

Step 1: Estimating Economic Sensitivities (t)

Since you want to **select stocks based on fundamental factors** but also **tilt weights based on economic exposure**, the first step is to measure each stock's **sensitivity to economic performance**. We will do this in two ways:

Method 1: Regression-Based Beta Estimation

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Estimate each stock's **economic beta** by regressing historical stock returns against key macroeconomic indicators (e.g., GDP growth, interest rates, inflation, PMI, etc.).

$$R_i = \alpha + \beta_{GDP} \cdot \Delta GDP + \beta_{INF} \cdot \Delta Inflation + \beta_{IR} \cdot \Delta InterestRate + \varepsilon$$

where:

- R_i = excess return of stock i
- ΔGDP = change in GDP growth
- $\Delta Inflation$ = change in inflation
- $\Delta InterestRate$ = change in short-term or long-term interest rates
- $\beta_{GDP}, \beta_{INF}, \beta_{IR}$ = **sensitivities** of stock i to each macroeconomic variable

The estimated coefficients (**economic betas**) will serve as indicators of how sensitive a stock is to economic conditions. A **high positive beta** suggests a stock performs well in good times but suffers in downturns. A **negative beta** implies a defensive stock.

Method 2: Scenario-Based Expected Returns

- Based on your **forecasted economic conditions (t+1)**, construct a **scenario matrix** mapping expected stock returns to different macroeconomic states:

$$E[R^{i,t+1}] = \sum_j w_j \cdot \beta_{ij}$$

where:

- w_j = forecasted weight of macroeconomic factor j in your scenario
- β_{ij} = sensitivity of stock i to factor j

This method ensures we **incorporate forward-looking expectations**, not just past relationships.

Approach to Implementing an Economic Sensitivity Tilt in a Market-Neutral Portfolio

To implement your pessimistic market outlook by tilting your **market-neutral portfolio**, we will integrate:

1. **Stock selection based on fundamental and economic factors**
2. **Regression-based betas or scenario-based return estimates** to gauge stocks' sensitivities to economic performance
3. **An optimization approach** to ensure the short portfolio is more sensitive to macroeconomic risks than the long portfolio
4. **Sector-neutrality with controlled exposure caps** to avoid excessive concentration in any sector or factor

Step 2: Constructing the Optimization Problem

Your portfolio is dollar and beta-neutral, so we will add a constraint to ensure:

- The short portfolio has higher exposure to economic sensitivity than the long portfolio
- Sector tilts are controlled
- The total economic exposure remains within risk bounds

The optimization objective function remains:

$$\max_{\omega} \sum_i \omega_i \cdot \hat{R}_i$$

where:

- ω_i = weight of stock i (long or short)
- \hat{R}_i = expected stock return based on fundamental factors

Constraints to Incorporate Economic Sensitivity

1. Dollar-neutrality:

$$\sum_{i \in \text{long}} \omega_i = \sum_{i \in \text{short}} |\omega_i|$$

2. Beta-neutrality:

$$\sum_i \omega_i \cdot \beta^{MKT,i} = 0$$

where $\beta^{MKT,i}$ is the stock's CAPM beta.

3. Economic Sensitivity Tilt (New Constraint):

$$\sum_{i \in \text{short}} |\omega_i| \cdot \beta^{ECON,i} > \sum_{i \in \text{long}} \omega_i \cdot \beta^{ECON,i} + \delta$$

where:

- $\beta^{ECON,i}$ is the **economic sensitivity** of stock i
- δ is a **minimum threshold** ensuring the short portfolio is significantly more sensitive than the long portfolio.

4. Sector-Neutrality Constraint:

$$\sum_{i \in \text{long}, s} \omega_i - \sum_{i \in \text{short}, s} |\omega_i| \leq \lambda_s, \quad \forall s \in \text{sectors}$$

where λ_s caps sector imbalances.

5. Risk Constraint (Exposure Caps):

$$\sum_i |\omega_i| \cdot \beta^{ECON,i} \leq \gamma$$

where γ limits total exposure to economic risks.

Step 3: Solving for Optimal Weights

This is now a **quadratic programming (QP) problem**, which can be efficiently solved with:

- Python (CVXPY, SciPy.optimize)
- MATLAB (quadprog)
- R (quadprog, ROI packages)

The optimizer will balance:

- Maximizing expected stock returns
- Ensuring market neutrality
- Enforcing the economic exposure tilt
- Avoiding excessive sector concentration

Step 4: Interpreting the Results

After solving for weights:

1. **Check the short portfolio's economic sensitivity:**
 - Verify that the weighted sensitivity of the short side is **greater** than the long side, confirming the tilt.
 2. **Monitor sector exposures:**
 - Ensure no single sector dominates due to the new constraints.
 3. **Assess portfolio stability in stress tests:**
 - Simulate performance under **different macroeconomic shocks** to confirm robustness.
 4. **Rebalance dynamically:**
 - As new economic data arrives, **update economic betas** and **re-run optimization**.
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Conclusion

By integrating **economic sensitivity into the optimization**, you create a **dynamically hedged market-neutral portfolio** that profits from fundamental factors **while being positioned for an economic downturn**. The use of **regression-based betas and scenario-driven estimates** ensures that the **short portfolio carries higher economic exposure**, reflecting your **pessimistic macro view** without violating market neutrality.

