Yale Budget Lab Tariff Model

Dependency Map and Calculation Reference

Generated from `ricco_tariffs_11-17.xlsm`

January 5, 2026

Contents

1 Overview

This document maps the calculation dependencies in the Budget Lab's tariff model Excel workbook. Each result is traced back to its inputs and intermediate calculations to facilitate conversion to R.

1.1 Model Structure

The workbook contains 34 worksheets organized into three layers:

- **Input Layer:** Tariff parameters, import data, external model outputs
- **Calculation Layer:** ETR computation, price effects, revenue scoring
- **Output Layer:** Key Results, tables (T1, T3), figures (F1–F7)

2 Effective Tariff Rates

2.1 Pre-Substitution ETR (Increase)

Output Cell	`Key Results!B3`
Value	14.4%

Dependency Chain:

```
Key Results!B3
  -> 'F1 Historical'!F239
       -> = F236 - E236
            F236 = E237 (All-In Pre-Sub ETR)
            E236 = B236 (Baseline ETR = 2.418%)
```

Calculation:

$$\text{ETR}_{\text{increase}} = \text{ETR}_{\text{all-in}} - \text{ETR}_{\text{baseline}} \tag{1}$$

2.2 Pre-Substitution ETR (All-In)

Output Cell	`Key Results!B4`
Value	16.8%

Dependency Chain:

```
Key Results!B4
  -> 'F1 Historical'!F237
       -> = E237
            -> = B236 + ricco_price_effects_and_etr!D25 * 100
                 B236 = 2.418 (Baseline ETR)
                 D25 = BW55/100 (Weighted ETR)
```

The weighted ETR is computed as:

$$\text{ETR}_{\text{weighted}} = \frac{\sum_c \text{ETR}_c \times \text{Import}_c}{\sum_c \text{Import}_c} \tag{2}$$

where $c \in \{\text{China, Canada, Mexico, UK, Japan, EU, ROW, FTROW}\}$.

2.3 Post-Substitution ETR

Metric	Cell	Value
Increase	`Key Results!B7`	11.9%
All-In	`Key Results!B8`	14.4%

Post-substitution values use row 25 of `ricco_price_effects_and_etr` instead of row 24, reflecting import substitution responses.

2.4 ETR Input Sources

Input	Location	Description
Baseline ETR	`F1 Historical!B236`	2.418% (2024 baseline)
Country ETRs	`Weighted US Tariff!Z83:AG127`	Matrix: GTAP sector × country
Import weights	`ricco_price_effects!BE:BL`	Country import shares from GTAP
Country mapping	`Weighted US Tariff!Z82:AG82`	china, canada, mexico, uk, japan, eu, row, ftrow

3 Price Effects

3.1 Consumer Price Increase (Pre-Substitution)

Output Cell	`Key Results!B12`
Value	1.2%

Dependency Chain:

```
Key Results!B12
  -> ricco_price_effects_and_etr!E24
       -> = (D24 * -B13 * F24 * H24)
          + (D24*100) * H24 * F24 * (1+B14) / 100
```

Formula:

$$\Delta P = \underbrace{\tau \cdot (-\delta) \cdot \alpha_g \cdot \alpha_m}_{\text{USD offset effect}} + \underbrace{\tau \cdot \alpha_m \cdot \alpha_g \cdot (1+\phi)}_{\text{Passthrough effect}} \tag{3}$$

where:

- τ = Effective tariff rate
- δ = USD offset (0.17)
- ϕ = Domestic price passthrough (0.50)
- α_g = Goods share of PCE (0.31)
- α_m = Import share of goods PCE (0.21)

3.2 Per-Household Cost

Metric	Cell	Value
Pre-Substitution	`Key Results!B13`	$1,671
Post-Substitution	`Key Results!B15`	$1,257

Dependency Chain:

```
Key Results!B13
  -> -ricco_price_effects_and_etr!I24
       -> I24 = 'F6 Distribution (C)'!N23
            -> N23 = AVERAGE(B23:K23)
                     [Average cost across income deciles]
```

3.3 Price Effect Parameters

Parameter	Cell	Value	Description
USD Offset	`B13`	0.17	$= 0.3 \times 0.58$ (exchange rate adjustment)
Price Passthrough	`B14`	0.50	Domestic price passthrough rate
Goods Share of PCE	`B15`	0.31	Share of consumption on goods
Import Share	`B16`	0.21	Import share of goods consumption

4 Revenue Estimates

4.1 Conventional Revenue (10-Year)

Output Cell	`Key Results!B18`
Value	$2,728 billion

Dependency Chain:

```
Key Results!B18
  -> 'T3 Fiscal'!L6
       -> = SUM(B6:K6)  [FY2026-FY2035]
            -> B6 = 'Fiscal Summary'!C28
                 -> C28 = C25 + C27 + C26
                      C25 = Gross revenue
                      C26 = Compliance effect (-10%)
                      C27 = Income effect (-23%)
```

Revenue Formula:

$$R_{\text{net}} = \underbrace{(D_{\text{new}} - D_{\text{baseline}})}_{\text{Gross Revenue}} \times \underbrace{(1 - 0.10 - 0.23)}_{\text{Behavioral adjustments}} \tag{4}$$

where:

$$D_{\text{new}} = \text{ETR}_{\text{new}} \times M_{\text{adjusted}} \tag{5}$$

$$M_{\text{adjusted}} = M_{\text{baseline}} \times (1 - \varepsilon \cdot \Delta\tau) \tag{6}$$

4.2 Dynamic Revenue (10-Year)

Output Cell	`Key Results!B19`
Value	$2,342 billion

Calculation:

$$R_{\text{dynamic}} = R_{\text{conventional}} + \sum_{t=2026}^{2035} \Delta_t^{\text{dynamic}} \tag{7}$$

The dynamic scoring adjustments $\Delta_t^{\text{dynamic}}$ are stored in `T3 Fiscal!B8:K8`.

4.3 Revenue Input Sources

Input	Source	Description
Baseline Imports	`Fiscal Summary!C16`	CBO January baseline ($4,283B for FY2026)
Baseline Duties	`Fiscal Summary!C17`	CBO baseline duties ($84B)
Import Elasticity	`Fiscal Summary!C42`	Response of imports to tariffs
Compliance Effect	Hard-coded	−10% of gross revenue
Income Effect	Hard-coded	−23% of gross revenue
Dynamic Effects	`T3 Fiscal!B8:K8`	Year-by-year dynamic adjustments

5 Macroeconomic Effects

5.1 GDP Impact

Metric	Cell	Value	Period
Q4-Q4 GDP	`Key Results!B22`	−0.50%	2025
Q4-Q4 GDP	`Key Results!B23`	−0.39%	2026
Long-Run GDP	`Key Results!B28`	−0.31%	Steady state

Q4-Q4 GDP Formula:

$$\Delta\text{GDP}_t^{Q4} = 100 \times \left[\frac{Y_t^{\text{tariff}} / Y_{t-1}^{\text{tariff}}}{Y_t^{\text{baseline}} / Y_{t-1}^{\text{baseline}}} - 1 \right] \tag{8}$$

Dependency Chain:

```
Key Results!B22
  -> 'F3 GDP'!AF8
       -> = 100 * ((Y8/Y4) - (H8/H4))
            Y8 = H8 * (1 + B8/100)  [GDP with tariffs]
            H8 = 21203.3            [Baseline GDP, Q4 2025]
            B8 = 100 * (T8/H8 - 1) [GDP deviation %]
            T8 = 21099.8            [MAUS projection]
```

5.2 Labor Market Effects

Metric	Cell	Formula	Value
U-rate 2025 Q4	B24	$W8 - K8$	+0.28 pp
U-rate 2026 Q4	B25	$W12 - K12$	+0.62 pp
Payroll 2025 Q4	B26	$1000 \times (V8 - J8)$	−463K
Payroll 2026 Q4	B27	$1000 \times (V12 - J12)$	$-1,230$K

Column definitions in F3 GDP:

- W: Unemployment rate with tariffs (MAUS)
- K: Baseline unemployment rate (CBO)
- V: Employment with tariffs (millions, MAUS)
- J: Baseline employment (millions, CBO)

5.3 Macro Input Sources

Input	Source	Description
Baseline GDP (quarterly)	F3 GDP!H	CBO/MAUS baseline projections
Tariff GDP (quarterly)	F3 GDP!T	MAUS projections with tariffs
Baseline Unemployment	F3 GDP!K	CBO baseline
Tariff Unemployment	F3 GDP!W	MAUS with tariffs
Baseline Employment	F3 GDP!J	CBO baseline (millions)
Tariff Employment	F3 GDP!V	MAUS with tariffs
Long-run GDP effects	F5 Foreign GDP!H	GTAP simulation results

Note: MAUS = Macro model outputs (pasted from external model runs).

6 Sector Effects

6.1 Sector Output Changes

Sector	Cell	Value
Agriculture	B32 → B1	−1.4%
Mining & Extraction	B33 → B2	−2.1%
Total Manufacturing	B34 → B3	+2.9%
Durable Manufacturing	B35 → B4	+4.9%
Advanced Manufacturing	B36 → B5	+1.6%
Nondurable Manufacturing	B37 → B6	+0.6%
Utilities	B38 → B7	+0.4%
Construction	B39 → B8	−4.1%
Services	B40 → B9	−0.2%

Calculation Formula:

$$\text{Sector Effect}_s = \frac{\sum_{i \in s} L_i \cdot X_i \cdot S_i}{\sum_{i \in s} L_i \cdot S_i} \tag{9}$$

where:

- L_i = Output weight for GTAP sector i
- X_i = Output change for sector i (from GTAP simulation)
- S_i = Additional weight (e.g., durable/nondurable flag)

6.2 GTAP Sector Mapping

Output Sector	GTAP Sectors (rows)
Agriculture	pdr, wht, gro, v_f, osd, c_b, pfb, ocr, ctl, oap, rmk, wol, frs, fsh
Mining & Extraction	coa, oil, gas, oxt
Manufacturing	All manufacturing sectors (rows 29–55)
Utilities	ely, gdt, wtr
Construction	cns
Services	trd, otp, wtp, atp, cmn, ofi, isr, obs, ros, osg, dwe

7 Foreign GDP Effects

Region	Cell Path	Value
USA	`B45` → `F5!B2` → `H2`	−0.31%
China	`B46` → `F5!B3` → `H3`	−0.23%
ROW	`B47` → `F5!B4` → `H4`	+0.01%
Canada	`B48` → `F5!B5` → `H5`	−0.23%
Mexico	`B49` → `F5!B6` → `H6`	+0.02%
FTROW	`B50` → `F5!B7` → `H7`	+0.04%
Japan	`B51` → `F5!B8` → `H8`	–
EU	`B52` → `F5!B9` → `H9`	–
UK	`B53` → `F5!B10` → `H10`	–

Source: Column H values are GTAP simulation results (`qgdp` variable), pasted from RunGTAP output.

8 Food Price Effects

8.1 Short-Run Food Price

Output Cell	`Key Results!B58`
Source	`Weighted US Tariff!B11`

$$\text{Food Price}_{\text{SR}} = \frac{\sum_i K_i \cdot N_i \cdot T_i}{\sum_i K_i \cdot T_i} \tag{10}$$

where K_i = inclusion flag, N_i = scaled price impact, T_i = price effect.

8.2 Long-Run Food Price

Output Cell	`Key Results!B59`
Source	`LR Products!AM88`

$$\text{Food Price}_{\text{LR}} = \frac{\sum_i X_i \cdot AS_i \cdot AH_i}{\sum_i AH_i \cdot AS_i} \tag{11}$$

Weighted average of GTAP price effects for food sectors.

9 Tariff Rate Parameters

9.1 IEEPA Tariff Rates

Parameter	Cell	Rate
IEEPA Canada	`Weighted US Tariff!B26`	35%
IEEPA Canada energy	`Weighted US Tariff!B27`	10%
IEEPA Mexico	`Weighted US Tariff!B28`	25%
IEEPA Vietnam	`Weighted US Tariff!B30`	20%
IEEPA China Broad	`Weighted US Tariff!B31`	20%
IEEPA China Reciprocal	`Weighted US Tariff!B32`	10%
IEEPA EU Reciprocal	`Weighted US Tariff!B33`	15%
IEEPA Reciprocal	`Weighted US Tariff!B34`	10%

9.2 Section 232 Tariff Rates

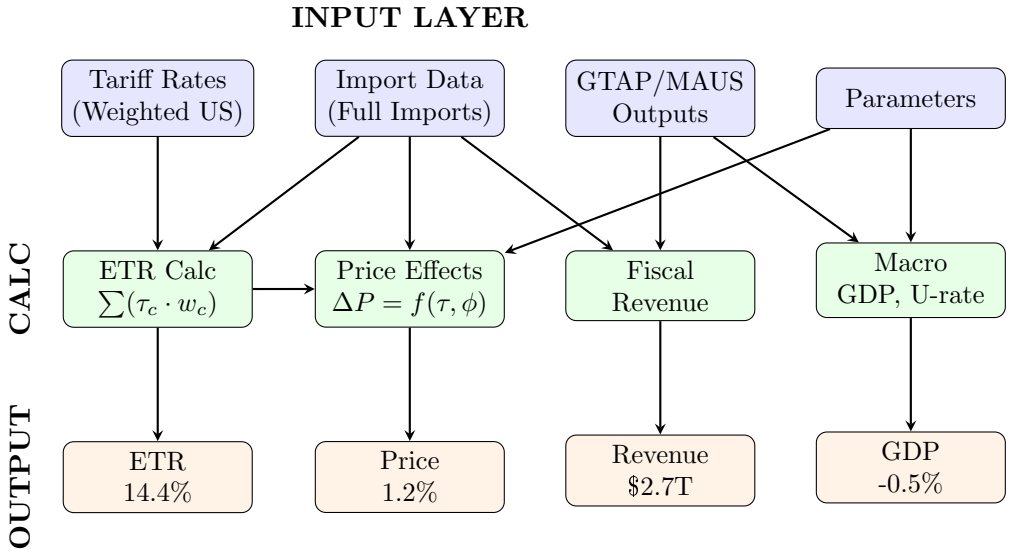
Parameter	Cell	Rate
232 Autos	`Weighted US Tariff!B37`	25%
232 Autos EU	`Weighted US Tariff!B38`	15%
232 Autos UK	`Weighted US Tariff!B39`	10%
232 Steel & Aluminum	`Weighted US Tariff!B40`	50%

9.3 Other Parameters

Parameter	Cell	Value
Canada USMCA Trade Share	`B16`	7%
Mexico USMCA Trade Share	`B17`	15%
US-assembled foreign autos	`B13`	0.33

Parameter	Cell	Value
Rebate, year 1	B14	3.75

10 Calculation Flow Diagram



11 External Model Dependencies

The following data are pasted from external model runs and cannot be computed within the spreadsheet:

Model	Sheet	Variables
GTAP	F5 Foreign GDP!H	GDP effects by region (qgdp)
GTAP	F4 US Sector Output!X	Output changes by sector
GTAP	ricco_price_effects cols AS–BB	Price/quantity effects
MAUS	F3 GDP!T	Quarterly GDP with tariffs
MAUS	F3 GDP!W	Quarterly unemployment with tariffs
MAUS	F3 GDP!V	Quarterly payrolls with tariffs

12 Key Formulas for R Conversion

12.1 Weighted Effective Tariff Rate

```
weighted_etr <- sum(country_etr * import_weights) / sum(import_weights)
```

12.2 Price Effect

```
price_effect <- (etr * -usd_offset * goods_share * import_share) +
                (etr * import_share * goods_share * (1 + passthrough))
```

12.3 Net Revenue

```
gross_revenue <- new_duties - baseline_duties
net_revenue <- gross_revenue * (1 - compliance_effect - income_effect)
```

12.4 GDP Impact (Q4-Q4)

```
gdp_impact <- ((tariff_gdp_q4 / tariff_gdp_q4_prior) /
               (baseline_gdp_q4 / baseline_gdp_q4_prior) - 1) * 100
```

12.5 Sector Effect

```
sector_effect <- sum(output_weight * gtap_effect * sector_flag) /
                 sum(output_weight * sector_flag)
```

13 Vestigial Elements

The following elements can be ignored during R conversion:

- `__123Graph_*` named ranges (Lotus 1-2-3 legacy)
- External links to old CBO/Yale SharePoint files
- Sheets marked with `IGNORE>>>`
- VBA macros in `vbaProject.bin` (primarily UI automation)

Generated from analysis of `ricco_tariffs_11-17.xlsm`
January 5, 2026