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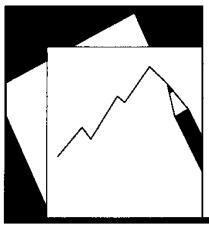

IMF Working Paper

Strategies for Fiscal Consolidation in Japan

Dennis Botman, Hali Edison, and
Papa N'Diaye

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Asia and Pacific Department

Strategies for Fiscal Consolidation in Japan

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Abstract

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Japan's key fiscal challenge is to put public finances on a more sustainable footing. This paper investigates the macroeconomic implications of alternative fiscal strategies for Japan using the IMF's Global Fiscal Model. The results suggest that: (i) an adjustment package that achieves primary balance through lower social transfers and government spending and a higher VAT is the most viable option and has a smaller negative impact on growth than other fiscal measures; (ii) achieving primary balance is not sufficient to stabilize the net debt ratio; (iii) prefunding future aging costs provides greater long-term benefits compared with less front-loaded strategies; (iv) tax reform involving shifting from corporate taxation to consumption taxation could mitigate the short-term output losses associated with fiscal consolidation; and (v) the spillovers to the rest of the world from consolidation in Japan are positive in the medium term, but modest.

JEL Classification Numbers: E62, F47, H20, H30, H63

Keywords: Fiscal adjustment, aging, debt sustainability, tax reform, spillover effects, GFM

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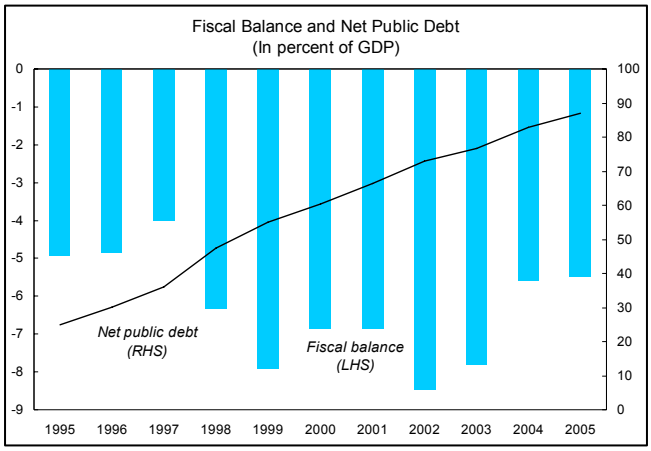
I. INTRODUCTION

Japan's key fiscal challenge is to put public finances on a more sustainable footing. Large government budget deficits have boosted Japan's net public debt to over 85 percent of GDP, one of the highest in the OECD.[2] In the years ahead, rising health and elderly care costs will add further strain to public resources. The Cabinet Office estimates, that in the absence of adjustment, social security expenditure will reach 22 percent of GDP by 2025, up from about 18 percent of GDP in 2005.[3] As a result, the government's net debt could rise to over 150 percent of GDP. Rising debt could increase interest rates, lower investment, and ultimately hamper growth in the context of population aging.



The authorities are committed to address these risks by achieving a primary balance of the general government (excluding social security) by 2011. Although the government has not yet announced a detailed plan on how to attain this target, there is a growing consensus that consolidation would contain a mixture of both expenditure and revenue measures. The debate focuses on how to design a successful adjustment, while minimizing the output costs.

This paper investigates the macroeconomic implications of alternative fiscal strategies that differ in the composition, pace, and timing of the measures. It uses a two-country version of the IMF's Global Fiscal Model (GFM), calibrated to the Japanese economy. Specifically, the paper poses the following questions:

- What are the costs of expenditure cuts versus selected tax increases?
- What is the effect of a more ambitious consolidation that aims at stabilizing the debt-to-GDP ratio rather than achieving primary balance?
- What is the trade-off between a gradual and a stop-and-go adjustment?
- What are the gains from a revenue-neutral shift from corporate taxation to consumption taxation? Could such a policy help offset some of the output costs of fiscal adjustment?
- What are the spillover effects of fiscal consolidation in Japan to its trading partners?

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[2] See Kaizuka and Krueger (2006).

[3] The 2004 reform of the pension system will help contain longer-term pension outlays by streamlining benefits and gradually increasing the contributions of employees and employers. Most of the remaining pressure on the budget will be related to healthcare.

II. ANALYTICAL FRAMEWORK

The framework used is a two-country version of the IMF's GFM calibrated to the Japanese economy.[4] In GFM, the impact of fiscal policy on real activity reflects responses from both aggregate demand and supply. Aggregate demand responses result from a non-zero effect of debt on interest rates and consumers' impatience. Aggregate supply responses arise from the distortionary effects of payroll and corporate income taxes.

In GFM, fiscal policy matters because of the following departures from Ricardian equivalence:

- Consumers have finite horizons. As a result, even temporary changes in fiscal policy may affect consumption because any offsetting action required by the government's intertemporal budget constraint is (perceived to be) borne by future generations. This follows from the overlapping-generations (or perpetual youth) structure of the model—consumers have finite lives as they face a constant probability of death (Blanchard, 1985; Weil, 1989; and Buiter, 1981).

- Taxes are distortionary because labor supply and capital accumulation decisions are endogenous and taxes are not lump sum. Households and firms change their labor supply and capital investment decisions with changes to labor and capital income tax rates. The extent to which these decisions are affected depends on the degree of competition in the labor and product markets. In GFM, these markets are not fully competitive. Firms and workers have some monopolistic power, so that prices and wages are above their perfectly competitive levels. In addition, profits reflect both returns to capital and economic rents extracted by firms. Compared with the case of perfect competition, these rents reduce the distortionary impact of corporate and personal income taxes.

- A fraction of consumers are liquidity constrained. Liquidity constrained consumers do not save and cannot borrow, and therefore any change in fiscal policy that affects their disposable income immediately changes their consumption as well.

The model incorporates five taxes: a labor income tax levied on wage compensation paid by workers or employers (payroll tax); a corporate income tax levied on including profits of firms; a personal income tax levied on labor income, accounting profits, government transfers, and interest income (on government bonds and net foreign assets); and a VAT which is levied on final consumption without exemptions—and is equivalent to a sales tax. Since liquidity constrained consumers have no wealth and do not save, they are not directly affected by corporate income taxes. It is assumed that for all four taxes, there is a single (although different) marginal rate, which coincides with the average tax rate. Revenues raised by taxation are spent on lump-sum transfers to consumers, government consumption of nontraded goods (home bias), and servicing government debt.

[4] The model has been applied by IMF staff for background work on recent Article IV consultations with Canada (Bayoumi and Botman, 2005), the United Kingdom (Botman and Honjo, 2006), and the United States (Bayoumi, Botman, and Kumar, 2005). A brief overview of the model is provided in the Appendix.

The model has been parameterized to reflect key macroeconomic features of Japan (Tables 1 and 2). In particular, the ratios of consumption, investment, government spending, wage income, and income from capital relative to GDP are set to their current values. Similarly, key fiscal variables—revenue to GDP ratios from taxation of corporate, labor, and personal income and consumption tax, as well as government debt and current government spending—have been calibrated to Japan's fiscal structure.[5]

The macroeconomic effects of fiscal consolidation are likely to be sensitive to the uncertainty about the behavioral response of consumers and producers to changes in tax policy and government spending. Behavioral parameters are based on micro-economic estimates and consistent with earlier studies on Japan (Table 2). These include parameters characterizing rigidities in investment, markups for firms and workers, the elasticity of labor supply, the elasticity of substitution between labor and capital, the elasticity of intertemporal substitution, and the rate of time preference.[6]

- *The sensitivity of labor supply to the real wage.* The baseline value (0.08) is at the mid-range of values found by micro-economic studies. An alternative simulation assumes a value close to the lower limits of these estimates representing the case of inelastic labor supply.

- *The elasticity of intertemporal substitution.* The baseline value for this parameter that describes the sensitivity of consumption to changes in the real interest rate is 0.33. The parameter value in the alternative simulation (0.2) is consistent with the lower end of microeconomic estimates.

- *The wedge between the rate of time preference and the yield on government bonds*. This parameter—which determines consumers' degree of impatience—has not been subject to extensive microeconomic analysis. The baseline value of the wedge is set to 5 percent, with an alternative simulation using 10 percent. The baseline value implies an effective planning horizon of twenty years, which is obviously much lower than the probability of survival for most of the population, but it is a simple way of introducing a form of myopia into the model.

- *The fraction of consumers that does not have access to financial markets*. In the baseline, 40 percent of the population is assumed to be liquidity constrained and consumes its entire disposable income every period. This translates into about 20 percent of total private consumption, since these agents have no wealth. To investigate the importance of

[5] The tax rates for the VAT, social security contributions by employers, personal income tax, and corporate income tax are calibrated such that the revenue yield as a share of GDP is equal to figures observed in Japan. The tax rate for social security contributions by workers, on the other hand, adjusts endogenously in the model such that the initial steady-state is consistent with a stable debt path—taking into account the revenue from other sources, spending on goods and transfers, and financing costs of the initial level of government debt.

[6] For a discussion of empirical estimates of structural parameters see Laxton and Pesenti (2003) and Batini and others (2005).

this assumption, an alternative simulation assumes that all consumers can use financial markets to smooth their consumption over time.

Other main aspects of the model are:

- Consumption and production are characterized by constant elasticity of substitution functions.

- There are traded and non-traded goods that allow for a bias toward domestic goods in private or government consumption.

- There are two factors of production—capital and labor—which are used to produce traded and non-traded goods. Capital and labor can move freely between sectors, but are not mobile internationally.

- Investment is driven by a Tobin's Q relationship, with adjustment costs. Firms respond sluggishly to differences between the discounted value of future profits and the market value of the capital stock.

- Wages and prices are fully flexible. The central bank implements money targeting.

- There are two kinds of financial assets, government debt (traded internationally) and equity (held domestically). International trade in government debt implies the equalization of nominal interest rates across countries over time. However, real interest rates across countries could differ because of the presence of non-traded goods and home bias in consumption.

III. Alternative Fiscal Adjustment Strategies

A. Composition of Fiscal Adjustment

In principle, a primary balance could be attained by 2011 through expenditure or tax measures (amounting to around ½ percent of GDP each year) or some combination of both. In particular, the structure of the model permits to consider the following options: (i) lower government transfers, (ii) lower government spending, (iii) higher workers' social security contribution, (iv) higher employers' social security contribution, (v) higher personal income taxes, (vi) higher corporate income taxes, (vii) higher consumption taxes, or (viii) a package that combines some expenditure reductions and some tax increases.

Given the size of the necessary adjustment, consolidation is likely to be accomplished through a combination of expenditure and revenue measures. As shown in the text table, if the adjustment relies solely on one type of measure, substantial changes will be necessary. For example, reaching a primary balance by 2011 would require: a doubling of the consumption tax rate to 10 percent; a 5 percentage-point increase in the corporate income tax; or about a 25 percentage-point cut in "discretionary" spending of the central government's general account (as defined in the table).

Illustrative Fiscal Consolidation Measures

(In percent)

	Before	After
Revenue		
Consumption/sales tax (VAT)		
Actual rate	5.0	10.0
Effective rate	4.5	8.3
Revenue (in percent of GDP)	2.0	4.5
Corporate income tax (CIT)		
Actual rate		
Effective rate	7.5	12.5
Revenue (in percent of GDP)	2.6	5.1
Employers' Social Security contribution (ESSC)		
Actual rate		
Effective rate	11.0	22.3
Revenue (in percent of GDP)	4.7	7.2
Personal income tax (PIT)		
Actual rate		
Effective rate	9.5	12.0
Revenue (in percent of GDP)	2.5	5.0
Workers' Social Security contribution (WSSC)		
Actual rate		
Effective rate	20.1	27.6
Revenue (in percent of GDP)	5.6	8.1
Expenditure		
Spending on goods and services 1/		
In percent of GDP	6.2	3.7
Percent change		-25.0 3/
Transfers 2/		
In percent of GDP	4.1	1.6
Percent change		-54.3 3/

Sources: IMF staff estimates.

1/ Includes education and science, energy measures, major foodstuff measures, national defense, miscellaneous, local allocation tax, special local allocation tax, transfer to the industrial investment special account, small business, economic assistance, and contingencies.

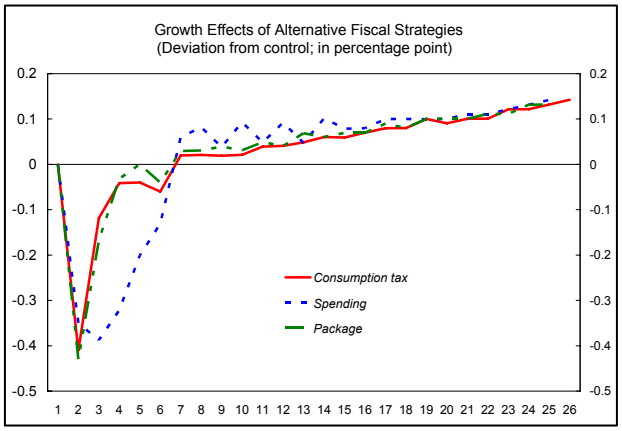
2/ Includes social security and government employee pension and others.

3/ Cumulative percent change 2006–11.

The simulations show that in the short run there are modest differences in the output cost of the various options. In particular, a strategy based on reducing only social security transfers would be less damaging to economic growth than one based on cutting other spending or increasing taxes. Specifically:

- Reducing transfers act just like increasing a lump-sum tax. It does not distort consumers' labor efforts decisions. Therefore, it limits the fall in output to the reduction in the demand of liquidity constraint households.

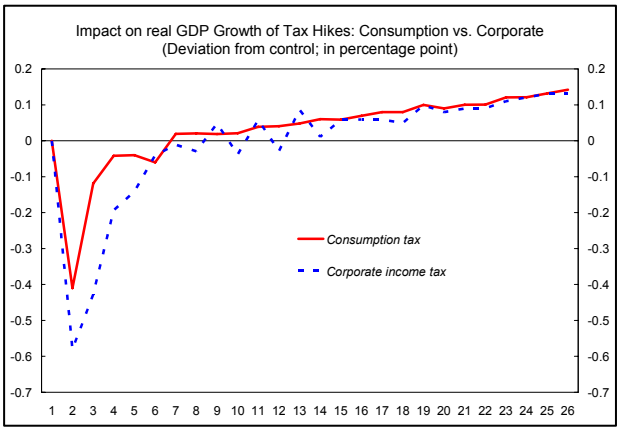
- An increase in the consumption tax has qualitatively similar effects to a cut back of social transfers, but these effects are amplified. A higher consumption tax reduces output and nominal interest rates. Notwithstanding a reduction in prices, real interest rates decline supporting investment and limiting the decline in output. On the external front, lower imports improve the current account.



- A reduction in government spending decreases demand, particularly that of non-traded goods, and leads to a decline in nominal interest rates and prices. As prices fall less than interest rates, an increased real interest crowds out private investment, which reinforces the adverse effects of fiscal consolidation on output. On the external side, the real exchange rate depreciates, although by less than in the case of the consumption tax increase or a transfer cut, providing less of a support to the strengthening of the current account.[7]

- Finally, a package of measures involving lower government spending and higher taxes would have an impact on growth that compares favorably with that of a strategy based solely on increasing the consumption tax rate or on reducing government expenditure.[8] This result is independent of the sequencing of these measures.

Among the revenue measures, a consumption tax increase has the least negative effect on output.



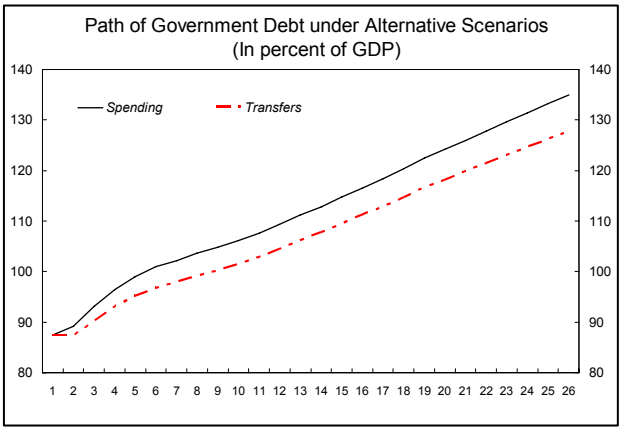
- This result stems from the fact that the tax base is the discounted stream of future income and accumulated savings. With this tax base, the distortion in the consumption-leisure decision is more limited. By contrast, if consumption were to depend only on current income, then a consumption tax would be equivalent to a payroll tax.

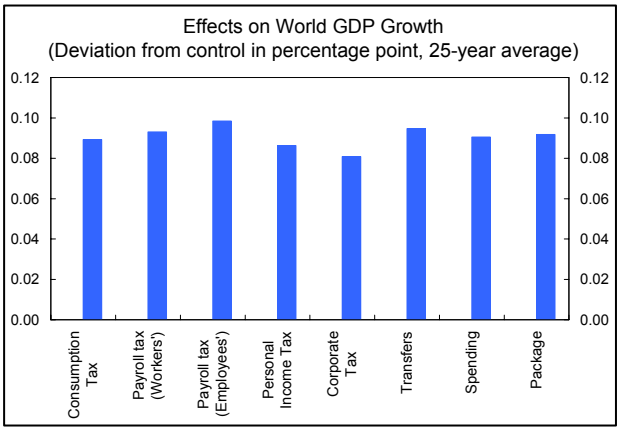
[7] GFM does not include nominal rigidities, which explains the negative correlation between government spending and private consumption. Thus, despite the presence of rule-of-thumb consumers and monopolistic competition, GFM replicates the result obtained in real-business cycle models (see Galí, López-Salido, and Vallés, 2005; Fatás and Mihov, 2001; Blanchard and Perotti, 2002; and Perotti, 2004; for theoretical and empirical work in support of the Keynesian view).

[8] The package includes a reduction in spending of 0.5 percent of GDP during the first two years, followed by a lowering of transfers by 0.5 percent of GDP a year for the next two years, and a 1-percentage point increase in the consumption tax rate in the fifth year.

- Raising the corporate income tax rate would involve larger short-term output costs than other taxes because it directly discourages investment (by raising the after-tax cost of capital) in addition to the negative impact on consumption (for those consumers who own capital).[9] These adverse effects are somewhat mitigated by a fall in real interest rate following consolidation. Overall, the effect of corporate taxation on the economy depends on how sensitive capital and labor are to changes in the respective tax rates. The current calibration of the model is such that capital is more sensitive to taxes than labor, a feature in line with empirical evidence.[10]

The strategies simulated above achieve a primary balance for the general government (excluding social security), but do not stabilize the debt ratio. The net debt ratio rises to around 130 percent of GDP from 90 percent of GDP after 25 years. The consolidation scenario with transfers yields the lowest debt ratio (around 125 percent) mostly because of a more favorable impact on output. Lowering government spending on goods and services, on the other hand, would generate the highest debt ratio (around 135 percent), as the real interest rate tends to be higher and GDP lower.





The planned consolidation of 2½ percent over 5 years will have limited spillover effects to the rest of the world. This result is largely invariant to the consolidation strategy. Spillover effects occur in the model through two channels: trade and financial.

- Initially, consolidation lowers Japan's demand for imports, which reduces foreign growth. However, given the share of the Japan's economy in world output and the share of net external demand on foreign output the effect on world output is small (trade channel).

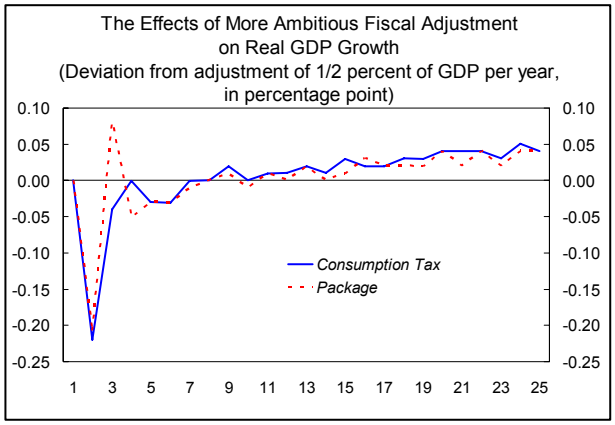
- In the medium term, a lower debt ratio is associated with higher national savings, lower world interest rates, and higher investment at home and abroad (finance channel).

[9] This result is in line with evidence from Baylor (2005).

[10] The model probably understates the sensitivity of investment to taxation as capital is not internationally mobile.

B. Size, Pace, and Timing of Adjustment

An alternative consolidation plan that envisages a larger consolidation would stabilize the debt ratio and secure longer-term gains. Debt stabilization will require an adjustment of at least ¾ percent of GDP on average per year or 3¾ percent of GDP over 5 years. This adjustment entails larger output costs in the short-run, but would raise longer-term growth. In particular, labor effort and consumption are stimulated in the longer-term, relative to the baseline, because a lower debt ratio reduces the anticipated tax burden, and thus raises after-tax real wages. The positive effect on output increases with the size of the effect of the interest rate on consumption, which in turn depends on how impatient consumers are.

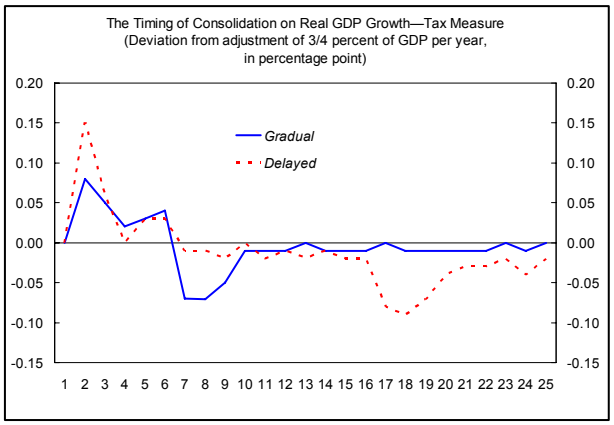


The rest of the world also benefits from debt stabilization in Japan since world interest rates are lower. Although consolidation in Japan reduces demand for imports, this effect is more than compensated by the decline in the demand for world saving, which creates financing room for additional capital spending in the rest of the world.

The timing of the adjustment also matters. We have simulated two alternative scenarios to stabilize the debt ratio: a gradual and stop-and-go scenario. The gradual scenario envisages a sustained adjustment of ½ percent of GDP a year over eight years (to yield the primary surplus (excluding social security) necessary to stabilize the debt ratio). The stop-and-go scenario envisages a pause in the adjustment for three years (see text table below). The simulations show that less front-loaded adjustment limits the short-term negative effects of consolidation on growth but also reduces the long-term benefits. This stems from the fact that the delayed adjustment yields higher debt, which in turn would crowd out private domestic and foreign investment through higher interest rates.[11]

Illustrative Consolidation Scenarios

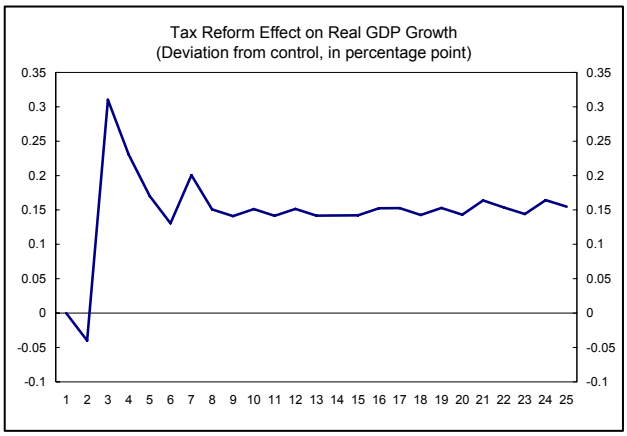
		Stabilizing debt-to-GDP ratio		
Year	Achieving primary balance	Front loading	Gradual	Stop-and-go
1	0.5	1	0.5	0.5
2	0.5	1	0.5	0.5
3	0.5	0.75	0.5	0.5
4	0.5	0.5	0.5	0.5
5	0.5	0.5	0.5	0.5
6	0	0	0.5	0
7	0	0	0.5	0
8	0	0	0.25	0
9	0	0	0	0.5
10	0	0	0	0.5
11	0	0	0	0.25



[11] This trade-off increases with the shortening of consumers' planning horizon as future consolidation measures are less discounted. It should also be noted that GFM does not incorporate menu costs, which may provide an additional reason against a gradual increase particularly in the consumption tax rate.

IV. TAX REFORM

With Japan having the highest statutory corporate tax rates and the lowest consumption tax rate compared with other G8 countries, there is scope for some tax reform that could enhance the efficiency of the current tax system as taxation of corporate (or labor income) is more distortionary than indirect taxation. Substituting direct taxation with indirect taxation would also be more "growth" friendly. To analyze the potential gains of such a reform in Japan, we consider a reduction in the effective corporate income tax rate by 0.5 percentage point a year for five years, offset by increases in the VAT rate that leaves the reform revenue neutral. With the VAT having a broader tax base than the corporate income tax, the required increases in the effective VAT rate is about 2 percentage points, slightly less than the envisaged decline in the corporate income tax rate.



Reducing corporate income taxation in a revenue-neutral manner by increasing the VAT has significant long-term positive effects. In the short run, a small and temporary decline in real GDP occurs as the higher VAT rate dampens consumption, particularly that of liquidity constrained consumers (this type of tax reform is regressive). Over time, however, national saving increases substantially, the interest rate declines, and increased capital accumulation results in output increasing. As such, this particular type of tax reform also contributes to improving the current account balance in a sustained manner.

Overall, revenue-neutral tax reform could mitigate the adverse effects of fiscal adjustment in Japan. The fall in corporate taxes spurs investment, and ultimately output growth. On the external side, the spillovers to the rest of the world would be positive, albeit modest. Moreover, a revenue-neutral shift to taxation of consumption also could be justified on intergenerational equity grounds since it would foster burden-sharing in the context of an aging population.

V. SENSITIVITY ANALYSIS

The non-Ricardian setting of GFM suggests that the planning horizon of consumers, the fraction of liquidity constrained consumers, and the elasticity of labor supply could be fundamental determinants of the qualitative and quantitative effects of fiscal policy. Furthermore, as GFM is rooted in consumer and producer optimization, the intertemporal elasticity of substitution and the substitutability between capital and labor could also affect

the results derived above.[12] Nonetheless, sensitivity analysis indicates that the results outlined above are robust to changes in the behavioral parameters of the model. In particular,

- The relative impact of alternative consolidation measures depends on the sensitivity of workers to changes in real wages. Consolidation through expenditure reduction becomes more attractive if workers are more sensitive to changes in real wages. In this case, a payroll tax or a consumption tax increase would have a larger impact on their consumption-leisure decision.

- The impact of the timing of consolidation depends on the planning horizon of consumers and how sensitive they are to changes in the interest rates. The longer the planning horizon, the smaller the impact of fiscal consolidation on the real interest rates and current account. The sensitivity of consumers to changes in interest rates depends on the degree of impatience of consumers (the intertemporal elasticity of substitution). With a lower degree of impatience (higher intertemporal elasticity of substitution), consumption would be more sensitive to changes in interest rates, which implies that smaller changes to interest rates will be necessary to re-equilibrate world savings and investment flows.

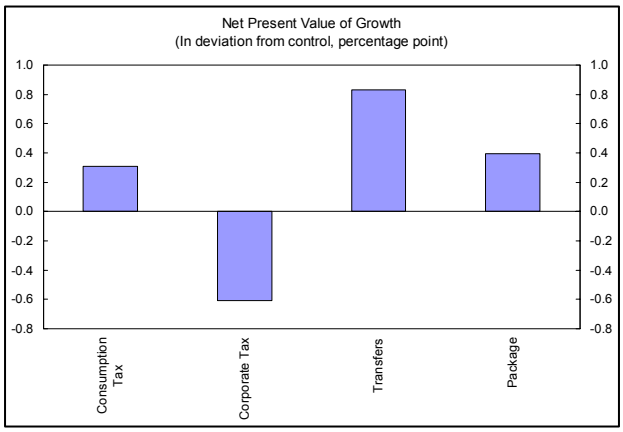
- The benefits of tax reform are robust to alternative assumptions on other key behavioral parameters and the spill-over effects remain modest, but positive. For example, less elastic labor supply increases the benefits of moving from taxation of corporate income towards indirect taxation. A lower intertemporal elasticity of substitution reduces the sensitivity of savings to changes in interest rates, which implies a larger negative effect on interest rates from tax reform. Lower markups on prices—a proxy for higher competition in the product market—increases the distortionary effects of corporate income taxation as a larger share of the tax burden falls on capital rather than on rents. At the same time, the benefits of this type of tax reform are somewhat smaller with lower markups because with higher competition wages bear a larger share of the burden of adjustment. The planning horizon of consumers and access to financial markets have a somewhat more limited impact on the benefits of tax reform with the effects depending largely on whether households perceive the reform-induced changes in the tax rates as permanent or transitory. Finally, by stimulating saving and encouraging investment, this type of tax reform implies positive, but modest spill-over effects to the foreign economy in most cases.

VI. CONCLUSION

The key issue in the fiscal debate in Japan is the design of fiscal adjustment, particularly the desirable mix of expenditure and revenue adjustment as well as the magnitude, pace, and timing of adjustment measures. The simulations presented in this paper show that in the short run the design of fiscal adjustment matters for growth. On balance, the short-term output

[12] See also Botman and Kumar, 2006, for an analysis of these and other fundamental determinants of various fiscal policies, for a representative small and large open economy.

losses may be carried over for quite some time before being fully recovered. Net present value calculations indicate that the cumulative impact of consolidation on growth is nonetheless positive for strategies based on reducing transfers, increasing the consumption tax, or a combination of expenditure cuts and tax increases. The results also indicate that the cumulative impact is negative for strategies based on raising corporate taxes or personal income taxes.



A front-loaded consolidation that accounts for future aging costs and stabilizes the debt ratio entails greater long-term benefits than an adjustment that targets primary balance (excluding social security). However, such a strategy carries somewhat larger short-term output costs. A less front-loaded or a stop-and-go approach limits short-term output costs, but also reduces longer-term benefits. Shifting from corporate taxation to consumption taxation facilitates fiscal adjustment and locks in permanent gains. The spillover to the rest of the world from consolidation in Japan are positive in the medium term, but modest.

Table 1. Key Macroeconomic Variables in the Initial Steady State

	Japan	Rest of the World
Country size	11.5	88.5
Percent share of world real income	11.4	88.7
National expenditure accounts at market prices		
Consumption	57.0	51.5
Rule-of-thumb	12.4	7.2
Forward-looking	44.6	44.3
Domestic	47.4	50.1
Imported	9.5	1.4
Investment	18.1	18.7
For tradables	3.1	4.2
For non-tradables	15.0	14.6
Domestic	15.1	18.2
Imported	3.0	0.5
Government expenditures	22.7	30.0
Exports	14.4	1.6
Of consumption goods	10.4	1.2
Of investment goods	4.0	0.4
Imports	12.2	1.8
Of consumption goods	9.1	1.3
Of investment goods	3.0	0.5
Tradable/nontradable split		
Tradables	15.7	20.2
Domestic	1.1	18.6
Imported	12.3	1.9
Net exports	2.3	-0.3
Nontradables	84.3	79.8
Factor incomes		
Capital	37.7	36.1
Labor	62.4	63.9
Interest rate		
Real short-term interest rate	2.0	2.0
Government		
Debt	87.5	40.0
Tax rates		
On workers' social security contribution (effective)	20.1	32.4
Revenue as a percent of GDP	4.8	11.7
On employers' social security contribution (effective)	11.0	11.0
Revenue as a percent of GDP	4.5	5.0
On corporate income		
Revenue as a percent of GDP	3.7	3.3
Of which: on capital income	7.5	7.5
Of which: revenue as a percent of GDP	1.0	1.0
Of which: on dividend income (profits)	7.5	7.5
Of which: revenue as a percent of GDP	2.7	2.3
On personal income	9.5	9.5
Revenue as a percent of GDP	7.5	7.1
On consumption (effective VAT rate)	4.4	6.0
Revenue as a percent of GDP	2.5	3.0

Source: GFM simulations.

Table 2. Behavioral Assumptions and Key Parameters in the Initial Steady State

	Japan	Rest of the World
Behavioral assumptions subject to sensitivity analysis		
Planning horizon of consumers	20 years	12.5 years
Labor disutility parameters	0.92	0.92
Fraction of rule-of-thumb consumers	0.40	0.25
Intertemporal elasticity of substitution	0.33	0.33
Other key parameters		
Elasticity of substitution between capital and labor	0.93	0.93
Effective discount rate	0.92	0.92
Depreciation rate on capital	0.12	0.07
Capital adjustment cost parameters	1.00	0.60
Elasticity of substitution between varieties		
Tradables sector	4.85	7.67
Price markup over marginal cost	1.26	1.15
Nontradables sector	3.44	4.23
Price markup over marginal cost	1.41	1.31
Capital share in production tradables sector	0.42	0.42
Capital share in production nontradables sector	0.42	0.42
Utility from real money balances	0.02	0.02
Price stickiness parameters	0	0
Home bias in government consumption	yes	yes
Home bias in private consumption	no	no
Elasticity of substitution between traded and nontraded goods	0.75	0.75
Bias toward domestically produced tradables over nontradables	0.20	0.30

Source: GFM simulations.

APPENDIX: SUMMARY OF THE IMF'S GLOBAL FISCAL MODEL

This paper uses a two-country version of GFM. Japan is the home country and the foreign country represents the rest of the world. In each period, *n* individuals are born in the home economy and *1-n* individuals are born in the foreign economy. Under the assumption that consumers face identical probabilities of survival that are identical across countries, the relative size of the home economy versus the foreign economy will be equal to *n/(1-n)*.

There is a unit measure of monopolistic firms in the world producing intermediate goods which are traded internationally, with *n* of those located in the home economy and *1-n* located abroad. Firms survive forever and each firm specializes in the production of a single differentiated variety. As is customary in these models, the intermediate tradable goods are combined into a final traded good. A similar structure of production exists in the nontraded goods sector.

Asset markets are incomplete. The only assets traded internationally are nominal non-contingent bonds issued by each region. Both bonds are assumed to be denominated in the home currency. There is complete home bias in equity holdings: all shares of domestic (foreign) firms are owned by home (foreign) residents. The same assumption is made for government debt.

The equations below apply to both the home country and the rest of the world unless noted otherwise.

Households

In each period *t*, *n* individuals are born in the home country, where the world population is normalized to unity. Each agent has a planning horizon of *1/(1-q)* derived from the constant probability of survival *q*. A representative agent born in period *a* derives utility from consumption, *C*, leisure, *(1-L)*, where *L* denotes labor effort, and real money balances, *(M/P)*, which are described by the following utility function:

$$U_t = E_t \sum_{t=0}^{\infty} (q\beta)^t \left[\frac{\left(C_{a,t}^{\eta} \left(1 - L_{a,t}\right)^{1-\eta} \right)^{1-\rho}}{(1-\rho)} + \frac{\chi}{1-\rho} \left(\frac{M_{a,t}}{P_t} \right)^{1-\rho} \right]$$

where E_t denotes the mathematical expectation conditional on information available at time *t*, β is the subjective discount factor, $\rho>0$ is the inverse of the intertemporal elasticity of substitution, and we restrict the remaining parameters such that $0< \eta<1$ and $\chi>0$. Notice that with a constant probability of death, the agent discounts the future by an additional factor *q*.

As in Blanchard (1985) we assume the existence of insurance companies which charge a premium *(1-q)/q* to each agent that survives in a period and also confiscates the wealth of deceased agents and redistribute it to newborns and surviving generations. Denoting

government debt with $B_{a,s}$, Π after tax dividends by the firms, τ_L labor income tax, Φ any relevant rebates, P the aggregate price index, W the nominal wage, S the nominal exchange rate, $A_{a,t} = F_{a,t} + S_{t-1} F^*_{a,t}$ net foreign assets (NFA), V_i the value claim to all future profits of firm i, where $i \in [0,n]$, and, finally, $x^i_{a,t}$ the share of firm i owned by the representative agent born in period a in the beginning of period t, we have the agent's nominal budget constraint (abstracting from personal income taxation for simplicity):

$$P_t C_{a,t} + M_{a,t} + F_{a,t+1} + S_t F^*_{a,t+1} + \int V^i_t x^i_{a,t+1} di$$
$$= \frac{1}{q}\left[M_{a,t-1} + (1+i_t)(B_{a,t} + F_{a,t}) + (1+i^*_t) S_t F^*_{a,t}\right]$$
$$+ \frac{1}{q}\left[(1-\tau_l) W_t L_{a,t} + \int V^i_t x^i_{a,t} di + \int \Pi^i_t x^i_{a,t} di + \Phi_t\right]$$

Maximizing the utility function subject to the budget constraint yields optimality conditions that dictate the agent's behavior. Among them is a Euler equation (stating the preference to smooth consumption), and a labor supply schedule. It is important to underscore that because agents choose the amount of labor effort optimally, the labor income tax will have distortionary effects on the consumption and leisure choices. Furthermore, since NFA is composed of a home and a foreign asset, a standard uncovered interest parity (UIP) condition follows from the households' optimization problem, which underpins the main financial linkage between countries.

Botman, Laxton, Muir, and Romanov (2006) show that using the budget constraint along with the first order conditions, the decision rule of the optimizing agents, denoted $C^{opt}_{a,t}$ can be written as the sum of human wealth, $H_{a,t}$, and financial holdings:

$$P_t C^{opt}_{a,t} = \frac{1}{D_t}\left\{H_{a,t} + \frac{1}{q}\left[M_{a,t-1} + (1+i_{t-1})(A_{a,t-1} + B_{a,t-1})\right]\right\},$$
$$H_{a,t} = \sum_{s=t}^{\infty} R_{t,s} q^{s-t} (1-\Psi)\left[(1-\tau_{L,s}) W_s L_s + \Theta_s\right],$$

Where, for simplicity, we assume that period profits (captured by the term Θ_s) are distributed equally across consumers. Also, Ψ denotes the share of rule-of-thumb consumers and D_t is the marginal propensity to consume out of total wealth. Aggregate consumption by rule-of-thumb consumers is given by:

$$P_t C^{rot}_{a,t} = \Psi\left[(1-\tau_{L,s}) W_s L_s + \Theta_s\right],$$

The final consumption good in the home economy comprises traded, C_T, and nontraded, C_N, goods, and takes the form:

$$C = \left[\gamma^{\frac{1}{\varepsilon}} C_T^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma)^{\frac{1}{\varepsilon}} C_N^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

In turn, C_T is composed of home, C_H, and foreign, C_F, goods, which is also aggregated using a similar CES function. Both the traded and nontraded goods are themselves baskets of individual goods. For example, the nontraded good is composed of varieties, $C_N(i)$, produced by an arbitrary firm in the nontraded goods sector, with $i \in [0,n]$. More formally:

$$C_N = \left[\left(\frac{1}{n} \right)^{\theta} \int \left(C_N(i) \right)^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}}$$

The domestic traded good, C_H, is a similar basket of differentiated varieties. With the standard restrictions on parameters, we can obtain an optimization-based price index for each consumption aggregate.

Firms

A typical firm, in either sector, maximizes the discounted value of current and future dividends, subject to a CES production technology, and a law of motion for capital. Denoting output with Y, capital with K (subject to quadratic adjustment costs), investment with I, productivity with Z, and the corporate income tax rate with τ_n, we have:

$$Max \sum_{s=t}^{\infty} R_{t,s} P_s \left[\Pi_{i,s} - \tau_{\Pi,s} P_s \left(MPK_s - \delta \right) K_s \right]$$

$$\Pi_{i,s} = \left(1 - \tau_{\Pi,s}\right) \left[\frac{\left(P_s(i)\right)^{1-\theta}}{\left(P_{H,s}\right)^{\theta}} Y_s - W_s L_{i,s} - P_s \left(I_{i,s} + \frac{\psi}{2} \frac{I_{i,s}^2}{K_{i,s}} \right) \right]$$

$$Y = \left[\mu^{\frac{1}{\xi}} K^{\frac{\xi-1}{\xi}} + (1-\mu)^{\frac{1}{\xi}} (ZL)^{\frac{\xi-1}{\xi}} \right]^{\frac{\xi}{\xi-1}}$$

$$K_{i,s+1} = (1-\delta) K_{i,s} + I_{i,s}$$

where δ, ξ, μ, θ, and MPK denote the rate of capital depreciation, the elasticity of substitution between the factors of production, the bias towards the use of capital in the production function, the elasticity of substitution between the goods produced by the firm, and the marginal product of capital, respectively. Firms choose the optimal levels of capital and labor for production, but, exploiting their monopoly power, they also optimally set the price of their individual variety above marginal cost. Notice that the corporate income tax applies to both the return of capital and excess profits resulting from monopolistic competition.

Government and Fiscal Policy

All government spending, *G*, falls on nontraded goods. Expenditures are financed by collecting taxes, issuance of debt, and seignorage. The nominal government budget constraint is therefore:

$$P_{N,t}G_t + (1+i_t)B_t = T_t + (M_t - M_{t-1}) + B_{t+1}$$

Fiscal closure is achieved by specifying a target path for the desired level of government debt as a ratio of GDP, denoted by b^*. In the standard version of GFM, the aggregate tax rate, τ, adjusts until the actual debt-to-GDP ratio coincides with the target. By default, the change in the aggregate tax rate is achieved through a change in the labor income tax, but alternative adjustment (personal or corporate income taxation) are possible as well. The tax rate is determined by the following set of equations:

$$\tau_t = \varphi_t(\tau_t + debtgap_t) + (1-\varphi_t)\bar{\tau}_t,$$
$$debtgap_t = \left(\frac{B_t}{GDP_t} - v_1 b_t^* - (1-v_1)\frac{B_{t-1}}{GDP_{t-1}}\right) + v_2\left(\frac{\Delta B_t}{GDP_t} - \Delta b_t^*\right),$$

where φ is an exogenous (or dummy) variable that can temporary fix the tax rate at a certain level, $\bar{\tau}$. As shown in Botman et al. (2006), in the case when $\varphi=1$, this rule reduces to a simple error-correction formulation whereby the gap between the actual and desired government debt-to-GDP ratio gradually disappears. More specifically:

$$\frac{B_t}{GDP_t} = v_1 b_t^* + (1-v_1)\frac{B_{t-1}}{GDP_{t-1}} - v_2\left(\frac{\Delta B_t}{GDP_t} - \Delta b_t^*\right),$$

where the term $v_2>0$, prevents excessive cycling in the tax rate and the real economy.

Characteristics of the "Rest of the World"

The current account balance for the home economy is the sum of interest receipts on the stock of net foreign assets plus the trade balance:

$$CBAL_t = i_{t-1}A_{t-1} + TBAL_t,$$

where $TBAL_t$ is defined to be equal to nominal exports minus nominal imports. The change in net foreign assets will simply be equal to the current account balance. For the foreign economy the mirror image of this expression will be the following:

$$A_t^* = -\frac{n}{1-n}\frac{A_t}{S_t},$$

where S_t denotes the nominal exchange rate, which (with RER_t denoting the real exchange rate) is equal to:

$$S_t = RER_t \frac{P_t}{P_t^*}$$

From the uncovered interest parity UIP condition, the real exchange rate, with r denoting the real interest rate, will be the following.

$$RER_{t+1} = RER_t \frac{1+r}{1+r^*}$$

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