be strongly addressed in future research. Further, the fiscal rules in some states within one country might be changed. In such case, the intranational comparison may be also worthy of investigation.

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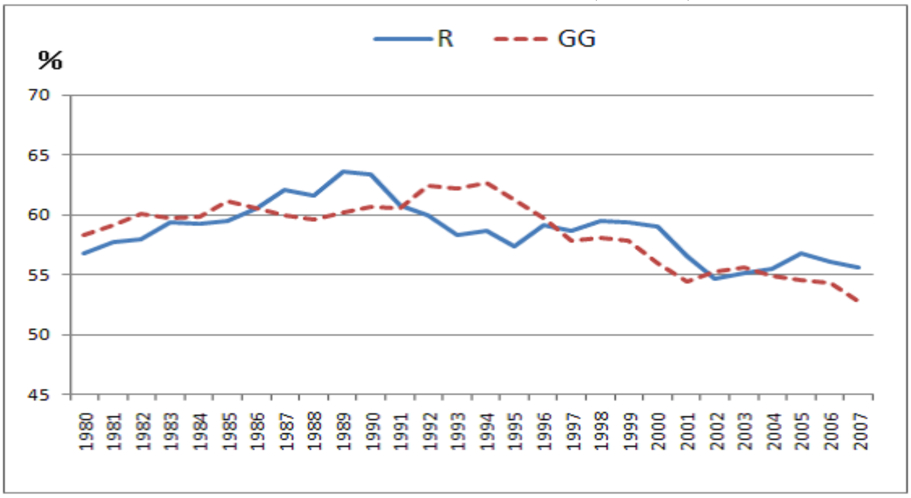
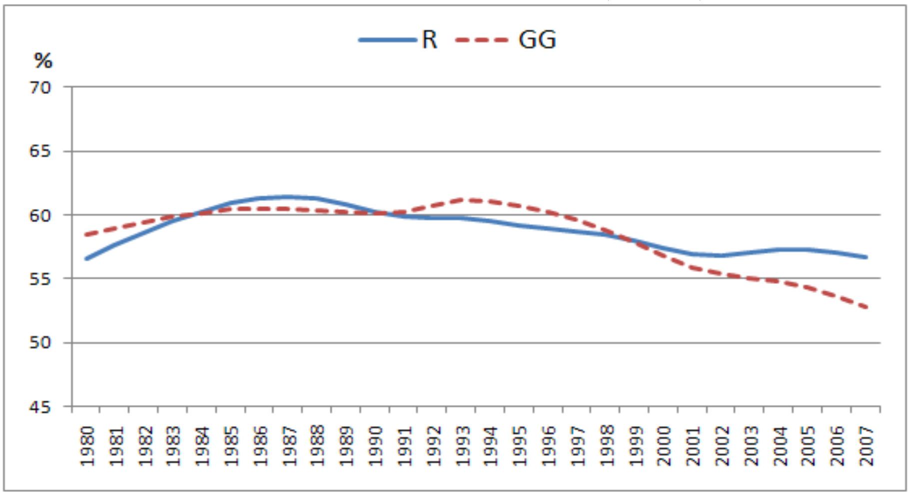
Figure 1: The budget balance (R–GG) in Australia



Source: OECD Economic Outlook (No.82)

Note: Quarterly data used.

Figure 2: The budget balance (R–GG) in Sweden



Source: OECD Economic Outlook (No.82)

Note: Quarterly data used.

Table 1

Unit-root test for long-term interest rate (r_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

	Australia	Sweden
ADF	–1.106	–1.229
Lags	3	1
DF-GLS	–1.013	0.000
Lags	4	4
Z-A	-5.015^{**}	-6.334^{***}
Lags	3	1
Break point	1991:Q1	1996:Q3

Note: ADF indicates the results of the Augmented Dickey–Fuller stationarity test, DF-GLS is the GLS detrended Dickey-Fuller stationarity test suggested by Elliott et al. (1996), and Z-A is the unit-root test including an unknown structural break suggested by Zivot and Andrews (1992). The lag length is chosen using the Akaike Information Criterion (AIC) by setting the maximum length as eight. Asterisks indicate level of significance: $* = 10\%$, $** = 5\%$, and $*** = 1\%$.

Table 2
Unit-root test for the government revenues (R_t) and the government expenditures with net interest payment (GG_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

Country		R_t	GG_t	ΔR_t	ΔGG_t
Australia	ADF	1.417	1.201	–11.680***	–5.810***
	Lags	2	3	1	2
	DF-GLS	–1.639*	1.001	–2.323**	–2.241**
	Lags	7	7	6	7
	Z-A	–3.372	–3.016	–12.381***	–6.736***
	Lags	3	3	1	2
	Breakpoint	1990:Q3	1992:Q3	1993:Q2	1989:Q2
Sweden	ADF	0.024	0.102	–3.331**	–4.248***
	Lags	8	8	7	7
	DF-GLS	1.253	1.188	–2.517**	–2.671***
	Lags	8	7	6	6
	Z-A	–4.609*	–3.563	–5.916***	–6.855***
	Lags	2	2	1	3
	Breakpoint	1991:Q1	1990:Q3	1989:Q4	1994:Q4

Note: All tests include an intercept. ADF indicates the results of the Augmented Dickey–Fuller stationarity test, DF-GLS is the GLS detrended Dickey–Fuller stationarity test suggested by Elliott et al. (1996), and Z-A is the unit-root test including an unknown structural break suggested by Zivot and Andrews (1992). The lag length is chosen using the AIC by setting the maximum length as eight. Asterisks indicate level of significance: $* = 10\%$, $** = 5\%$, and $*** = 1\%$.

Table 3

Trace statistics for Johansen's (1995) cointegration tests for the government revenues (R_t) and the government expenditures with net interest payment GG_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

Country	test statistics
Australia	60.533***
Sweden	36.729***

Note: Note: Our model assumes no linear time trends in levels. The lag length is three in Australia and eight in Sweden after setting the maximum length as eight (using the AIC in both cases). Critical values are from MacKinnon et al. (1999) (critical value = 25.08 (1%)). Asterisks indicate level of significance: $*$ = 10%, $**$ = 5%, and $***$ = 1%.

Table 4

Unit-root test for budget balance (R_t–GG_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

	Australia	Sweden
Z-A	–5.008**	–4.942**
Lags	3	2
Breakpoint	1984:Q3	1984:Q2

Note: Z-A is the unit-root test including an unknown structural break suggested by Zivot and Andrews (1992). The lag length is chosen using AIC by setting the maximum length as eight. Asterisks indicate level of significance: $*$ = 10%, $**$ = 5%, and $***$ = 1%.

Table 5

Results of DOLS (without the dummies for breaks). Dependent variable = the government revenues (R_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

Country	β	$\bar{R}^2$
Australia	0.382 (0.325)	0.975
Sweden	0.552 (0.783)	0.815

Note: The coefficients for the leading and lagged values of GG_t are not shown for brevity. A constant term is included (results not shown). Standard errors in parentheses. Asterisks indicate level of significance: $*$ = 10%, $**$ = 5%, and $***$ = 1%.

Table 6

Results of DOLS. Dependent variable = the government revenues (R_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

Australia	β_1	β_2	β_3	β_4	$\bar{R}^2$	Wald statistics
	–0.067 (0.407)	0.504* (0.328)	–0.030 (0.274)	0.639** (0.304)	0.984	15.6***
Sweden	$\tilde{\beta_1}$	$\tilde{\beta_2}$	$\tilde{\beta_3}$	$\tilde{\beta_4}$	$\bar{R}^2$	Wald statistics
	0.210 (0.640)	1.617*** (0.568)	–0.457 (0.449)	1.663*** (0.436)	0.952	45.7***

Note: The results of the coefficients for the leading and lagged values of GG_t, $D_f * GG_t$ in Australia, $\tilde{D_f} * GG_t$ in Sweden, $D_{84} * GG_t$ in Australia, $\tilde{D_{84}} * GG_t$ in Sweden, $D_{01} * GG_t$ in Australia, and $D_{02} * GG_t$ in Sweden are not shown for brevity. A constant term is added, and D_f in Australia, $\tilde{D_f}$ in Sweden, D_{84} in Australia, $\tilde{D_{84}}$ in Sweden, D_{01} in Australia, and D_{02} in Sweden are included in the regression equation as dummy variables for the intercept (results not shown for brevity). Standard errors are in parentheses. Wald statistics are the results of tests of the null hypothesis that $\beta_2 = \beta_4 = D_f = D_{01} = 0$ (in Australia) or $\tilde{\beta_2} = \tilde{\beta_4} = \tilde{D_f} = D_{01} = 0$ (in Sweden). Asterisks indicate level of significance: $*$ = 10%, $**$ = 5%, and $***$ = 1%.

Table 7

Results of DOLS (robustness check of changing lag and lead length). Dependent variable = the government revenues (R_t). Sample period = 1980:Q1–2007:Q4 for Australia (number of observations = 112) and 1980:Q1–2007:Q4 for Sweden (number of observations = 112)

Australia	Lags & Leads	β_1	β_2	β_3	β_4	$\bar{R}^2$	Wald statistics
	2	–0.399	1.027***	0.060	0.812***	0.986	29.6***
		(0.417)	(0.363)	(0.297)	(0.326)		
	3	–0.618	0.773**	0.093	0.686**	0.986	13.8***
		(0.458)	(0.434)	(0.346)	(0.382)		
Sweden	Lags & Leads	$\tilde{\beta_1}$	$\tilde{\beta_2}$	$\tilde{\beta_3}$	$\tilde{\beta_4}$	$\bar{R}^2$	Wald statistics
	2	0.191	1.651***	–0.563	1.545***	0.950	41.4***
		(0.698)	(0.626)	(0.502)	(0.499)		
	3	0.420	1.528**	–0.805*	1.509***	0.948	50.8***
		(0.788)	(0.716)	(0.600)	(0.574)		

Note: The coefficients for the leading and lagged values of GG_t, $D_f * GG_t$ in Australia, $\tilde{D_f} * GG_t$ in Sweden, $D_{84} * GG_t$ in Australia, $\tilde{D_{84}} * GG_t$ in Sweden, $D_{01} * GG_t$ in Australia, and $D_{02} * GG_t$ in Sweden are not shown for brevity. A constant term is added, and D_f in Australia, $\tilde{D_f}$ in Sweden, D_{84} in Australia, $\tilde{D_{84}}$ in Sweden, D_{01} in Australia, and D_{02} in Sweden are included in the regression equation as dummy variables for the intercept (results not shown for brevity). Standard errors are in parentheses. Wald statistics are the results of tests of the null hypothesis that $\beta_2 = \beta_4 = D_f = D_{01} = 0$ (in Australia) or $\tilde{\beta_2} = \tilde{\beta_4} = \tilde{D_f} = D_{01} = 0$ (in Sweden). Asterisks indicate level of significance: $* = 10\%$, $** = 5\%$, and $*** = 1\%$.