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Abstract

The Bank of Canada Global Economy Model (BoC-GEM) is used to examine the effect of various types of discretionary fiscal policies on different regions of the globe. The BoC-GEM is a microfounded dynamic stochastic general-equilibrium global model with six regions, multiple sectors, and international linkages. The authors use the model to assess four main fiscal policy concerns: (i) how the effect of an isolated local fiscal stimulus differs from one jointly implemented in all regions; (ii) which regions are most likely to gain from joint fiscal stimuli, and why; (iii) how the impact of fiscal stimulus can differ conditional on how it is implemented, its timing and duration, and its magnitude relative to that of other regions; and (iv) how the impact of fiscal policy is affected by the inability of monetary policy to push nominal interest rates below zero. The authors use their results to gauge the potential effect of fiscal policy initiatives of the G-20 countries in 2009 and 2010.

JEL classification: E52, E58, E61, E63, F42
Bank classification: Business fluctuations and cycles; Fiscal policy; International topics; Recent economic and financial developments

Résumé

Les auteurs utilisent BOC-GEM, le modèle de l'économie mondiale de la Banque du Canada, pour examiner les effets de diverses politiques budgétaires discrétionnaires sur les différentes régions du monde. BOC-GEM est un modèle d'équilibre général dynamique stochastique qui repose sur des fondements microéconomiques; il compte six blocs régionaux et plusieurs secteurs et intègre des liens internationaux. Les auteurs concentrent leur analyse sur quatre aspects. Ils cherchent à établir : 1) en quoi les retombées de mesures de relance budgétaire purement internes diffèrent de celles de mesures concertées dans l'ensemble des régions; 2) quelles régions sont les plus susceptibles de bénéficier de mesures coordonnées et pourquoi; 3) à quel point les effets d'un programme de relance peuvent dépendre du mode et du moment de sa mise en œuvre, de sa durée et de son importance par rapport à celle des programmes appliqués ailleurs; 4) si l'incapacité des autorités monétaires à abaisser les taux d'intérêt nominaux au-dessous de zéro modifie les effets de la politique budgétaire. Les auteurs se fondent sur leurs résultats pour évaluer l'incidence potentielle des mesures de relance budgétaire adoptées par les pays du G20 en 2009 et 2010.

Classification JEL : E52, E58, E61, E63, F42
Classification de la Banque : Cycles et fluctuations économiques; Politique budgétaire; Questions internationales; Évolution économique et financière récente

1 Introduction

In response to the largest recession experienced since the 1930s, many countries around the world implemented large expansionary fiscal measures to mitigate the effects of the global financial crisis and jump-start their economic recovery. This paper summarizes a number of analyses that were done as events were unfolding to gauge the probable impact of these fiscal initiatives.

Previous empirical estimates of the impact of fiscal stimulus vary widely, depending on the method used. Simultaneity problems and delayed responses also cause problems in estimation (Freedman et al. 2009). Structural vector autoregressions (VARs) have dominated this research and researchers typically find small impacts of expansionary credit-financed fiscal policies (Blanchard and Perotti 2002). Recent research using VARs has focused on the timing and identification of fiscal stimulus (Ramey 2009). Single-equation and reduced-form approaches find similar results, with fiscal multipliers less than one, and more muted effects of tax-based initiatives relative to expenditure-based measures (Hemming, Kell, and Mahfouz 2002).[1] In contrast, Romer and Romer (2009), using a narrative approach to identification in the United States, find robust estimates of tax multipliers of 2.5 to 3.

In this paper, we carry out the analysis via simulations with a modified version of the Bank of Canada Global Economy Model (BoC-GEM). The model has three distinct features that make it suitable for this type of analysis. First, it is a dynamic stochastic general-equilibrium (DSGE) model in the New Keynesian tradition that includes both Ricardian and liquidity-constrained, or "rule-of-thumb," consumers.[2] Second, it has rich international linkages that can reflect trade spillovers of foreign policy shocks. Finally, the presence of endogenous oil and commodity markets captures the effects of these prices on the real economy induced from the global stimulus.

We use the BoC-GEM to assess four main fiscal policy concerns: (i) how the effect of an isolated local fiscal stimulus differs from one jointly implemented in all regions; (ii) which regions are most likely to gain from joint fiscal stimuli, and why; (iii) how the impact of fiscal stimulus can differ conditional on how it is implemented, its timing and duration, and its magnitude relative to that of other regions; and (iv) how the impact of fiscal policy is affected by the inability of monetary policy to push nominal interest rates below zero.

1. Sustained changes of government consumption multipliers for the United States are generally found to exist in the range of 1.1 to 1.3, with more temporary stimulus having a range of 0.6 to 1.5. Discretionary tax cuts have less of an impact on GDP than expenditure-based stimuli ranging from 0.6 to 0.7.
2. Studies have shown that Ricardian equivalence – which implies that consumers are insensitive to fiscal initiatives financed by public borrowing because they automatically anticipate the future tax implications (Barro 1979) – is not empirically validated (e.g., Cardia 1997). All else equal, tax-based stimuli have a higher impact on GDP in economies that have a higher ratio of liquidity-constrained consumers (Jappelli and Pagano 1989). Thus, models typically assume partial Ricardian equivalence (e.g., Evans 1993; Sgherri and Bayoumi 2006).

We examine the impact that seven fiscal instruments have on GDP: (i) labour and (ii) capital income taxes, (iii) general transfers and (iv) targeted transfers (i.e., targeted to "rule-of-thumb" consumers), (v) government expenditure on investment goods, (vi) consumption goods, and (vii) government services. The effects of local versus joint or global measures are analyzed for different fiscal instruments, and the implications of a constraining zero lower bound are examined. While all simulations are carried out from an initial steady-state position, the non-linearities in the BoC-GEM are not sufficiently important for the initial starting point to affect the results either quantitatively or qualitatively.

Our major findings can be summarized as follows:

- Joint fiscal action is quite powerful, magnifying for all regions – though in various degrees – the impact of domestic actions, since, from a global perspective, external leakages are limited.
- A region is most likely to gain[3] from joint fiscal stimuli initiatives the smaller it is; and the smaller its own fiscal stimulus, the more open it is to international trade, and the more its policies are slanted towards tax cuts relative to other regions.
- A binding zero lower bound for monetary policy increases the leverage of fiscal policy, since crowding-out effects are forestalled.
- The distributions of gains for each region depend upon terms-of-trade effects that reflect trade specialization. Net importers of investment and consumption goods experience higher leakages through imports and negative terms-of-trade shocks (reducing the effect of domestic fiscal stimuli), whereas net exporters of commodity goods and crude oil experience positive terms-of-trade shocks.
- For all regions, the timing of the stimulus will influence the gains from simultaneity.

The rest of this paper is organized as follows. Section 2 briefly reviews the BoC-GEM's properties that matter for fiscal policy. Section 3 compares isolated versus joint fiscal stimuli effects. Section 4 describes various alternative scenarios. Section 5 assesses the G-20 fiscal initiatives. Section 6 offers some conclusions.

2 The BoC-GEM

In this section, we focus on the non-Ricardian features of the BoC-GEM, its production structure, and international trade linkages. The BoC-GEM is a dynamic stochastic general-equilibrium model that divides the world into six regions: Canada, the United States, Japan, emerging Asia, a commodity-exporting region,[4] and a remaining-countries region.[5] The underlying microfoundations of consumers'

3. Throughout this paper, we define one region's "gains" from joint fiscal stimuli as the increase in GDP observed when the stimulus is jointly implemented in all regions relative to the case when it is implemented only domestically.
4. OPEC countries, Norway, Russia, South Africa, Australia, New Zealand, Argentina, Brazil, Chile, and Mexico.
5. The remaining-countries region includes all the other countries in the world, but, effectively, this means the members of the European Union (since Africa is very small, economically).

and firms' behaviour, as well as of the fiscal and monetary policy authorities in each of the six regions, are modelled symmetrically. For a more detailed description of the model, see Lalonde and Muir (2007).

The BoC-GEM considers two types of households: "rule-of-thumb" and forward-looking consumers. Both consume a (non-traded) final good and monopolistically supply differentiated labour inputs to domestic firms. Forward-looking Ricardian households save on government bonds, foreign assets, and domestic capital stock (which they competitively rent to domestic firms, which they own). Rule-of-thumb consumers spend all their current labour income and transfers from the government on consumption goods. Since they do not save or borrow to insure against income risk, they can only use their labour decisions to smooth consumption over time.

Production technology in all sectors and regions is represented by a constant-elasticity-of-substitution (CES) production function. There are five sectors in the model, which use different inputs to produce output. First, firms producing oil and commodities combine capital, labour, and a fixed factor (crude oil reserves, in the case of oil, and natural resources in the production of commodities). Oil is assumed to be a homogeneous product across producers and regions, while there is some level of product differentiation in commodities. Both oil and commodities are sold domestically as inputs to other sectors, and they are also traded across regions. Second, a refined petroleum product (fuel), produced using capital, labour, and oil, is sold to domestic consumers. Third, tradable and non-tradable goods are produced using capital, labour, oil, and commodities. Fourth, a final consumption good is produced by a competitive firm that combines fuel with some tradable and non-tradable goods in a CES aggregator. Fifth, a competitive firm combines the remaining supply of tradable and non-tradable goods to produce a final investment good, which feeds the productive capacity of the economy. Together, these sectors provide a rich production structure to capture the pass-through of shocks through the real economy.

Government investment expenditure accumulates into a stock of government capital. As the level of public capital stock increases past its steady-state level, there is a general increase in total factor productivity (TFP), including that of private capital (section 4 provides a more detailed description of this mechanism).[6]

International financial markets are assumed to be incomplete and only a single international bond, denominated in U.S. dollars, is traded across regions. In order to insure a well-defined steady state in terms of a constant ratio of net foreign asset holdings to GDP in each region, the model relies on a modified risk-adjusted uncovered interest rate parity condition.[7] This condition helps to pin down bilateral real exchange rates vis-à-vis the U.S. dollar. The model also includes an explicit link between the level of government debt and the level of net foreign assets. Forward-looking households hold

6. Given our calibration, the impact of government investment on the production of each sector is lower than that of private investment.
7. In the absence of endogenous portfolio choice (see Devereux and Sutherland 2008), this ratio is exogenously specified to match long-run averages observed in the data. In the dynamics of the model, any increase in the ratio of net foreign assets (NFA) to GDP raises the premium on the interest rate paid by the borrowing foreign economies on their debt holdings, so that the domestic economy's NFA position does not permanently diverge from its steady-state level.

domestic government bonds and the internationally traded bond. Thus, as domestic government debt increases, domestic households will reduce their holdings of the international bond, which is another non-Ricardian feature of the model.

In summary, the presence of rule-of-thumb consumers, the effect of government capital stock on potential GDP, and the link between the level of government debt and the level of net foreign assets are the main non-Ricardian features of the model that will drive the effect of fiscal policy on real activity.[8]

The effect, and geographical distribution, of the benefits of a multi-regional fiscal expansion depend strongly on the international trade linkages across regions and sectors. In the BoC-GEM, bilateral trade flows of the exports and imports of crude oil, commodities, and tradable goods for consumption and investment are explicitly modelled. The trade matrix at the steady state is calibrated to match bilateral trade flows observed in the data.[9]

The monetary authority is modelled using a stylized, forward-looking Taylor-type interest rate reaction function. For all regions other than emerging Asia, the monetary authority targets core inflation (defined as the consumer price index excluding gasoline and oil prices) through the short-term interest rate. The emerging-Asia monetary authority region targets a fixed nominal exchange rate with the United States. In the new Keynesian tradition, the model also includes real adjustment costs and nominal rigidities that differ across regions. The presence of real and nominal rigidities allows the monetary policy to have real effects on the economy and helps to map the persistence observed in the data.

3 The Power of Many: Local versus Global Fiscal Stimuli

This section provides a quantitative assessment of the effect on economic activity (GDP), after one year, of a variety of temporary fiscal measures, implemented either in each region in isolation or across all regions simultaneously. The impacts on GDP of seven fiscal policies are examined, including cuts in labour or capital income taxes, a general increase in transfers or one targeted to rule-of-thumb consumers, and government expenditure on either investment goods, consumption goods, or government services. The magnitude of each fiscal shock is calibrated to be equal to 1 per cent of GDP for one year. The standardized stimulus provides a controlled experiment to analyze what factors influence the potential gains from simultaneous implementation of a particular type of fiscal stimulus. By assumption, these fiscal shocks are unexpected. Moreover, we assume no monetary policy accommodation to the shock. In Tables 1 and 2 we report the resulting increase in GDP in response to these standardized shocks. We call these numbers fiscal multipliers. Table 3 reports the ratios of the multipliers in Tables 1 and 2.

8. There are also secondary non-Ricardian elements in the BoC-GEM. For one example, the government raises revenues through distortionary taxation on labour and capital income. For another, it consumes non-tradable goods, consumption goods, and investment goods.
9. We use data from the United Nations Commodity Trade Statistics (COMTRADE) for trade composition, and from the Direction of Trade Statistics on Merchandise Trade (International Monetary Fund) for national accounts data on imports of goods and services.

For all regions, fiscal multipliers are larger for new government spending than for tax cuts or larger transfers (Table 1). This result differs from Romer and Romer (2009), but is robust across similar DSGE models, such as in Coenen et al. (Forthcoming). This result is explained by the fact that government spending directly increases aggregate demand, and that forward-looking Ricardian consumers save part of the tax cuts or increased transfers in anticipation of future taxes. For similar reasons, targeted transfers are the most effective measure in their category, because they target consumers with the highest propensity to consume.

Focusing on the expenditure shocks, we can see from Table 3 the effect of fiscal policies "leaking" abroad, depending on the degree of openness of the region and the nature of its net imports. Relatively closed economies (the United States, Japan, the remaining countries) have larger domestic multipliers. Emerging Asia, whose imports tend to be more intensive in investment goods than consumption goods, has a lower multiplier when government expenditure is concentrated on the former.

Fiscal multipliers are larger in each region and for all options under a joint stimulus, because regions can mutually benefit from greater foreign demand (Tables 2 and 3). Smaller countries/regions benefit proportionally more from a global stimulus. In the limit, as a country's share of world GDP approaches one, the less the ability to free ride on the external demand generated by the stimulus in the other regions.

The effects of a domestic fiscal stimulus on the national account aggregates (which are not reported here) are qualitatively similar for all regions. The government expenditure stimulus immediately begins to crowd out private investment and consumption. There is an immediate and persistent increase in imports for the goods whose demand is mostly affected by the stimulus, with almost no change in exports. In contrast, a tax-based stimulus creates a persistent increase in consumption and a more gradual increase in private investment. Again, there is almost no change in exports with a persistent increase in imports, mainly of consumption goods.

The distributions of gains for each region depend upon terms-of-trade effects that reflect trade specialization (Table 3). Regions that are net importers of investment and consumption goods experience greater leakages into imports from a domestic stimulus. Moreover, as the prices of these goods rise, their terms of trade deteriorate, more so for expenditure-based fiscal expansions. In contrast, net commodity exporters benefit from the increase in global demand, both in terms of larger exports and improved terms of trade. This is particularly evident for a small open economy such as Canada. The contribution of regional characteristics to the effectiveness of the fiscal measures is summarized in Table 4.

Market size and government preferences also matter (Table 3). Since the market for consumption goods is larger than that for investment goods, crowding out by government expenditures is more apparent in

the latter for a given stimulus.[10] Expenditures in government services typically have less import content, and thus a greater effect on the domestic economy than other expenditures, though this matters little under joint fiscal expansion.

Table 4 shows that, on a regional basis, the United States, as a large and relatively less open region, benefits the least from a global stimulus. Moreover, the impact of different measures depends on its trade patterns. The United States is a net exporter of investment goods and commodities other than oil, but a net importer of consumption goods and oil. The United States therefore benefits more from a global stimulus when global demand is slanted towards its comparative advantage in trade (e.g., investment goods). Japan also has a relatively closed economy, but its trade patterns are somewhat different: it is a large net exporter of consumption and investment goods, and an importer of oil and commodity goods.

In contrast, Canada is a small open economy and a net importer of investment and consumption goods, but a net exporter of oil and commodities. As such, it profits greatly from the global stimulus (Table 4), the multipliers being twice as large as in the case of an isolated stimulus, owing in part to a substantial improvement in its terms of trade derived from the increase in oil and commodity prices. For similar reasons, the commodity-exporting region also benefits from a global stimulus.

Emerging Asia is highly open to trade, a net importer of oil and commodities, and a large net exporter of consumption goods (Table 4). Thus, it experiences contradictory forces to its terms of trade under a global stimulus. Moreover, the presence of a large contingent of non-Ricardian agents results in almost no change in private consumption and investment under a fiscal stimulus, either local or global. The remaining countries benefit less from a global stimulus, owing to the large size of this region (39 per cent of global GDP).

4 Alternative Scenarios

To better understand our results, we looked at different alternatives, focusing on the case of the United States.

4.1 Varying the speed of adjustment of the tax rate

In the BoC-GEM, the tax rate is adjusted to converge to a target level of government debt (as a proportion of GDP) after roughly seven years, which is the estimated response of the reaction in the model of the U.S. economy at the Bank of Canada (Gosselin and Lalonde 2005). We consider both a faster and a slower response for a particular case (which has general application): the effect of greater

10. In the BoC-GEM, there is only one investment good. This means that we cannot take into account the fact that some countries are more specialized in certain types of investment goods and may benefit proportionally, depending on the type of government expenditure that is implemented (e.g., computers versus roads).

government investment on U.S. GDP (Table 5). Varying the time the debt to GDP returns to initial steady-state equilibrium has a small effect on the multipliers of the fiscal stimulus.

4.2 Monetary policy at the zero lower bound

The degree to which monetary policy accommodates (in response to output and inflation pressures) fiscal stimulus has been found to be a determining factor in the estimation of fiscal multipliers (Al-Eyd and Barrell 2005). Within the BoC-GEM, the monetary authority responds to the increase in core inflation, caused by the fiscal stimulus, by increasing policy interest rates, which decreases aggregate demand. This dampens the impact of the fiscal stimulus on GDP. This is especially true for expenditure-based stimulus, which directly impacts aggregate demand and has, relatively, the largest increase in core inflation.

The current global recession and the financial crisis have resulted in large excess supply and disinflation risks. The desired level of the nominal interest rate, prescribed by a Taylor-type rule, is well below the lower bound in countries such as the United States and countries in the euro area. In that context, in Table 6 we report the results of a case where the monetary authority holds the policy rate fixed for the first two years of the stimulus, allowing it to respond normally after two years.[11] The results provide insight into the relative importance of the offsetting effects of monetary policy on fiscal stimulus. As expected, the accommodation of monetary policy results in a larger impact on GDP and increases the gains from simultaneity. The impact of the stimulus increases when monetary policy is accommodative in other regions, due to the positive effect of external aggregate demand on domestic exports.

4.3 Different assumptions regarding the productivity of government capital

Another feature of the model is that, as the capital stock of the economy increases, so does its potential output. In effect, within the model, as the government capital shock (e.g., public infrastructure) rises above the steady-state level of government capital, the TFP of the economy increases for all sectors. To model the effect of the government capital on TFP, we first define

$$M_t = (KG_t / KG^{ss})^{\kappa},$$

where $\kappa \in (0,1)$ is a parameter, KG^{ss} is the level of government capital stock in steady state, and KG_t is the level of government capital stock at time t, which evolves according to:

$$KG_t = (1-\delta)\, KG_{t-1} + GI_{t-1},$$

11. Accommodation of monetary policy for a tax-based stimulus generates a different response than for the expenditure-based case, due to the tax-based stimulus inducing a small decrease in core inflation. This result hinges upon the use of the Greenwood, Hercowitz, and Huffman (1988) preferences for households in the BoC-GEM. The income effect is absent using this representation of consumer choice, implying that the substitution effect dominates when the real wage increases. As such, the decrease in labour taxes increases the after-tax real wage, inducing an increase in the labour supply. This results in a decrease in the marginal cost of production for each sector and generates a small decrease in core inflation. In this case, the monetary response would be a reduction in interest rates that magnifies the expansionary impact of the tax reductions. However, since rates are kept constant, this does not occur, resulting in a reduction of the fiscal multiplier.

where GI_t is the government expenditures in public investment at time t.

We then use M_t as a shock that multiplies the production functions of all productive sectors and captures any potential increase in productivity following an increase in the stock of public capital. In the BoC-GEM, the elasticity of output to government capital (i.e., κ) is calibrated to 0.14, as in Ligthart and Suarez (2005) and as used in the IMF's Global Integrated Monetary and Fiscal model. Therefore, an increase in public capital has a smaller effect on potential GDP than its private counterpart.

The accumulation of capital stock above steady-state levels increases the productivity of all sectors in the BoC-GEM and increases potential GDP. The gains from simultaneous fiscal stimulus from the potential GDP channel decrease as the productivity of government capital increases (Table 7). This results from the increase in productivity having different impacts on the national account aggregates. A higher productivity level increases consumption and imports; however, because the United States is an importer of consumption goods, the impact of the negative terms-of-trade effect from consumption goods is magnified and the gains from simultaneity are decreased. For the other regions, results depend on their relative net exports position for the four types of tradable goods (crude oil, commodities, and tradable goods for consumption and investment).

4.4 Other factors

While the BoC-GEM is non-linear in structure, it has roughly linear properties in simulations with respect to the size of the shocks (not reported here), such that estimated fiscal multipliers are not sensitive to the magnitude of the fiscal shock.

Simulations (not reported here) show that rapid fiscal expenditure-based injections have more of an impact than do long-drawn-out ones, because agents have more time to anticipate the negative crowding-out effects. On the other hand, more-sustained tax cuts get embedded in consumers' estimation of their potential income, and thus there is a larger impact on GDP via higher consumption.

5 The G-20 Initiatives

In this section, we scale the various fiscal programs to approximate the measures that the G-20 countries announced or implemented as of the end of August 2009 (Table 8). As in section 3, we examine both local and global stimuli. The simulations assume that the zero lower bound holds for four of the six regions (Canada, Japan, the United States, and the remaining-countries region), since policy rates are held constant until 2011. The initial implementation of the stimulus is in 2009Q1. We assume a gradual buildup of investment expenditure spending in the first two quarters of 2009 to approximate the observed path of implementation of the fiscal stimulus.

Results for 2009 and 2010 are reported in Table 9. Peak responses of GDP, which are most likely to occur between 2009Q3 and 2010Q1, are reported in Table 10. While the qualitative results are similar to

those discussed in section 3, actual differences in policy intentions offer new insights on the distribution of the benefits. The smaller the size of the domestic stimulus relative to other regions, the more a country can free ride on the spillovers from the stimuli enacted throughout the world. Tax- and transfer-based fiscal stimuli have a lower impact on GDP relative to expenditure-based stimulus. Again, countries can free ride from the bigger impact of expenditure-based stimuli coming from the rest of the world. As shown in Table 9, countries that implement the majority of their fiscal stimulus in 2010, ceteris paribus, gain more from the joint initiatives in 2009, but less so in 2010, and vice versa. Net commodity exporters benefit from higher terms of trade, since the simulation shows that, with the joint measures, oil and commodity prices rise by 40 per cent and 6.6 per cent, respectively.

In our simulation, the impact on world GDP peaks at 1.75 per cent in 2009Q4. For most regions (the United States being an exception), the largest impact of the stimulus occurs in 2009. Canada enjoys the second-highest gain from the global fiscal stimulus (after the remaining-countries region, whose own initiatives are limited). Canada's high level of openness sharply curtails the effectiveness of a domestic stimulus. In contrast, Canada reaps the benefits of more growth in the United States and improving terms of trade following the global fiscal impulse and its effect on oil and commodities prices. The commodity-exporting region also enjoys a positive income and wealth effects from higher oil and commodity prices and exports, but is held back because its largest trading partner (representing over 50 per cent of trade) is the remaining-countries region, which has a smaller stimulus relative to the total global stimulus.

6 Conclusion

This paper uses the BoC-GEM to study the extension and regional distribution of gains from the announced fiscal stimuli around the world. We find that all regions benefit from a global, jointly implemented fiscal stimulus relative to a purely domestic stimulus. We also find that, for any given region, the potential gains from a global fiscal stimulus depend negatively on the size of the domestic fiscal stimulus and on the size of the economy, and that they depend positively on the proportion of tax and transfer stimulus in the overall stimulus relative to other regions, and on openness to trade. Whether the region gains more in 2009 or 2010 depends upon the timing of the implementation of the stimulus relative to other regions. In addition, the distribution of gains for each region depends upon terms-of-trade effects that reflect trade specialization. Countries that are net importers of investment and consumption goods will have higher leakages into imports from domestic stimulus, and negative terms-of-trade shocks under jointly implemented fiscal stimuli. On the other hand, net exporters of crude oil and commodity goods experience positive terms-of-trade effects when fiscal stimuli are jointly implemented.

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Table 1: Impact of Domestic Fiscal Stimulus
(% increase in GDP in response to a 1-year fiscal stimulus equivalent to 1% of GDP)

	Fiscal stimulus type						
	Government investment	Government consumption	Government services	Labour income tax	Corporate income tax	Targeted transfers	General transfers
United States	1.05	1.20	1.23	0.06	0.02	0.16	0.01
Commodity exporting	0.40	0.70	0.96	0.07	0.00	0.15	0.01
Emerging Asia	0.67	0.99	0.99	0.25	0.05	0.42	0.13
Japan	0.98	1.14	1.09	0.06	0.02	0.19	0.01
Canada	0.40	0.80	0.98	0.05	0.00	0.13	0.01
Remaining countries	0.98	1.11	1.13	0.09	0.01	0.25	0.03

Table 2: Impact of Simultaneous Fiscal Stimulus
(% increase in GDP in response to a 1-year fiscal stimulus equivalent to 1% of GDP)

	Fiscal stimulus type						
	Government investment	Government consumption	Government services	Labour income tax	Corporate income tax	Targeted transfers	General transfers
United States	1.52	1.44	1.31	0.09	0.03	0.21	0.02
Commodity exporting	0.74	1.00	1.10	0.09	0.01	0.21	0.02
Emerging Asia	1.36	1.31	1.07	0.27	0.05	0.48	0.13
Japan	1.42	1.35	1.18	0.10	0.03	0.26	0.03
Canada	1.09	1.26	1.22	0.09	0.02	0.22	0.02
Remaining countries	1.22	1.23	1.19	0.11	0.02	0.28	0.04

Table 3: Impact of Simultaneous Fiscal Stimulus
(Ratio between the changes in GDP from a 1% of GDP fiscal stimulus with and without simultaneity)

	Fiscal stimulus type						
	Government investment	Government consumption	Government services	Labour income tax	Corporate income tax	Targeted transfers	General transfers
United States	1.45	1.20	1.07	1.50	1.50	1.31	2.00
Commodity exporting	1.85	1.43	1.15	1.29	—	1.40	2.00
Emerging Asia	2.03	1.32	1.08	1.08	1.00	1.14	1.00
Japan	1.45	1.18	1.08	1.67	1.50	1.37	3.00
Canada	2.73	1.58	1.24	1.80	—	1.69	2.00
Remaining countries	1.24	1.11	1.05	1.22	2.00	1.12	1.33

Table 4: Regional Characteristics Shown to be Important for Their Impact on GDP

	Per cent in calibration			Net export position			
	Size	Imports/GDP	Liquidity-constrained agents	Con[1]	Inv	Oil	Com
Remaining countries	38.5	11.7	15	-	-	+	-
United States	27.3	14	25	-	+	-	+
Japan	9	15	20	+	+	-	-
Commodity exp.	10.7	28	25	-	-	+	+
Emerging Asia	11.9	30.5	50	+	+	-	-
Canada	2.6	36.5	20	-	-	+	+

1. Con: Consumption. Inv: Investment. Com: Commodities.

Table 5: U.S. Fiscal Multipliers under Various Scenarios for a Government Investment Shock

Year to return debt to GDP to steady state	3.5 years	Baseline: 7 years	14 years
a. Only in the U.S.	1.03	1.05	1.06
b. In all six regions	1.50	1.52	1.52
Ratio (b/a)	1.46	1.45	1.43

Table 6: Impact of Accommodation of the Monetary Authority to an Expenditure Shock in the United States (% increase in GDP in response to a fiscal stimulus equivalent to 1% of GDP)

	Fiscal stimulus type													
	Government investment		Government consumption		Government non-tradable		Labour income tax		Corporate income tax		Targeted transfers		General transfers	
Accommodation	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
a. Only in the U.S.	1.21	1.05	1.35	1.20	1.44	1.23	0.02	0.06	0.02	0.02	0.18	0.16	0.01	0.01
b. In all six regions	1.79	1.52	1.61	1.44	1.57	1.31	0.06	0.09	0.05	0.03	0.26	0.21	0.03	0.02
Ratio (b/a)	1.48	1.45	1.19	1.20	1.09	1.07	3.00	1.50	2.50	1.50	1.44	1.31	3.00	2.00

Table 7: U.S. Fiscal Multipliers under Various Productivity Gain Assumptions

	50% greater productivity of government capital	Baseline productivity of government capital	50% less productivity of government capital	Absence of productivity of government capital
a. Only in the U.S.	1.08	1.05	1.01	0.98
b. In all six regions	1.56	1.52	1.48	1.44
Ratio (b/a)	1.44	1.45	1.46	1.47

Table 8: Estimate of the Impact of the G-20 Initiatives (% of GDP)

2009

	GOVCONS	GOVINV	TRANS_TARG	TRANSFER	TAU_L	TAU_K	*TOTAL*
Canada	0.00	0.91	0.23	0.45	0.23	0.05	1.88
Emerging Asia	0.29	1.44	0.24	0.11	0.08	0.06	2.22
Commodity exporter	0.34	0.25	0.61	0.23	0.16	0.34	1.93
Japan	0.33	0.32	0.95	0.66	0.05	0.05	2.36
Remaining countries	0.01	0.13	0.08	0.06	0.22	0.02	0.52
United States	0.00	0.34	1.12	0.13	0.19	0.40	2.19

2010

	GOVCONS	GOVINV	TRANS_TARG	TRANSFER	TAU_L	TAU_K	*TOTAL*
Canada	0.00	0.68	0.28	0.24	0.35	0.06	1.61
Emerging Asia	0.18	1.42	0.00	0.04	0.07	0.07	1.79
Commodity exporter	0.22	0.04	0.16	0.07	0.08	0.36	0.92
Japan	0.00	0.58	0.21	0.89	0.04	0.04	1.76
Remaining countries	0.01	0.04	0.03	-0.01	0.15	0.08	0.31
United States	0.00	0.56	0.62	0.69	0.40	0.21	2.49

2011

	GOVCONS	GOVINV	TRANS_TARG	TRANSFER	TAU_L	TAU_K	*TOTAL*
Canada	0.00	0.34	0.00	0.00	0.00	0.00	0.34
Emerging Asia	0.00	0.71	0.00	0.00	0.00	0.00	0.71
Commodity exporter	0.00	0.02	0.00	0.00	0.00	0.00	0.02
Japan	0.00	0.29	0.00	0.00	0.00	0.00	0.29
Remaining countries	0.00	0.02	0.00	0.00	0.00	0.00	0.02
United States	0.00	0.44	0.13	0.10	0.18	0.05	0.90

2012

	GOVCONS	GOVINV	TRANS_TARG	TRANSFER	TAU_L	TAU_K	*TOTAL*
Canada	0.00	0.17	0.00	0.00	0.00	0.00	0.17
Emerging Asia	0.00	0.36	0.00	0.00	0.00	0.00	0.36
Commodity exporter	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Japan	0.00	0.15	0.00	0.00	0.00	0.00	0.15
Remaining countries	0.00	0.01	0.00	0.00	0.00	0.00	0.01
United States	0.00	0.26	0.01	0.00	0.00	-0.05	0.23

2013

	GOVCONS	GOVINV	TRANS_TARG	TRANSFER	TAU_L	TAU_K	*TOTAL*
Canada	0.00	0.08	0.00	0.00	0.00	0.00	0.08
Emerging Asia	0.00	0.18	0.00	0.00	0.00	0.00	0.18
Commodity exporter	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Japan	0.00	0.07	0.00	0.00	0.00	0.00	0.07
Remaining countries	0.00	0.01	0.00	0.00	0.00	0.00	0.01
United States	0.00	0.16	0.01	0.00	0.00	-0.02	0.16

Table 9: Impact on GDP from Domestic Fiscal Stimulus Packages (per cent increase in GDP; deviation from control)

Fiscal stimulus type	Domestic stimulus domestic stimulus(a)		Global simultaneous global stimuli (b)		Impact from simultaneity (b/a)	
Average over	2009	2010	2009	2010	2009	2010
United States	1.10	1.27	1.83	1.94	1.66	1.53
Commodity exporting	0.42	0.35	0.61	0.53	1.45	1.51
Emerging Asia	1.34	1.16	2.33	2.16	1.74	1.86
Japan	1.08	1.04	2.00	2.03	1.85	1.94
Canada	0.41	0.40	1.41	1.52	3.40	3.80
Remaining countries	0.20	0.15	0.71	0.67	3.55	4.47
World	—	—	1.32	1.32	—	—

Table 10: Peak GDP Response from Fiscal Stimulus Packages (per cent increase in GDP; deviation from control)

Fiscal stimulus type	Domestic stimulus (a)		Global simultaneous stimuli (b)	
	Peak	Timing	Peak	Timing
United States	1.60	2009Q4	2.53	2009Q4
Commodity exporting	0.55	2009Q3	0.81	2009Q4
Emerging Asia	1.57	2009Q3	2.81	2009Q4
Japan	1.52	2009Q4	2.75	2009Q4
Canada	0.67	2009Q4	2.05	2009Q4
Remaining countries	0.26	2009Q4	0.91	2009Q4
World	—	—	1.75	2009Q4