The Global Integrated Monetary and Fiscal Model:
Introduction and Applications with Stronger
Macro-Financial Linkages

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Douglas Laxton, Dirk Muir, and Susanna Mursula
The Global Integrated Monetary and Fiscal Model: Introduction and Applications with

Stronger Macro-Financial Linkages

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Outline of the Presentation

1. High Level Overview of the GIMF

2. Modelling Macro-Financial Linkages - BGG

3. New Model Properties
High Level Overview of the GIMF

- GIMF is the Global Integrated Monetary and Fiscal model.

- Uses a Blanchard-Weil-Buiter overlapping generations framework to incorporate both fiscal and monetary policy, in a multi-country setting.
GIMF as a Policy Tool

- Monetary policy = inflation targeting, nominal exchange rate targeting.
  - Other targeting regimes are possible.

- Fiscal policy = debt targeting; deficit targeting; tax rates available on labour and capital income; value added tax on consumption.
  - tax smoothing.

- Monetary and fiscal policy can be examined in a rich economic framework.
Economic Structure of the GIMF

- Agents face a consumption-leisure choice – agents can be forward looking or liquidity constrained.
  - subject to their budget constraint – forward-looking consumers hold government debt and net foreign assets.

- Net foreign assets are internationally-traded bonds, denominated in a single numeraire currency → incomplete markets.
  - U.S. dollar serves as numeraire in most applications of GIMF.
Production

- Firms are monopolistically competitive.

- Production is multilayered.
  - Factors of production are combined to produce intermediate tradable and nontradable goods.
  - Intermediate goods are combined to produce final consumption and investment goods.
International Features

- some intermediate goods and all final goods are tradable internationally.
- the model tracks bilateral trade flows in all goods.
- there can be country risk premia (relative to a numeraire country, such as the United States).
Other Features

- GIMF can be used at either an annual or quarterly frequency.
- nominal price stickiness; nominal wage stickiness.
- more features will be described, in detail, throughout the day.
- This presentation illustrates a new development in the GIMF model - macro-financial linkages.
Macro-Financial Linkages in the GIMF

- We have introduced a financial sector into GIMF, focusing on the demand side of credit, modelled on:
What is the Financial Accelerator?

- Introduce an endogenous risk premium to the cost of financing by firms, relative to the risk-free interest rate.
  
  - There are **information asymmetries** between lenders and borrowers that lead to increased monitoring costs, and extra costs to projects financed by funds external to the firm.

- **Firms**, producing tradable and non-tradable goods, are risk neutral and have finite expected lifetimes. They borrow from **financial intermediaries** to finance a fraction of their capital acquisitions.
What is the Financial Accelerator? (cont’d)

- **Information asymmetry** and **costly state verification** mean **financial intermediaries** charge an **external financing premium** to firms, which is inversely related to the firms’ **degree of leverage**.

  - **Leverage** = ratio of corporate debt to a firm’s net worth.

- **Financial intermediaries**, aside from their auditing function, serve only as a conduit between households and firms – solely taking deposits and making loans.

  ➞ Negative shocks to the economy, which can decrease firms’ cash flow and net worth, raising premia on external financing.
BGG in the Context of a Macroeconomic Model

- The BGG financial accelerator is often formulated and solved in a partial equilibrium setting, so that a linearized version of the resulting firm maximization problem can be introduced into a larger model of the economy.

- With GIMF, we have incorporated the fully non-linear representation of the BGG financial accelerator.
  - there are some modifications, but the underlying stories we tell with our financial accelerator are fundamentally the same as BGG.
Advantages of the Nonlinear Representation

- No longer confined to having only a negative relationship between leverage and the external financing premium (predicated on some arbitrary functional form).

- If we can solve the full nonlinear model, the response of the financial sector is more extreme in the presence of higher leverage.
  - for example, an economy with a leverage ratio of 100% reacts more strongly (proportionately) to negative shocks than an economy with 50% leverage.
Advantages of the Nonlinear Representation (cont’d)

- We have richer stories that we can tell about:
  - the cost of firms’ bankruptcies to financial intermediaries.
  - the probability of bankruptcy of firms at any point in time.
  - the level of the external financing premium, which is inverse to the firms’ leverage.
  - the equity premium required by investors.
Disadvantages of the Nonlinear Representation

- the full nonlinear representation is very difficult to solve for shocks of the magnitude that interest us.

- one solution – numeric linearization of the entire model around a steady state.
  - lose the nonlinear response of the model to leverage and some other variables.
  - retain the full menu of features (i.e. bankruptcy costs, probability of bankruptcy).
Properties of the New Financial Sector in the GIMF

1. Look at the GIMF with BGG, in a two-country context – Canada and the United States.
   - Canada is 6.5% of GDP, while the United States is 93.5%.
   - Trade flows for Canada are decent – 80% of exports go to, and 55% of imports come from, the United States.
   - Under 20% of U.S. trade is accounted for – roughly 15% of exports go to, and 20% of imports come from, Canada.
Properties of the New Financial Sector (cont’d)

• We will consider shocks that hit the United States, and discuss their effects over the first 4 years.

• We will then look at the effects in Canada, and any exacerbation of the effects by the new financial sector.
A Temporary Increase in the Corporate Risk Premium

- There is a temporary, but persistent, 25 basis point increase in the spread between
  - the private corporate interest rate;
  - the public interest rate (which is both the policy rate, and the rate of return on domestic government debt).
United States - Financial Sector

- For firms, the increase in the spread leads to a higher cost for loans – drives down net worth, increases leverage.

- Also drives down investment by roughly 1% – reinforces fall in net worth.

- As leverage increases from 100% to 102.5% (economy wide), there is an increase of the external finance premium of around 14 bp.

- Probability of bankruptcies increase by almost 0.2%age pts.
United States: Increase in the Exogenous Private / Public Interest Rate Spread in the United States

Tradables __ and Nontradables - -

- Financial Return to Capital (ex ante)
  (Difference)
- Investment
  (% Difference)
- Corporate Net Worth
  (% Difference)
- Corporate Insolvencies (ex ante)
  (Difference in % of all Firms)
- Corporate Leverage
  (Difference)
- External Finance Premium (ex ante)
  (Difference)
United States - Overall

- GDP falls overall by 0.2% – weaker investment, lower consumer wealth as firms deteriorate.

- Monetary policy can try to offset this – fall in policy rate of 25bp by year 2; but still cannot prevent financial difficulties.

- Mild depreciation leads to very small improvement in current account.
United States: Increase in the Exogenous Private / Public Interest Rate Spread in the United States

<table>
<thead>
<tr>
<th>GDP (% Difference)</th>
<th>Nominal Policy Rate (% Difference)</th>
<th>Inflation (% Difference)</th>
<th>Real Interest Rate: Government and Private (% Difference)</th>
<th>TB/GDP, CA/GDP (% Difference)</th>
<th>Real Exchange Rate (% Difference; + = Depreciation)</th>
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![Graphs showing changes in GDP, Nominal Policy Rate, Inflation, Real Interest Rate, TB/GDP, CA/GDP, and Real Exchange Rate](https://via.placeholder.com/150)
Spillovers in Canada - Overall

- Exchange rate appreciates, slight deterioration of the trade balance.

- Leads to fall in inflation, rise in real interest rate, undone by monetary policy with a slight delay, since it is an unanticipated surprise.

- Higher real interest rate leads to fall in investment by 0.7%.
Canada: Increase in the Exogenous Private / Public Interest Rate Spread in the United States
Spillovers in Canada - Financial Sector

- Financial sector exacerbates this, with same channels as in the United States.

This is a common theme in all shocks – the financial accelerator magnifies the spillover effects in Canada.

- There would still be negative spillovers in Canada, but they are accelerated by the BGG mechanism.

- External finance premium increases by roughly 10 bp; probability of bankruptcy up by roughly 0.15% economy-wide.
Canada: Increase in the Exogenous Private / Public Interest Rate Spread in the United States

Tradables and Nontradables

Financial Return to Capital (ex ante)

Investment

Corporate Net Worth

Corporate Insolvencies (ex ante)

Corporate Leverage

External Finance Premium (ex ante)
The following graphs show the Canadian response with and without the financial sector based on the BGG financial accelerator.

- The lack of an external financing premium means investment would be much stronger.
  - Monetary policy would be more effective in undoing the spillovers of the shock from the United States.
Increase in the Exogenous Private/Public Interest Rate Spread in the United States

___ With a financial sector; - - without a financial sector

GDP (% Difference)

Investment (% Difference)

Inflation (Difference)

Nominal Policy Rate (Difference)

Real Interest Rate (Difference)

Real Exchange Rate (% Difference; + = Depreciation)
A Temporary Increase in the Cost of Firm Bankruptcies to Lenders

- When a firm goes bankrupt, a certain percentage of the firm’s assets are irretrievably lost, resulting in a deadweight loss to the lender.

- We assume a temporary, but persistent, increase in that deadweight loss by all firms.
  - Could result from effects of regulations that reduce the retrievability of bankrupt firms’ assets – for example, ”mark to market” pricing in the subprime mortgage crisis.

- To show the nonlinear model, we consider only a very small shock – it is the relative magnitudes, not the absolute, that matter in the results.
United States - Financial Sector

- The external financing premium increases directly from the shock – drives a wedge between the private and corporate interest rates → increase in higher loan costs, drives down net worth, increases leverage.

- External financing premium increase is reinforced by:
  - increase of leverage by 0.3 %age pts.
  - 0.1% fall in investment that reinforces fall in net worth.

∴ Increase in the probability of bankruptcy for firms.
United States: Temporary But Persistent Increase in Bankruptcy Costs in the United States

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<th>Nontradables</th>
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<td>Financial Return to Capital (ex ante)</td>
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<tr>
<td>Corporate Insolvencies (ex ante)</td>
<td>Corporate Leverage</td>
</tr>
</tbody>
</table>

![Graphs showing financial and corporate metrics](image-url)
United States - Overall

- GDP falls overall by 0.01% – weaker investment, lower consumer wealth as firms deteriorate.

- Monetary policy can try to offset this – fall in policy rate of 1bp by year 2; but still cannot prevent financial difficulties.

- Mild depreciation leads to very small improvement in current account.
United States: Temporary But Persistent Increase in Bankruptcy Costs in the United States
Spillovers in Canada

- Again, spillovers come mostly through the trade channel, that put downward pressure on the economy. Most important feature is the rise in the real interest rate, leading to a fall in investment.

- Here, again, the new financial sector leads to a worsening of the situation in Canada – accelerator effect of higher corporate leverage.

- We will no longer consider the results in Canada – story is the same.
Canada: Temporary But Persistent Increase in Bankruptcy Costs in the United States

[Graphs showing changes in GDP, Nominal Policy Rate, Inflation, Real Interest Rate (Government and Private), TB/GDP, CA/GDP, and Real Exchange Rate over time.]
Canada: Temporary But Persistent Increase in Bankruptcy Costs in the United States

Tradables and Nontradables

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<th>Financial Return to Capital (ex ante)</th>
<th>Investment</th>
<th>Corporate Net Worth</th>
<th>Corporate Insolvencies (ex ante)</th>
<th>Corporate Leverage</th>
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<td>[Graphs showing fluctuations in values]</td>
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A Temporary Increase in the Probability of Corporate Bankruptcy

- In any given period, there is a probability of bankruptcy for each firm, which results in an average percentage of firms going bankrupt each quarter.

- We assume a temporary but persistent increase in the rate of bankruptcies (or, in other words, borrower riskiness).
United States - Financial Sector

- As probability of bankruptcy increases by 0.2\%age pts, financial intermediaries need to better monitor the risky firms, so they charge a higher external finance premium – drives down net worth, increases leverage.

- Also drives down investment by roughly 0.5\% – reinforces fall in net worth.

- So leverage increases from by roughly 1.2\% (economy wide).

= overall, an increase of the external finance premium of around 15 bp.
United States: Temporary But Persistent Increase in Borrower Riskiness in the United States

Tradables and Nontradables - -

Financial Return to Capital (ex ante) (Difference)

Investment (% Difference)

Corporate Net Worth (% Difference)

Corporate Insolvencies (ex ante) (Difference, in % of all Firms)

Corporate Leverage (Difference)

External Finance Premium (ex ante) (Difference)
United States - Overall

- GDP falls overall by 0.05% – weaker investment, lower consumer wealth as firms deteriorate.

- Monetary policy can try to offset this – fall in policy rate of 25bp by year 2; but still cannot prevent financial difficulties.

- Mild depreciation leads to very small improvement in current account.
United States: Temporary But Persistent Increase in Borrower Riskiness in the United States
A Temporary Loss of Net Worth - Destruction of Firm Value

- Firms temporarily (but persistently) distribute a dividend to their shareholders (consumers) that is higher than the steady-state level.

- The higher level of dividend gradually reduces the firm’s net worth, increasing its reliance on borrowing.
United States - Financial Sector

- Increased distribution of dividends lowers firms’ net worth by 2.5%, leading to higher leverage of 2.5% age pts.

  → higher external finance premium (reinforced by lower investment → lower net worth) of roughly 13bp.

- Probability of bankruptcies increase by almost 0.2% age pts.
United States: Temporary Decrease in Net Worth - Dividend Distribution in the United States

Tradables and Nontradables - -
United States - Overall

- GDP falls overall by 0.15% – weaker investment, lower consumer wealth as firms deteriorate.

- Monetary policy can try to offset this – fall in policy rate of 25bp by year 2; but still cannot prevent financial difficulties.

- Mild depreciation leads to very small improvement in current account.
United States: Temporary Decrease in Net Worth - Dividend Distribution in the United States

**GDP (\(\%\) Difference)**

**Nominal Policy Rate (Difference)**

**Inflation (Difference)**

**Real Interest Rate: Government and Private -**

**TB/GDP - CA/GDP -**

**Real Exchange Rate (\(\%\) Difference; \(+ = \) Depreciation)**
In this case, net worth of the firms decline, because of a temporary but persistent increase in the rate of depreciation of capital by 0.8% on an annual basis.

This can thought of as a sudden obsolescence of capital stock.

United States - Financial Sector

- As the capital stock falls rapidly, net worth falls with it, driving up corporate leverage nearly 2.5%age pts.
  
  \[ \rightarrow \text{Increase in the external finance premium of around 14 bp.} \]

- Investment is actually falling in the short run, by 0.6%.
  
  - It begins rebounding in year 4, as there is a need to rebuild the capital stock to maintain the steady-state capital-output ratio.

- The probability of bankruptcies by firms increase by almost 0.2%age pts.
United States: Temporary Decrease in Net Worth - Capital Destruction in the United States

Traditional and Nontradables -

Financial Return to Capital (ex ante)

Investment

Corporate Net Worth

Corporate Insolvencies (ex ante)

Corporate Leverage

External Finance Premium (ex ante)
United States - Overall

- GDP falls overall by 0.25% – weaker investment, lower consumer wealth as firms deteriorate.

- Monetary policy can try to offset this – fall in policy rate of 25bp during the second year; but still cannot prevent financial difficulties.
  - inflation falling more rapidly in the short-run, leading to an increase in the real interest rate. \( \therefore \) real exchange rate is appreciating
  - nonetheless, current account improves as investment falls more than savings.
United States: Temporary Decrease in Net Worth - Capital Destruction in the United States
Conclusions

- GIMF has a new financial sector, based on the BGG financial accelerator model.

- It has richer features than in models hitherto published – potential to exploit the full nonlinearity of the BGG formulation.

- Still work to be done on simulating the nonlinear model, without numeric linearization.
  - even if we depend on numeric linearization, we still have a richer framework for storytelling than the standard BGG implementation.