

Increased U.S. Investment Risk: A Macro to Micro Perspective

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Abstract

This paper is a pedagogical exploration of the macro and micro effects of the 2025 ratings downgrade of U.S. treasury bonds using the GTAP CGE model. We describe the investment-savings macro variables and relationships in the model and explain why the experiment leads to falling investment demand in the U.S., a global reallocation of capital and a decline in global capital returns. We then show how to link macro results to micro outcomes based on the structural characteristics of the U.S. economy. This macro-micro linkage approach, led by macro outcomes, demonstrates how an analysis of the factor and commodity results of an experiment can be deepened by grounding it in the broader economic context of the GTAP model's macro economy. We also find that macro relationships and results are consistent across different GTAP model aggregations, so a macro-micro approach to explaining micro results can be generalized.

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Contents

Background.....	3
Quantifying the Change in U.S. Investment Risk.....	4
Equity Risk Premium	4
Change in U.S. ERP	4
Capital Flows in the GTAP Model.....	6
Macroeconomic Effects of an Increase in U.S. Investment Risk	7
Savings-Investment Balance	7
Trade Balance	9
Welfare.....	10
From Macro to Micro.....	11
Output Effects of Fall in Gross Investment Demand	11
Output Effects of Real Exchange Rate Depreciation	11
Output Effects of Relative Factor Price Changes	12
Predicted versus Actual Model Results	12
Comparing Macro Effects of Increased U.S. Investment Risk Across Model Versions	12
Version Comparison	12
Comparison of Macro Results	13
Conclusion	16
References	18
Appendix: Database Aggregations.....	19

Background

This paper is a pedagogical exploration of the macro and micro effects of the 2025 ratings downgrade of U.S. treasury bonds in a standard CGE model.¹ We use MacroToy, a static, two-region, tax-free version (U.S. and rest-of-world) of the GTAP model for demonstration.² We describe the savings-investment macro variables and relationships in the GTAP model and explain why the experiment leads to falling investment demand in the U.S., a global reallocation of capital and a decline in global capital returns. We then show how to link macro results to micro outcomes based on the structural characteristics of the U.S. economy. This macro-micro linkage approach, led by macro outcomes, demonstrates how an analysis of the factor and commodity results of an experiment can be deepened by grounding it in the broader economic context of the GTAP model's macro economy. We also find that macro relationships and results are consistent across different GTAP model aggregations, so a macro-micro approach to explaining micro results can be generalized.

While a change in investment demand is fundamentally a dynamic problem, it is useful to use a static framework as starting point for its analysis. The static model clarifies how macro adjustments lead to general equilibrium outcomes which then determine dynamic economic growth trajectories.

Investment in U.S. Becoming Riskier

The United States is an attractive market for global investors. Its robust, market-based economy, its effective rule of law, and, until recently, its relative fiscal probity made U.S. treasuries, equities and bonds appealing to domestic and foreign investors alike. U.S. treasury bills, backed by the full faith and credit of the U.S. government, have until recently provided an almost risk-free foundation in public and private investment portfolios and currency reserves.

However, investment in the U.S. is becoming riskier when compared to investments in other mature economies. Growing equity risks include the elevated valuations of U.S. companies and the impacts of the high and unpredictable U.S. import tariffs introduced in 2025. U.S. sovereign debt risk is rising due to the intractable and growing U.S. federal deficit, expectations of future U.S. inflation, repeated political debt-ceiling crises, and the increased share of the federal budget that must be spent on servicing the debt. These fiscal and monetary conditions led the three major credit rating agencies to downgrade U.S. treasury debt – the S&P in 2011, Fitch in 2023 and Moody's in 2025.

¹ This paper is an application drawn from Burfisher and Akgul (forthcoming), “Macroeconomics in the GTAP Model,” which provides a more comprehensive description of macro relationships and behavior in the GTAP model.

² MacroToy is the NUS333 model version included in the RunGTAP model suite, with taxes removed using the Altax utility. NUS333 uses the v8.1 database representing the world economy in 2007.

Quantifying the Change in U.S. Investment Risk

Equity Risk Premium

We quantify the change in investment risk in the U.S. as a change in its equity risk premium (ERP). An ERP is the additional return that investors require to compensate them for the risk of investing in equities (stocks and other forms of company ownership) relative to a risk-free asset like a government bond. For example, an ERP of 4% means that investors require an additional 4% return on an equity investment over and above the bond yield to compensate for taking greater risk. In general terms, the ERP can be expressed as in Equation 1:

$$ERP = \text{returns to equity investment} - \text{yield on a safe government bond} \quad (1)$$

The expression describes the risk-return trade-off where higher returns are accompanied by higher risk. An increase in returns to equities relative to a safe bond yield indicates greater risk for the investor and a higher risk premium.

The GTAP model is a real model that does not include capital markets or financial instruments like stocks and bonds. Investment demand in the GTAP model is the gross expenditure on a region's real assets such as machinery and equipment. While equity investments are a financial asset, they reflect the values and profitability of the underlying real assets. Accordingly, the equity risk premium provides a meaningful proxy for the riskiness of real investment in capital goods.

Change in U.S. ERP

We use the implied ERPs estimated by Damodaran (2026) to describe the effect of the change in U.S. investment risk following the downgrade of U.S. debt. An implied ERP is a forward-looking measure of the rate of return based on current market expectations, such as earnings forecasts, rather than the historical yield trends otherwise used in ERP calculations.

The implied ERP for a region r is calculated as:

$$ERP_r = (\text{expected equity returns} - \text{bond yield}) + (\text{default spread}_r * \text{volatility ratio}) \quad (2)$$

Table 1 reports the values used in Damodaran (2026) for each term in Equation (2). The first term in the equation is the mature-market risk premium, which is the gap between the expected return on equities in a mature market versus the yield on a safe government bond. Damodaran uses U.S. markets as a global benchmark, calculating an expected annual return to the S&P 500

of 8.41 percent versus the 4.18 percent yield on a 10-year U.S. treasury bill in January 2026 (table 1). The mature-market premium of 4.23 (8.41 – 4.18) percent is the same for all countries.

Table 1. Implied equity risk premium (ERP) for United States relative to a AAA-rated country (Switzerland)					
Country	Expected returns to equities	U.S. 10-year treasury yield	CDS default spread	Volatility ratio	Implied ERP
United States	8.41	4.18	0.30	1.52	4.69
Switzerland	8.41	4.18	0.00	1.52	4.23
Source: Damodaran (2026).					

The term on the right in Equation (2) is an adjustment factor that measures country-specific risk. The default spread is the gap in yields between a country's sovereign bond and that of an AAA-rated country. For some mature economies, including the U.S., the default spread can be measured using prices of credit default swaps (CDS) instead of bond yields. Swaps function as insurance policies against a default on securities so they directly price expected yield risks. An increase in the CDS spread indicates that investors see a higher probability of default, which causes the ERP to rise. Conversely, a fall in the CDS spread decreases the ERP.

Until the Moody's downgrade of U.S. bonds, the CDS for the AAA-rated U.S. 10-year treasury bill was widely used as the benchmark for comparison. The U.S. CDS spread was therefore zero – its CDS price was compared to itself. The downgrade to an AA1 rating means that the U.S. CDS price is now being compared to that of an AAA country, specifically Switzerland. In early 2026, the CDS yield spread between the AA1-rated 10-year U.S. treasury and the AAA-rated Swiss bond was 0.3 percent, as reported in table 1.

An ERP calculation may also include a global measure of the relative volatility of equity returns and bond yields, measured as the ratio of their annualized standard deviations over the past five years. The global average ratio of 1.52 indicates the higher volatility of returns to equities relative to bonds, as reported in table 1.

Based on these rates, the U.S. implied ERP is calculated as:

$$ERP_r = (\text{expected equity returns} - \text{bond yield}) + (\text{default spread}_r * \text{volatility ratio})$$

$$= (8.41 - 4.18) + (0.30 * 1.52) = 4.23 + 0.456 = 4.69 \%$$

Due to the U.S. ratings downgrade, the U.S. equity risk premium is 10.9 percent higher than the 4.23 percent risk premium of AAA-rated countries like Switzerland where:

$$\frac{4.69-4.23}{4.23} \times 100 = \frac{0.46}{4.23} \times 100 = 10.87 \%$$

This is the value we implement in the model as the percent change in U.S. investment risk.

Capital Flows in the GTAP Model

The GTAP model incorporates global capital mobility by creating a “global bank.” This entity serves as a financial intermediary, aggregating the savings from all regions into a single global investment pool. Under the model’s default macro closure — which we adopt in this analysis — the global bank then serves as something akin to an investment fund manager, allocating global investment funds to those regions that provide the highest expected net rates of return to capital.³ The allocation process continues until expected returns to capital are equalized across all regions.

In the linearized GTAP model, global capital market equilibrium is expressed as:⁴

$$rore_r = rorg + cgdslack_r \quad (3)$$

where $rore_r$ is the percent change in the expected net rate of return to capital in region r , $rorg$ is the percent change in the global average expected net rate of return to capital, and $cgdslack_r$ is the percent change in an exogenous variable that is defined for each region r with a default value of 0.⁵

Malcolm (1998) models investment risk by treating the $cgdslack$ variable as an exogenous measure of a region’s risk premium. We follow Malcolm in depicting the ERP as the additional return that is required to compensate global investors for the risk of investing in r relative to global average returns. We rename $cgdslack$ as $risk$ and express the equilibrium condition as:

$$rore_r = rorg + risk_r \quad (4)$$

Variable $rore_r$ becomes the percent change in a region’s expected rate of return, inclusive of the risk premium. Variable $rorg$ is the percent change in the global average rate of return to capital, excluding risk premia. The exogenous variable $risk_r$ is the percent change in the country-specific risk premium associated with net investments in region r . If the risk premium increases, the risk-adjusted change in the regional rate of return will also rise, signaling that investors are requiring greater returns as compensation for higher risk. We focus on the variable $cgdslack$ in our experiments as the proxy for a change in U.S. investment risk.

³ Returns to net investment, excluding depreciation expenditure.

⁴ For more detail, see Corong et al., page 43.

⁵ The $cgdslack$ variable is useful for experiments that make regional investment exogenous, by endogenizing $cgdslack$ and breaking this equilibrium constraint.

Macroeconomic Effects of an Increase in U.S. Investment Risk

We introduce the change in U.S. investment risk in the GTAP model by imposing the 10.9-percent increase in the U.S. implied ERP on the *cgdslack (risk)* variable. In a general equilibrium framework, experiment results reflect the simultaneous adjustment of all goods and prices as the model searches for a new, post-shock equilibrium. To structure our discussion, we order our analysis as a sequence that begins with the macroeconomic adjustments, which we then rely on to understand and explain our microeconomic results.⁶

Our starting point is the capital outflow – trade balance identity equation. In the GTAP model, for each region r :

$$S - I = X - M$$

where S is net regional savings.⁷ Regions' net savings go to the global bank, which then supplies regions with investment capital ("I"), a mix of domestic and foreign net savings that funds a region's net investment. The region's capital account balance is, then, $S - I$. Initially, the U.S. runs a capital account surplus ($S < I$), with a net capital inflow of \$688 billion.

X is the FOB value of regional exports and M is the CIF value of its imports. $X - M$ is the current account balance, which is the flip side of the capital account balance.⁸ The initial U.S. current account balance is a trade deficit of \$688 billion.

Savings-Investment Balance

Table 2 reports the results of the experiment. With zero taxes in MacroToy, and absent changes in factor supplies or productivity in this experiment, real GDP in the U.S. does not change following the shock. However, regional income, which is a nominal value, falls two percent, causing nominal regional net savings – the "S" in the identity equation – to also fall 2 percent. Real net savings (variable *qsave*) declines 0.4 percent (table 2).⁹

⁶ See Burfisher and Akgul (forthcoming) for more detail on macro balances and relationships in the GTAP model.

⁷ Regional income is "net national income" - GDP minus depreciation - hence the amount of net regional income that is saved is termed "net" savings. Depreciation expenditure is fixed at base levels.

⁸ The current account and the $X - M$ trade balance are the same in the GTAP model because it does not include international income payments on ownership of assets.

⁹ Nominal net savings is calculated as *psave* + *qsave*. In the U.S., *psave* = -1.62 and *qsave* = -0.39. Nominal U.S. gross investment spending is calculated as *pinv* + *qinv*. In the U.S., *pinv* = -1.42 and *qinv* = -10.69.

Table 2. Savings-investment balance with 10.9% increase in U.S. investment risk premium								
	% change from base							\$US mill.
	Risk premium (<i>cgdslack</i>)	Real GDP (<i>qgdp</i>)	Regional income (<i>y</i>)	Expected net rate of return to capital (<i>rore</i>)	Real gross investment demand (<i>qinv</i>)	Real net savings (<i>qsave</i>)	Ending capital stock (<i>ke</i>)	Change in capital inflow to U.S. – (<i>del_tbal</i>)
USA	10.9	0.0	-2.0	8.3	-10.7	-0.4	–0.9	-241,818
ROW	0.0	0.0	0.7	-2.3	3.0	0.3	0.3	241,818
Source: MacroToy version of GTAP model, default macro closure, Gragg 2-4-6 solution.								

The increase in U.S. investment risk discourages capital inflows. As U.S. investment risk rises, the initial capital inflow into the U.S. diminishes by \$242 billion. Nominal U.S. gross investment spending falls 12 percent and real investment spending (variable *qinv*) falls almost 11 percent. Reduced investment spending causes the end-of-period capital stock in the U.S. to fall about one percent. This drop leads to a slower U.S. economic growth trajectory when using a dynamic modeling framework.

When capital inflows to the U.S. decline, the global bank reallocates global savings to the aggregated rest-of world (ROW) region. As the flow of capital into ROW increases, its real gross investment spending rises three percent. As ROW's capital goods increase in quantity, their marginal product falls, resulting in a 2.3 percent decline in the global average expected net rate of return to capital. The fall in returns to investment describes the global loss that results from increased U.S. investment risk as capital is reallocated across regions. Still, the increase in ROW's ending capital stock will put it on a stronger economic growth path in a dynamic framework.

Trade Balance

The decline in U.S. capital inflows is accompanied by a \$242 billion reduction in the initial U.S. trade deficit (table 3). Although that may seem desirable to some, its root cause is declining investment demand in the U.S. The mechanism for the trade balance adjustment is the real exchange rate (variable *pfactor*). In the GTAP model, the real exchange rate for a region is the ratio between an index of a region's factor prices and a global average factor price index. The fall in investment demand places downward pressure on U.S. wages and rents while the price of land, a specific factor, increases as agricultural output rises. Falling U.S. wages and rents cause a 1.9 percent depreciation of its real exchange rate. This boosts U.S. exports and dampens U.S. import demand.

Table3. Factor prices and trade balance with 10.9% increase in U.S. investment risk premium							
	% change from base						\$US mill.
	Rental rate of capital (<i>pe_k</i>)	Supply price of labor (<i>pe_l</i>)	Rental rate of land (<i>pe_l</i>)	Real aggregate exports (<i>q_{xwreg}</i>)	Real aggregate imports (<i>q_{mwreg}</i>)	Real exchange rate (<i>pfactor</i>)	Change in trade balance (X-M) (<i>del_tbal</i>)
USA	-1.92	-2.0	10.45	12.48	-5.33	-1.94	241,818
ROW	0.67	0.70	-1.02	-1.57	0.57	0.67	-241,818
Source: MacroToy version of GTAP model, default macro closure, Gragg 2-4-6 solution.							

Welfare

The welfare effects of increased U.S. investment risk are negative and due solely to terms of trade losses (table 4). There are no allocative efficiency effects because our model has zero initial taxes. The advantage of this stripped-down model is that it depicts the welfare effects of the shock without the noise of tax-related efficiency effects. Our experiment also does not change factor supplies, productivity or regional population.

Terms of trade effects result from changes in the relative price of exports to the price of imports. An increase in a region's export supply will tend to reduce the price of its exports, and an increase in its import demand will push up the price of its imports. Market size has a major influence on the relative sizes of export and import price responses. The Armington assumption, widely adopted in CGE models, describes traded products as being differentiated to some degree. For example, Italian cheese is different than U.S. cheese. An implication is that the U.S. is the monopoly exporter of the U.S. variety of cheese and a change in its supply quantity will have a relatively large export price effect. But the U.S. is just one of many customers for Italy's cheese so a change in the U.S. import demand quantity will have only a small effect on Italy's global export price. As a result, the change in a region's export prices often outweighs the change in its import prices.

In our experiment, the increase in the U.S. export supply as investment demand falls, especially for manufacturing (MFG), has a larger downward impact on its aggregate export price index than the small decrease in the price index of its imports. This causes its terms of trade to deteriorate.

Table 4. Welfare effects of a 10.9% increase in U.S. investment risk premium

	Allocative efficiency	Endowment change	Technical change	Population change	Terms of trade	Investment-savings terms of trade	Total
USA	0.0	0.0	0.0	0.0	-29,595	-9,267	-38,861
ROW	0.0	0.0	0.0	0.0	29,272	9,174	38,446

Source: MacroToy version of GTAP model, default macro closure, Gragg 2-4-6 solution.

The investment terms of trade measure the relative price of a region's investment goods, which are sold to the global bank's portfolio, and the purchase price of a share in the global bank portfolio (also called the region's price of savings), which is based on the global average price of investment goods. The decline in the U.S. investment terms of trade reflects its initial position as a capital account surplus country, in which its investment exceeds its savings. This balance places more weight on the decline in price of its own investment goods than the decline in its price of savings and its investment terms of trade falls.

From Macro to Micro

We link our macro results to the micro results of our experiment by first examining the structure of the U.S. economy and using these structural characteristics to make predictions of micro outcomes. This approach allows us to recognize and explain the macro-micro linkages in our model and, in some cases, to identify conflicting macro influences on micro variables. We demonstrate this approach in a discussion of changes in the sectoral composition of output following the increase in U.S. investment risk.

Output Effects of Fall in Gross Investment Demand

Table 5 presents four key shares in the structure of the U.S. economy. The first is the commodity shares in gross investment spending. Services (SER) account for almost 60% of U.S. investment spending, manufacturing (MFG) accounts for a smaller share, and agriculture (AGR) has a zero share. Based on these shares, we can predict that a fall in investment demand in the U.S. will have the largest impact on the production of services. A fall in output of the large SER activity will push out its factors and other inputs. Given our full employment assumption, this increases the supply of factors that must be absorbed by AGR and MFG, causing factor prices to fall. Lower factor costs will cause output of AGR to rise but the effect on MFG is ambiguous. The positive output effect due to the lower cost of its inputs will be offset by the decline in investment demand for MFG.

Table 5. Output effects of a 10.9% increase in U.S. investment risk premium: predicted and actual model results									
	Share in gross investment spending	Predicted change in output	Export share of output	Predicted change in output	Import share of consumption	Predicted change in output	K/L ratio	Predicted change in output	Model result: % change in output
AGR	0.0	+	17.0	+	19.7	+	1.06	+	2.2
MFG	40.1	?	15.6	+	26.7	+	0.43	+	3.1
SER	59.9	-	2.0	-	0.0	-	0.38	-	-0.7
Source: MacroToy version of GTAP model, default macro closure, Gragg 2-4-6 solution.									

Output Effects of Real Exchange Rate Depreciation

U.S. real exchange rate depreciation increases foreign demand for U.S. exports. This will cause output in the more export-intensive production activities to rise, pulling in resources from production of less export-dependent activities. We can predict that this will boost output of AGR, the most export-intensive activity, and likely increase MFG output – creating an intersectoral competition for factors and inputs that will cause output to fall in SER, the least-traded commodity.

The U.S. exchange rate depreciation will cause its import demand to fall as foreign goods become more expensive, causing production of import-competing commodities to increase. MFG is the most import-intensive consumption commodity in the U.S., so we can predict its output is likely to increase by more than AGR, which also has a large import dependence. Given the limited trade in SER, its production will fall as it yields some of its resources to meet increased input demand from the expanding MFG and AGR sectors.

Output Effects of Relative Factor Price Changes

SER is the largest employer in the U.S. economy and when its demand for workers and capital stock fall with the decline in investment demand, they must be absorbed by the smaller AGR and MFG sectors, causing wages and rents to fall. U.S. capital rents fall slightly more than wages. This will benefit the relatively capital-intensive sectors because rents account for a proportionately larger share of their total factor costs. The fall in the rent-wage ratio will boost production in AGR, which is the most capital-intensive sector. MFG is a labor-intensive sector but its output is also likely to rise as its factor input costs fall. Services output will fall as it yields inputs to the expanding AGR and MFG activities.

Predicted versus Actual Model Results

Our predictions for output changes in AGR and SER have consistent signs, and model results align with our predictions, with AGR production increasing 2.2% and SER production declining 0.7%. We have a mixed prediction for MFG and find that on net its output increases by 3.1% following the investment risk shock. Model results are of value because they enable us to quantify the magnitudes of adjustments that we can predict based on theory and structure, and they can resolve the relative importance of competing macro influences on micro variables.

Comparing Macro Effects of Increased U.S. Investment Risk Across Model Versions

Version Comparison

We explore whether the macro relationships and the macro-micro linkages that we demonstrate in MacroToy are consistent across different GTAP model versions. Table 6 summarizes the versions we use in simulations of the increase in U.S. investment risk.¹⁰

Table 6. GTAP model version descriptions						
Name	Database version	Reference year	Regions	Activities/ Commodities	Factor endowments	Taxes
MacroToy	V8.1	2007	Two	Three	Three	No

¹⁰ See database aggregation maps in Appendix 1.

NUS333	V8.1	2007	Two	Three	Three	Yes
V12-333	V12	2023	Two	Three	Three	Yes
V12-Large	V12	2023	Eleven	Ten	Three	Yes

MacroToy is a two-region model of the United States and the Rest of the World (ROW) built on the GTAP Version 8.1 database, released in February 2013. Tax distortions are removed using the Altermat utility. NUS333 is the same build as MacroToy but includes taxes. In contrast, the V12 database is released in February 2026. For comparability, we first aggregate the V12 database into a 3x3x3 model with USA and ROW regions, using the 2023 reference year. We then compare the results with a larger V12 model with 10 activities, 10 commodities, 3 endowments and 11 regions.

Comparison of Macro Results

Table 7 reports the macro results of the same simulation across the three two-region model versions, and table 8 reports macro results for the 11-region model version. The shock in all versions is the same 10.9 percent increase in the U.S. risk premium. The results indicate that an increase in U.S. investment risk reduces net capital inflow by \$298 billion in the tax-inclusive NUS333 model, compared with \$622 billion in the V12-333 model with the 2023 reference year. Thus, although the percentage changes are very similar across databases, the absolute magnitudes differ substantially when moving from Version 8.1 to Version 12.

Real gross investment spending in the U.S. declines by comparable amounts across all model variants: by 10.9 percent in NUS333, 10.3 percent in V12-333, and 10.4 percent in the larger V12 model. Hence, there is little difference in percentage terms, indicating that the investment response is highly robust to database version and aggregation structure. Consequently, the end-of-period U.S. capital stock declines by approximately one percent in all cases. This similarity holds both across databases and across alternative aggregations because capital accumulation is driven primarily by the investment response, which is itself stable across model configurations.

Table 7. 10.9 % Increase in US Risk Premium in MacroToy, NUS333 and V12-333 Versions							
		MacroToy		NUS333		V12-333	
Description	Variable	USA	ROW	USA	ROW	USA	ROW
Percent change from base							
Risk premium	<i>cgdslack</i>	10.9	0	10.9	0	10.9	0
Expected net rate of return to capital	<i>rore</i>	8.3	-2.3	8.3	-2.3	8.4	-2.3
Global rate of return	<i>rorg</i>	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3
Real gross investment	<i>qinv</i>	-10.7	3.0	-10.9	3.0	-10.3	2.9
Real net savings	<i>qsave</i>	-0.4	0.3	-0.5	0.4	-0.4	0.3
Ending capital stock	<i>ke</i>	-0.9	0.2	-0.9	0.3	-0.9	0.2
Rental rate of capital	<i>pe</i>	-1.9	0.7	-2.2	0.8	-2.3	0.8
Supply price of labor	<i>pe</i>	-2.0	0.7	-2.3	0.8	-2.5	0.9
Rental rate of land	<i>pe</i>	10.4	-1.0	11.9	-1.0	1.3	0.2
Real aggregate exports	<i>qxwreg</i>	12.5	-1.5	14.5	-1.8	16.0	-2.0
Real aggregate imports	<i>qmwreg</i>	-53	0.6	-6.1	0.7	-7.4	0.8
Real exchange rate	<i>pfactor</i>	-1.9	0.7	-2.2	0.8	-2.4	0.8
Change from base (\$US millions)							
Change in trade balance \$US	<i>del_tbal</i>	241,818	-241,818	297,622	-297,622	622,041	-622,041
Change in welfare \$US	<i>EV</i>	-39,517	39,087	-56,429	55,901	-68,596	132,593

The reduction in U.S. investment is part of the reallocation of global savings by the global bank. As U.S. investment becomes less attractive on a risk-adjusted basis, global capital is redirected toward the ROW. In the two-region aggregation, investment in ROW increases by approximately three percent, while in the multi-region specification, increases range between two and 3.5 percent across regions. This consistency suggests that global capital reallocation is not highly sensitive to regional disaggregation but rather governed by aggregate return differentials.

As investment expands in ROW, its marginal productivity of capital declines, leading to a 2.3 percent reduction in the global expected rate of return (*rorg*). This reflects the standard equilibrium mechanism in which increased capital accumulation reduces returns in receiving regions. In the United States, the expected rate of return increases by approximately 8.3 – 8.4 percent, which is smaller than the imposed risk shock. This outcome reflects two offsetting forces:

- (i) the increase in required returns due to higher risk, and
- (ii) the decline in the global rate of return resulting from capital reallocation.

Consequently, the increase in the U.S. risk-adjusted expected return is moderated, consistent with the equilibrium condition that risk-adjusted returns must equalize across regions.

Lower U.S. wages and rents contribute to a depreciation of the US real exchange rate: by 2.2 percent in the NUS333 model, 2.4 percent in the V12-333 model, and 2.7 percent in the larger V12 model. As a result, U.S. exports expand while imports contract, leading to a substantial improvement in the trade balance by \$298 billion in the NUS333 model and by \$622 billion and \$629 billion in the two V12 models, respectively.

Finally, the increase in U.S. investment risk leads to a welfare decline in the United States across all model versions, while generating welfare gains in non-US regions. Although the qualitative pattern is consistent, the magnitude and composition of welfare effects differ across model versions and aggregations.

For instance, in the distortion-free MacroToy model, the welfare loss in the United States is relatively modest (approximately \$39.5 billion). However, when taxes are introduced, as in the NUS333 specification, the welfare loss increases substantially to approximately \$56 billion. This amplification is primarily driven by the emergence of a negative allocative efficiency effect, which is absent in the tax-free environment. In addition, the inclusion of taxes increases the welfare losses associated with both the terms-of-trade and the IS terms-of-trade.

The negative allocative efficiency effect in the tax-inclusive specification is largely attributable to pre-existing distortions in the manufacturing commodity and the services activity. The adverse contribution from services is linked to the contraction in services production, while the

manufacturing component appears to be associated with distortions affecting intermediate demand, including investment-related input use.

In contrast, the allocative efficiency effect becomes positive in Version 12, reflecting improved resource allocation in the presence of different underlying distortions. This positive contribution is primarily driven by gains in manufacturing activity and services commodities. These differences can be attributed, in part, to variations in the structure and magnitude of pre-existing distortions between the Version 8.1 and Version 12 databases, as well as differences in the reference year. In addition, the stronger expansion of manufacturing output in Version 12 relative to the MacroToy and NUS333 versions contributes to the improved allocative efficiency outcome.

The consistency of the macro relationships and results across different GTAP model aggregations suggests that integrating macro outcomes with structural characteristics is a robust approach to explaining and understanding the microeconomic outcomes of model experiments.

Conclusion

This analysis describes the macroeconomic adjustments triggered by a macro shock such as an increase in U.S. investment risk. The experiment, modeled using the GTAP MacroToy model version, shows how we can link macroeconomic changes to micro outcomes using the structural characteristics of an economy. Our approach shows the value of integrating macro and micro perspectives when analyzing and explaining model results, ensuring that analysis of factor and commodity-level results are grounded in the broader economic context shaped by the macro economy. We also find these macro relationships and results to be consistent across different GTAP model aggregations.

Table 8. 10.9% Increase in US Risk Premium in V12-Large Model Version

	V12-Large Model										
Variable	Oceania	EastAsia	SEAsia	SouthAsia	USA	RNAmerica	LatinAmer	WestEurope	MENA	SSA	RestofWorld
Percent change from base											
<i>cgdslack</i>	0	0	0	0	10.9	0	0	0	0	0	0
<i>rore</i>	-2.3	-2.3	-2.3	-2.3	8.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3
<i>rorg</i>	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3	-2.3
<i>qinv</i>	2.9	2.9	2.4	2.4	-10.4	3.5	3.5	3.5	2.4	2.6	2.5
<i>qsave</i>	0.4	0.4	0.2	0.4	-0.5	0.6	0.4	0.4	0.3	0.2	0.2
<i>ke</i>	0.2	0.3	0.2	0.2	-0.9	0.3	0.3	0.3	0.2	0.2	0.2
<i>pe(capital)</i>	0.8	1.2	0.7	1.2	-2.7	0.2	0.7	0.9	0.7	0.8	0.7
<i>pe(labor)</i>	1.1	1.3	0.7	1.3	-2.9	0.3	0.8	0.9	0.9	0.9	1.0
<i>pe(land)</i>	-2.0	-0.4	0.3	0.4	8.9	0.1	-0.4	-1.4	0.4	0.0	-0.2
<i>qxwreg</i>	-2.2	-3.7	-1.1	-3.3	16.0	-1.4	-1.9	-1.3	-1.1	-1.5	-1.6
<i>qmwreg</i>	1.2	1.3	0.3	1.2	-7.6	1.5	1.7	0.6	0.8	0.6	0.6
<i>pfactor</i>	0.9	1.2	0.7	1.2	-2.7	0.3	0.8	0.9	0.8	0.8	0.8
Change from base (\$US millions)											
<i>del_tbal</i>	-14,219	-248,943	-26,456	-34,301	628,559	-29,502	-31,375	-176,831	-36,582	-12,735	-17,615
<i>EV</i>	3,211	54,307	3,317	6,747	-71,369	10,410	8,429	44,788	5,191	1,264	849

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Appendix: Database Aggregations

Appendix table 1. Aggregations in 333 model versions

Regions	Activities & Commodities	Endowments
USA	Agriculture	Land
ROW	Manufactures	Labor
	Services	Capital

Appendix table 2. Aggregation used in V12-large version

Regions	Description
Oceania	Australia, New Zealand
EastAsia	East Asia
SEAsia	Southeast Asia
SouthAsia	South Asia
USA	United States
RNAmerica	Rest of North America
LatinAmer	Latin America
WestEurope	Western Europe
MENA	Middle East and North Africa
SSA	Sub-Saharan Africa
RestofWorld	Rest of World

Activities & Commodities	Description
GrainsCrops	Grains and Crops
MeatLstk	Livestock and Meat Products
Extraction	Mining and Extraction
ProcFood	Processed Food
TextWapp	Textiles and Clothing
LightMnfc	Light Manufacturing
HeavyMnfc	Heavy Manufacturing
Util Cons	Utilities and Construction
TransComm	Transport and Communication
OthServices	Other Services