



Investigating Dynamics of the “Growth- Profitability Efficacy Syndrome”

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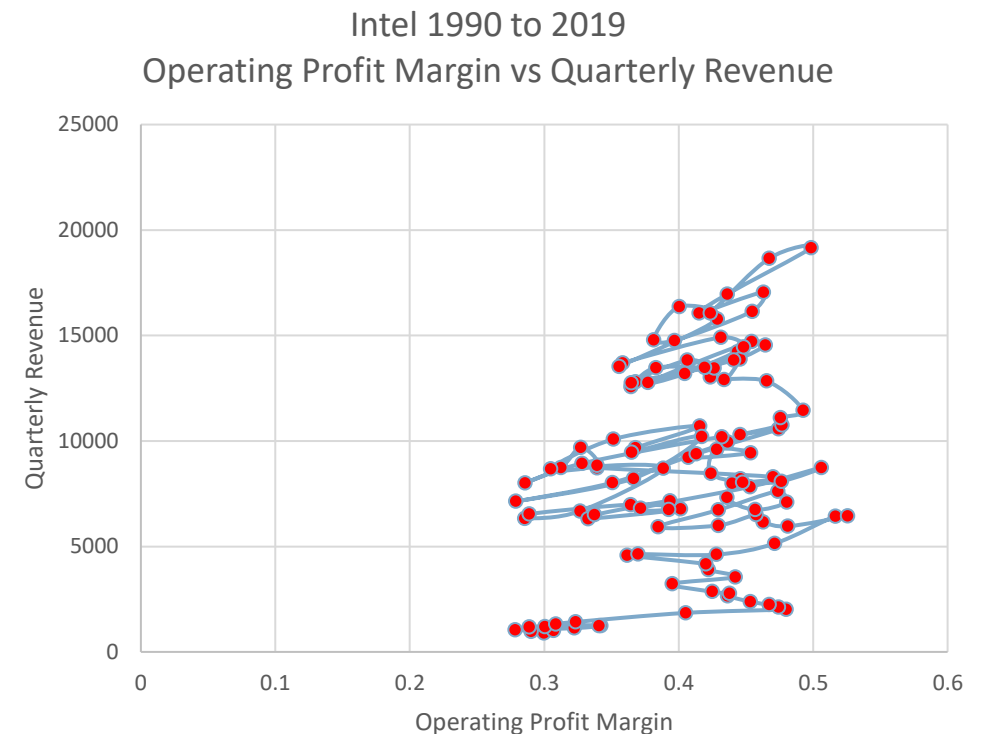
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The Growth-Profitability Efficacy Syndrome

- How does company growth impact profitability and vice versa?
 - Linear or Nonlinear relationship?
- Growth Corridor (Raisch and von Krough, 2005), Myth of Unbounded Growth (Mackey and Valikangas, 2004), Growth Stalls (Olson, van Bever, and Verry, 2008), Resource Acquisition in Corporate Growth (Packer), Get Big Fast (Oliva, Sterman, Giese)
 - Rapid growth – unsustainable, risk stalling and losing market value
 - Slow growth – loss of market share, and competitors will dominate
- Intel Growth
 - Slower Revenue Growth is evident when Profitability increases
 - Faster Revenue Growth is evident when Profitability declines
- Explore dynamic relationship between growth decision and profitability



Dynamic Hypothesis

- Variation on The Penrose Effect - Theory of the Growth of the Firm (Penrose, 1959)
- Penrose: The firm's growth rate is limited by the time needed to effectively integrate managers. New management is needed to effectively use new resources. Overall productivity of new resources will be low, but increase with new management's training and experience. Once resources are fully utilized and productivity increases, then the firm will have incentive to expand further.
 - Absorption of new management to increase resource productivity is a balancing feedback loop
 - Expanding too fast will decrease efficiency of firm
- We operationalize the Penrose effect via production capacity and profit margin, rather than management and productivity.
 - Expansion of production capacity implies hiring and training of management
 - Profit Margin is a metric for productivity of assets and training of new management

Model Design

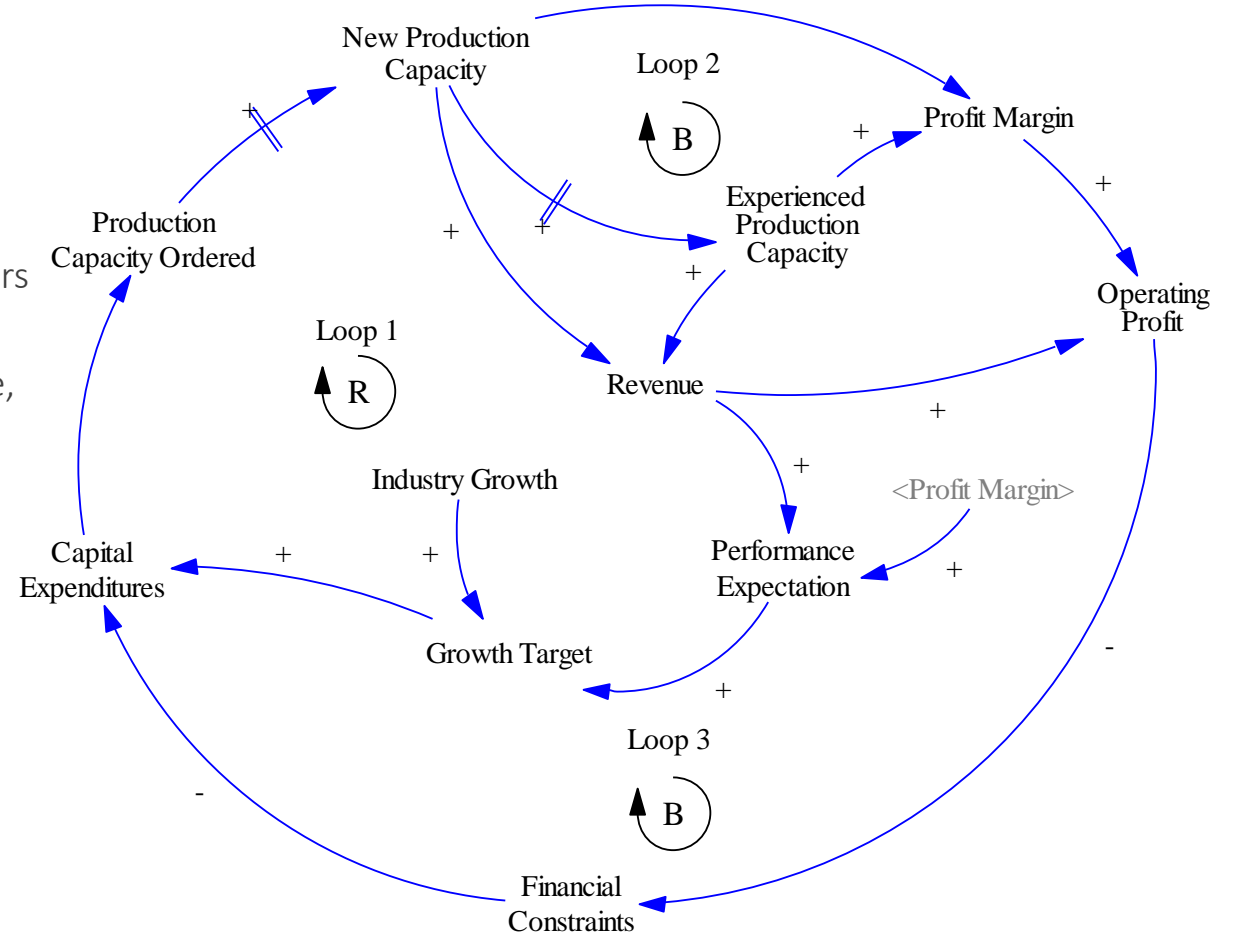
- All used data publicly available (10-K from Compustat)
 - Can calibrate/validate against real financial data
 - Don't need special access to private data sources, easy to replicate and use
- General enough to apply to most companies, but detailed enough to study dynamic behavior
- Real Financial Ratios used to establish parameters and eliminate exogenous variables
- Fixed Assets (split into Ordered, New, and Experienced Production Capacity) drives Revenue
 - Packer used Ordered and Effective Capacity
- Exogenous Variables
 - Fixed Asset Turnover Ratio (delayed for management's growth decision)
 - Industry Growth Rates (delayed 1 quarter)
 - Share Buyback
- Parameter design and specifications from both expert opinion, ratio averages, and optimization
- Calibration/Extreme Value testing with "0 growth" case

Assumptions

- Growth not limited by market or competition(no upper bound)
- Growth targets and dynamics are a consequence of human decision making, specifically central management
- Most ratios are averages taken from data, some calculations needed
- Firm Revenue based upon Fixed Assets (Fixed Asset Turnover Ratio)
- Profit Margin determined by relative magnitude of different production capacities
- No external equity investment, only debt financing as limited by banking covenants
- Cash (not Accrual) accounting based, Depreciation and Amortization is a constant % of Fixed Assets
- More details in paper

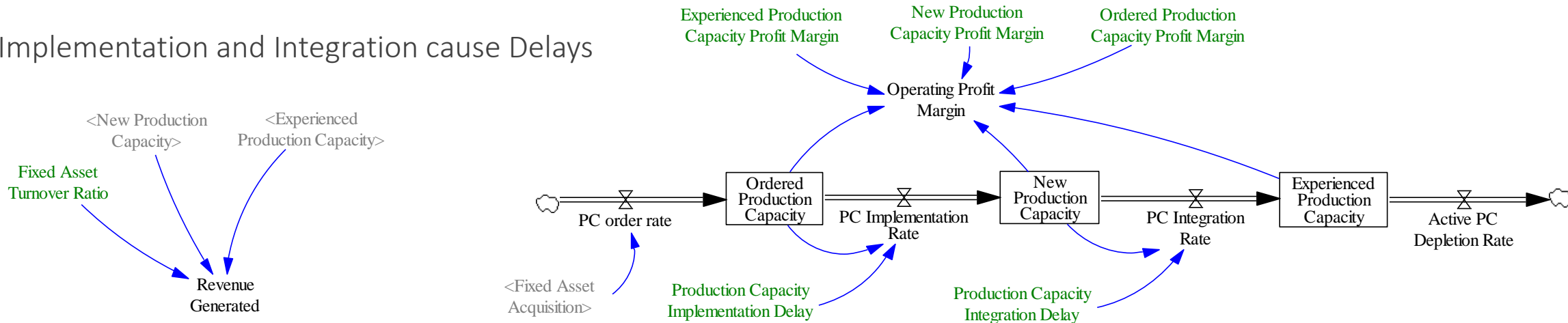
Internal Structure CLD

- Inspired by Forrester’s Industrial Dynamics model, Packer’s Resource Acquisition model, and Oliva, Serman, & Giese’s “Get Big Fast” model
- Divergent Aspects
 - Growth decision not based on magnitude of backlog orders
 - Performance not driven by quality of service or product
 - Growth based on Industry Growth, past firm performance, profit margin, and financial constraints
- Loop 1: Reinforcing
 - Successful Revenue Growth sets higher growth targets
- Loop 2 & 3: Balancing
 - Proportion of new capacity decreases Profit Margin
 - Profit Margin affects growth decision
 - Financial Constraints limit Investment



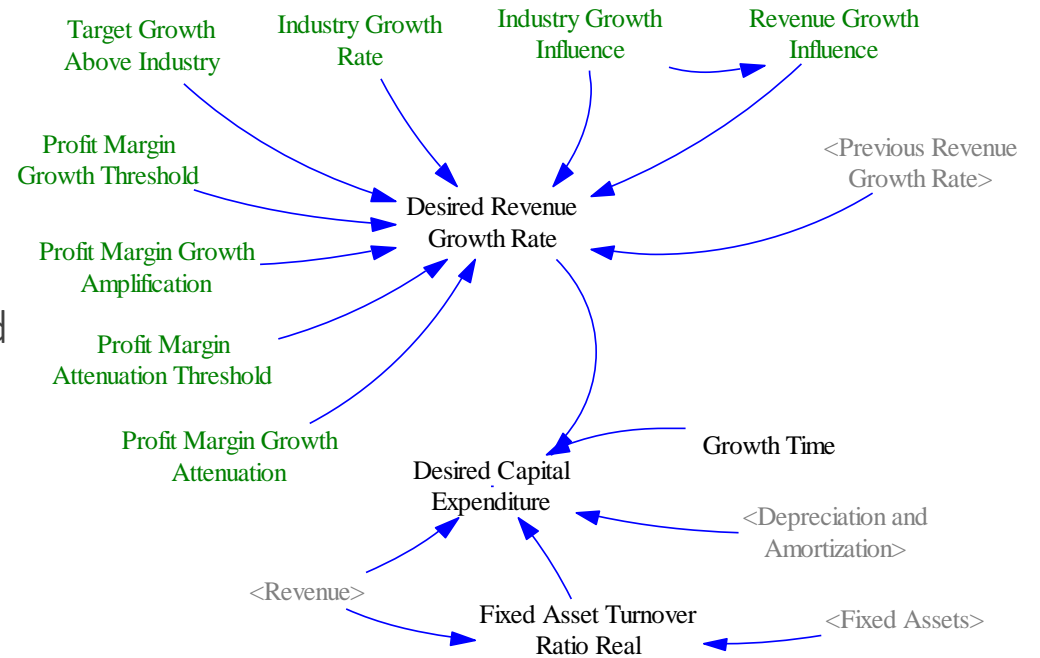
Production Capacity & Operating Profit Margin

- 3 Categories of Production Capacity (PC) sum to Fixed Assets
- Ordered Production Capacity does not generate revenue
- New and Experienced Production Capacities are productive
 - Combine to drive Revenue through Fixed Asset Turnover Ratio
 - Relative Proportion of Ordered to Experienced to New PC determines Operating Profit Margin
 - New has lower profit margin than Experienced PC
- Implementation and Integration cause Delays

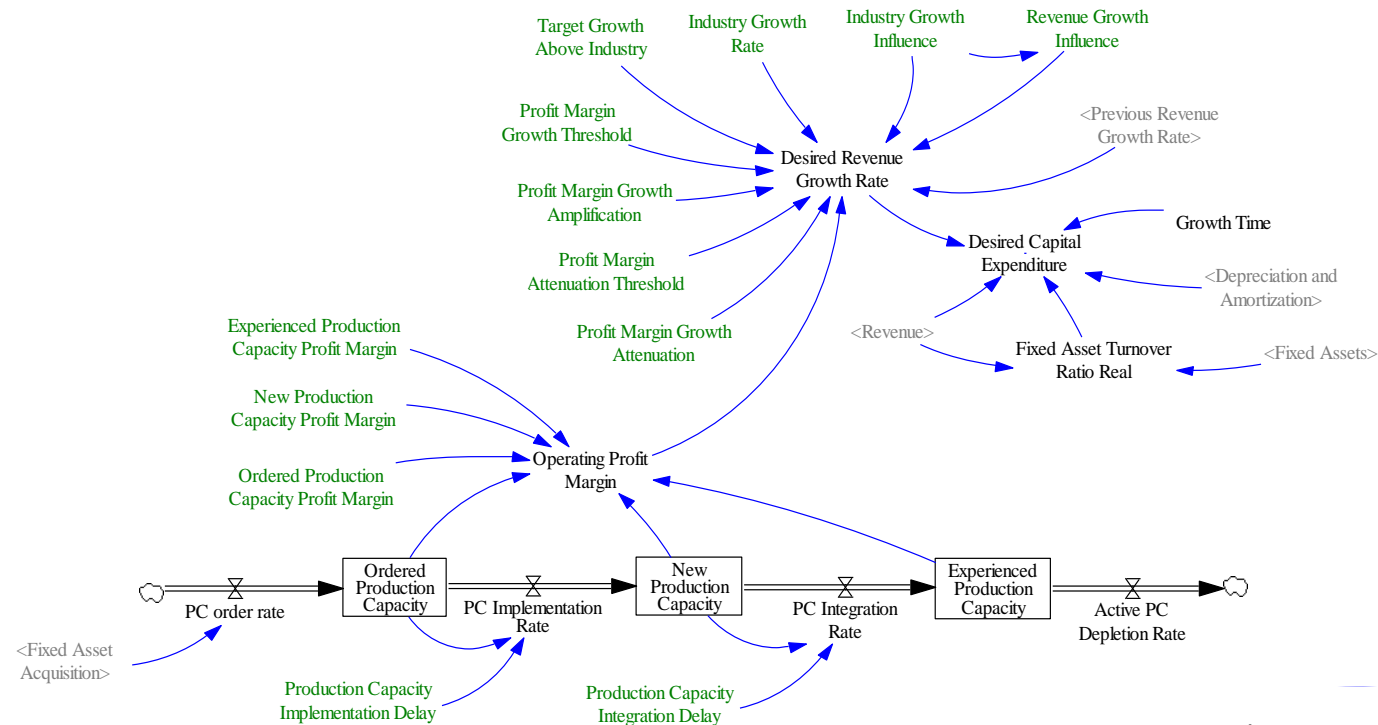


Growth Decision

- 3 main Factors influencing growth decision
 - Weighted average of Industry & Revenue Growth
 - Target Growth Above Industry
 - Profit Margin Threshold for Growth Amplification and Attenuation
 - Expert Opinions from a Director
- Desired Capital Expenditures calculated from Desired Revenue Growth Rate
- Actual Capital Expenditures may be limited by Financial Constraints (Debt Covenants)
 - Leverage Ratio
 - TIE Ratio
 - Current Ratio
- Divergence from “Get Big Fast” model because no outside investment



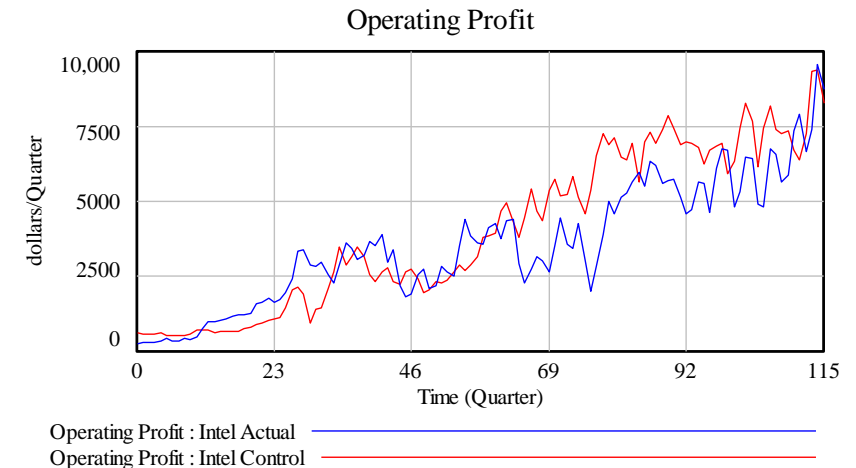
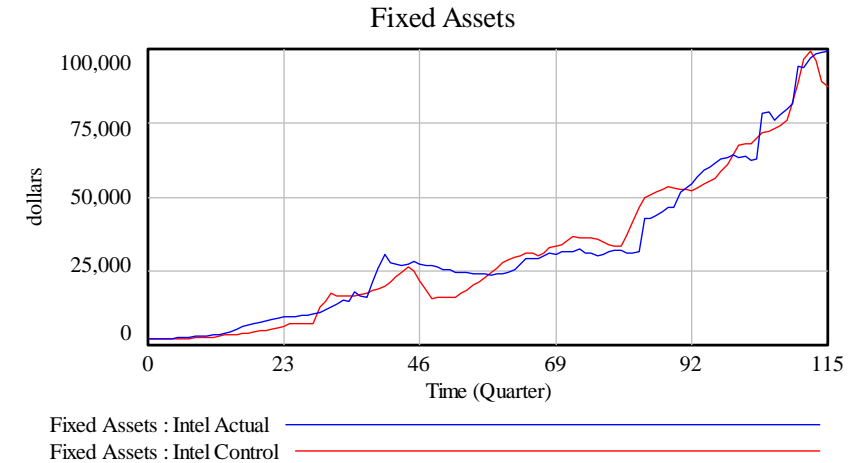
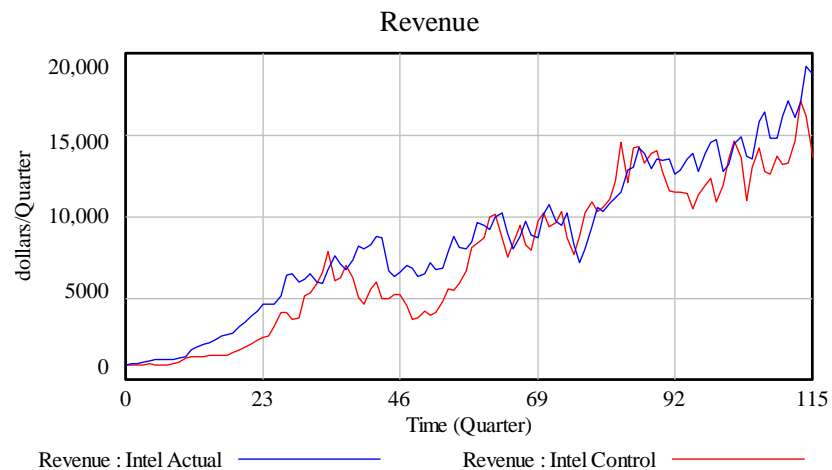
Internal Growth Structure



Calibration and Control

- Control run calibrated against 30 years of Intel Actual Data
 - PC Implementation Delay = 1.93 Quarters
 - PC Integration Delay = 6.36 Quarters
 - New PC Profit Margin = 0.24
 - Experienced PC Profit Margin = 0.9
 - Ordered PC Profit Margin = -0.13
- Dynamic Behavior is result of mostly endogenous variables

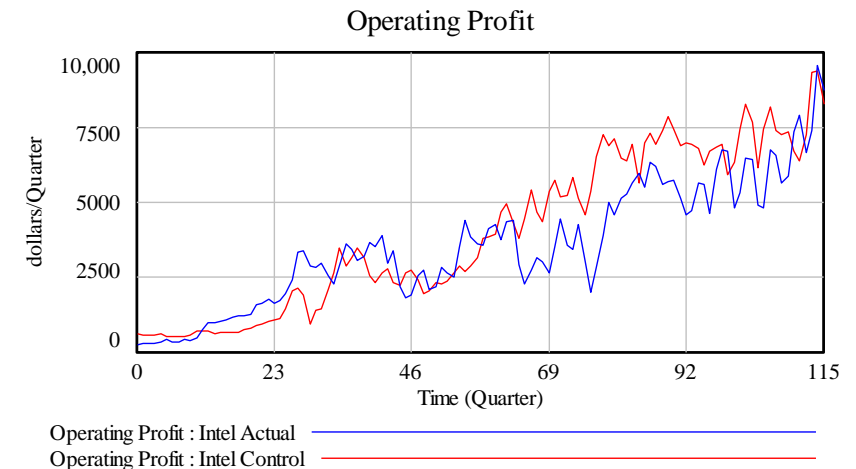
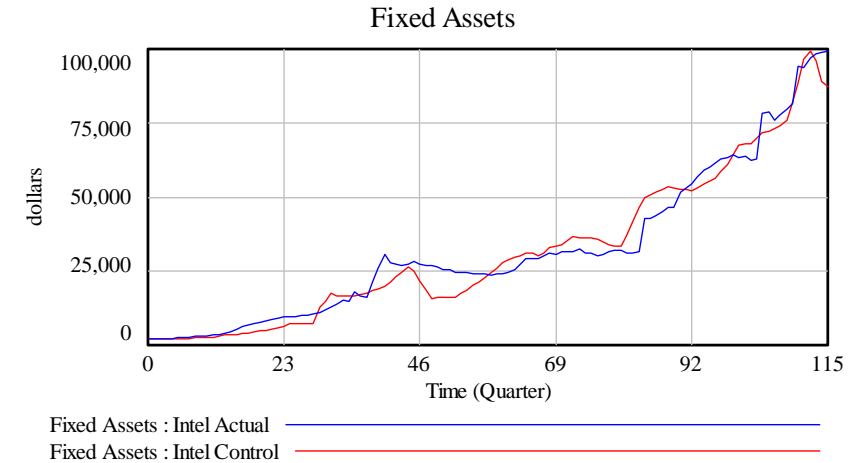
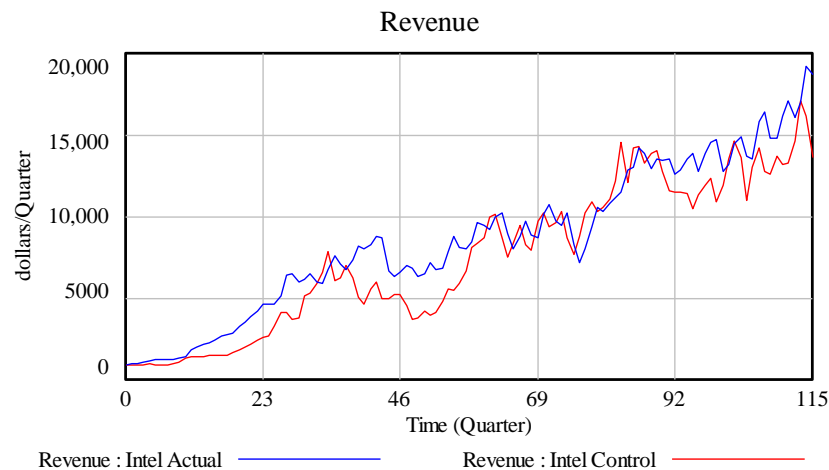
Penrose
Effect



Calibration and Control

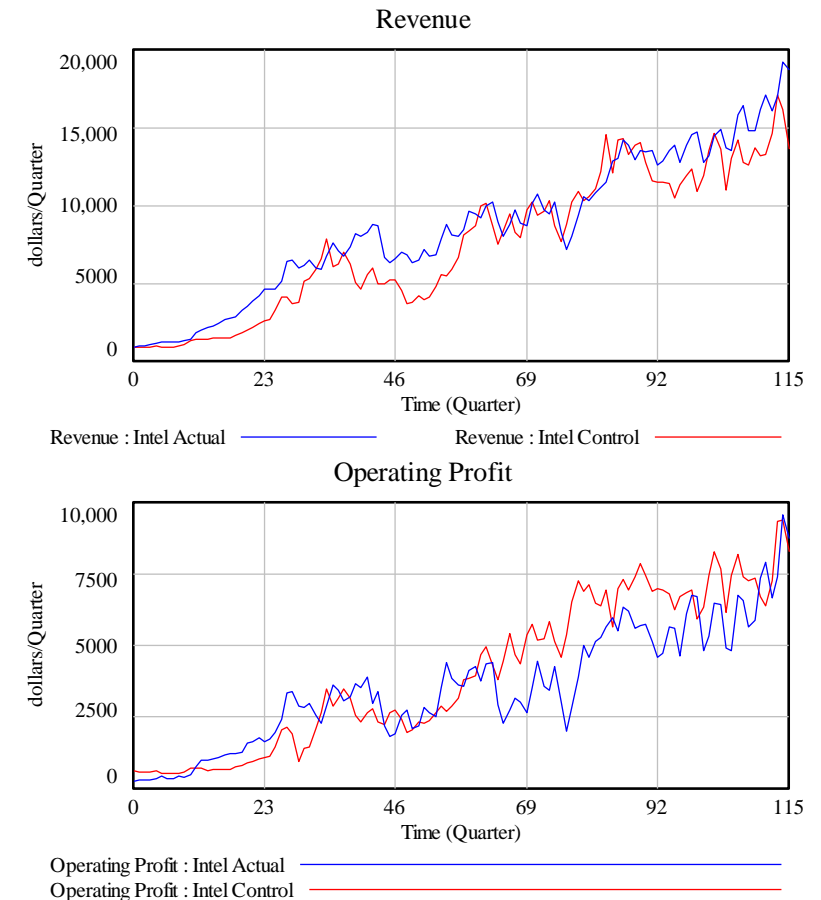
- Control run calibrated against 30 years of Intel Actual Data
 - Industry Growth Influence (Weight) = 0.79
 - Target Growth above Industry = 5.3%
 - Profit Margin Augmentation Threshold = 50%
 - Growth Target Augmentation = 90%
 - Profit Margin Attenuation & Threshold = 70%, 27%
- Dynamic Behavior is result of mostly endogenous variables

Growth target decision



Policy Experimentation Analysis

- Each Policy Experimentation only deviates 1 policy at a time
- Growth Decision
 - Control Industry Influence 78%
 - Industry Influence 50% and 25%
- Implementation and Integration Delays
 - Control Implementation 1.93 Quarters, Integration 6.36 Quarters
 - Implementation Delay 1 and 3
 - Integration Delay 4 and 8
- Leverage Ratio
 - Control Max Leverage Ratio 2
 - Max Leverage Ratio 1.5 and 4
- Stock Buyback

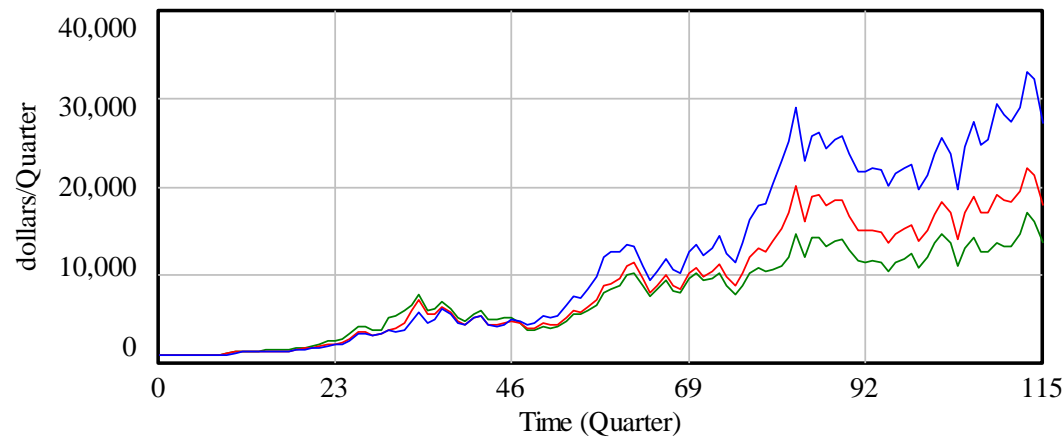


Policy Experimentation Analysis

- Growth Decision

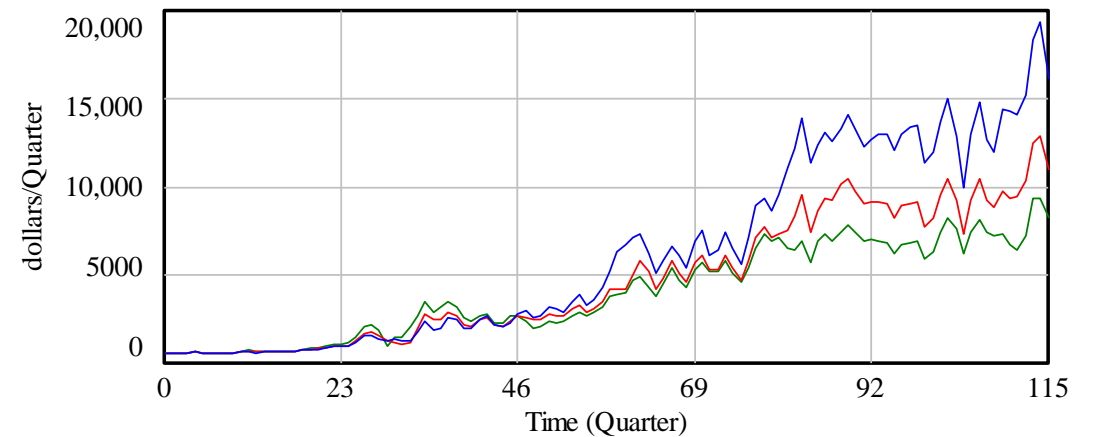
- Control Industry Influence 78%
- Industry Influence 50% and 25%
- Growth influenced by previous quarter's growth rate will generate more revenue and profit.

Revenue



Revenue : Industry Influence 25% —————
Revenue : Industry Influence 50% —————
Revenue : Intel Control —————

Operating Profit



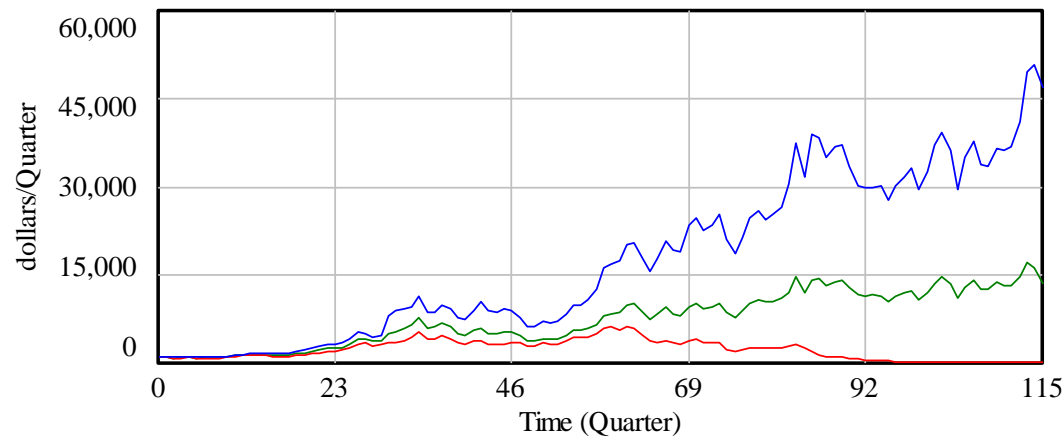
Operating Profit : Industry Influence 25% —————
Operating Profit : Industry Influence 50% —————
Operating Profit : Intel Control —————

Policy Experimentation Analysis

- Implementation and Integration Delays

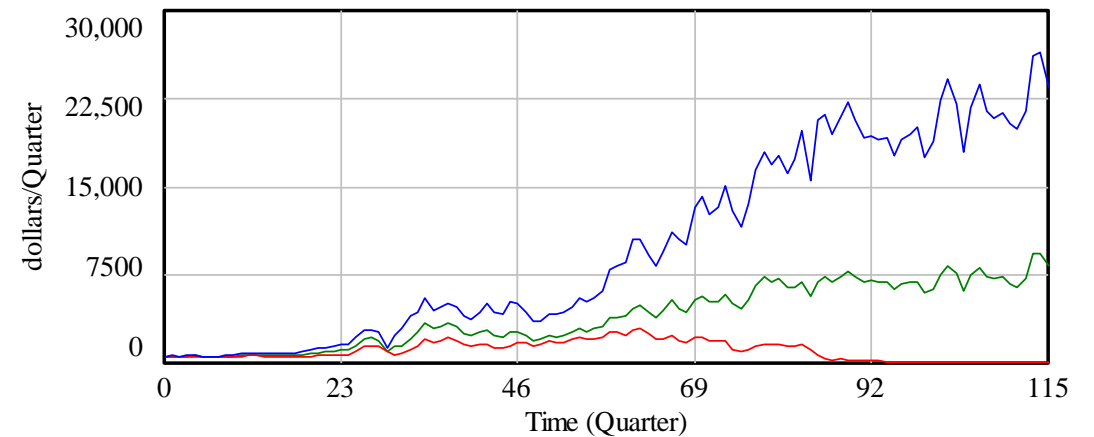
- Control Implementation 1.93 Quarters, Integration 6.36 Quarters
- Implementation Delay 1 and 3
- Decreased Implementation delays lead to higher growth, while Increased Implementation delays lead to lower growth

Revenue



Revenue : Implementation Delay 1 —————
Revenue : Implementatin Delay 3 —————
Revenue : Intel Control —————

Operating Profit



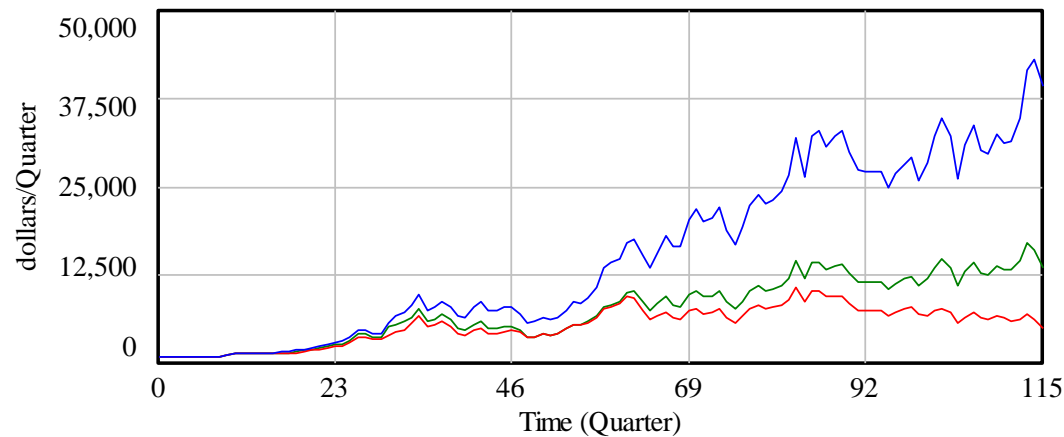
Operating Profit : Implementation Delay 1 —————
Operating Profit : Implementatin Delay 3 —————
Operating Profit : Intel Control —————

Policy Experimentation Analysis

- Implementation and Integration Delays

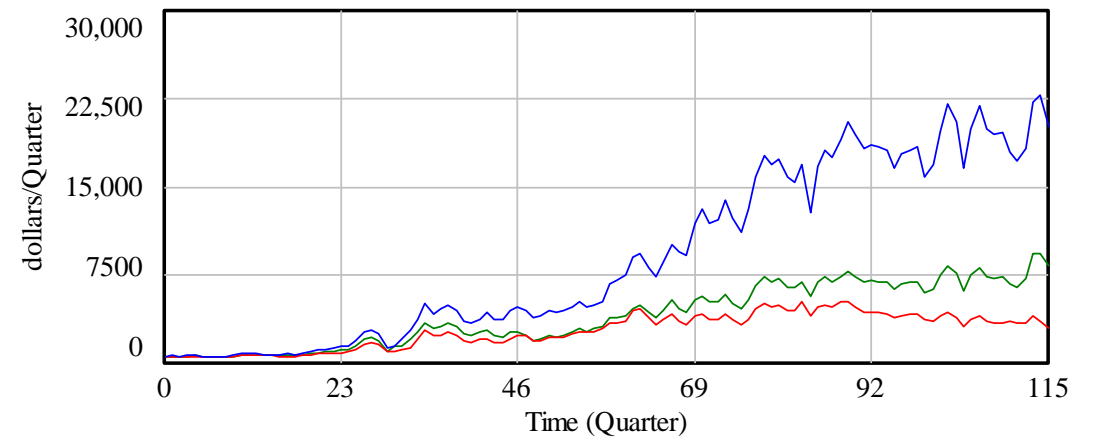
- Control Implementation 1.93 Quarters, Integration 6.36 Quarters
- Integration Delay 4 and 8
- Decreased Integration delays lead to higher growth, while Increased Integration delays lead to lower growth

Revenue



Revenue : Integration Delay 4 —————
Revenue : Integration Delay 8 —————
Revenue : Intel Control —————

Operating Profit



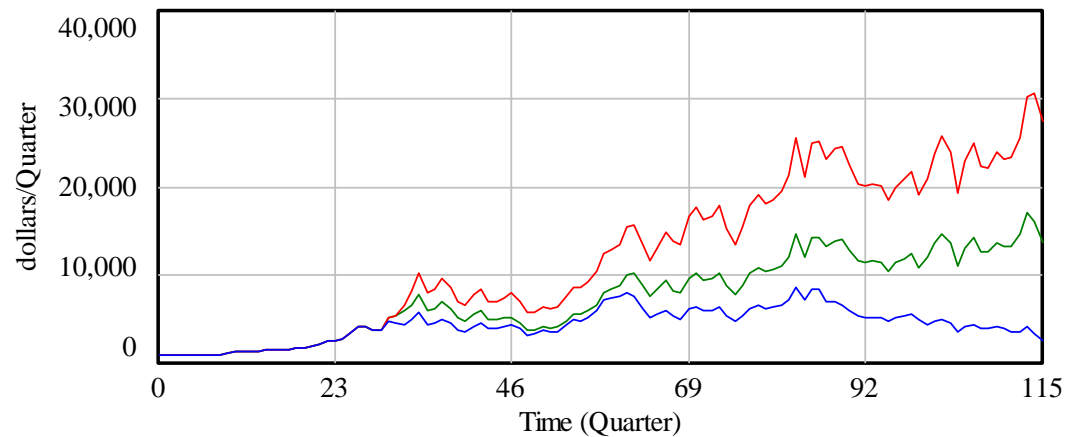
Operating Profit : Integration Delay 4 —————
Operating Profit : Integration Delay 8 —————
Operating Profit : Intel Control —————

Policy Experimentation Analysis

- Leverage Ratio

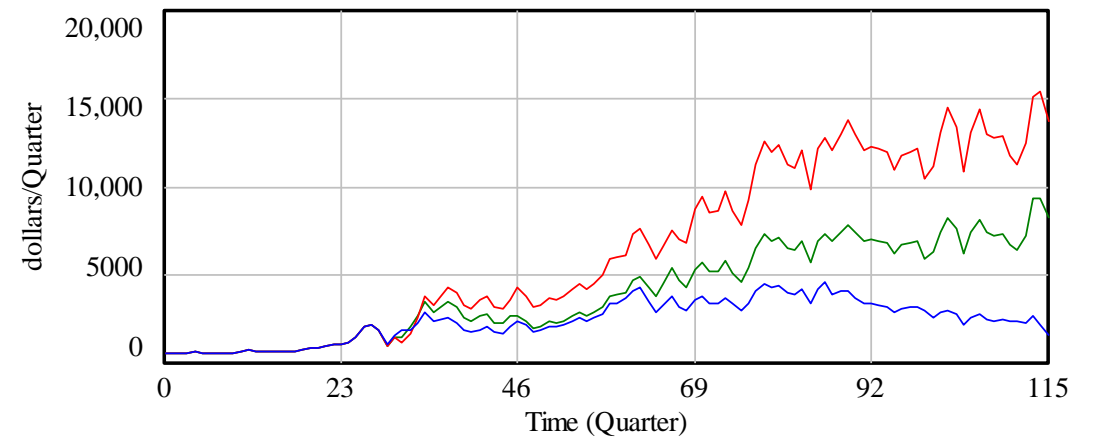
- Control Max Leverage Ratio 2
- Max Leverage Ratio 1.5 and 4
- Higher Leverage ratio allows more borrowing of debt, which fuels more growth

Revenue



Revenue : Max Leverage 1 —————
Revenue : Max Leverage 4 —————
Revenue : Intel Control —————

Operating Profit



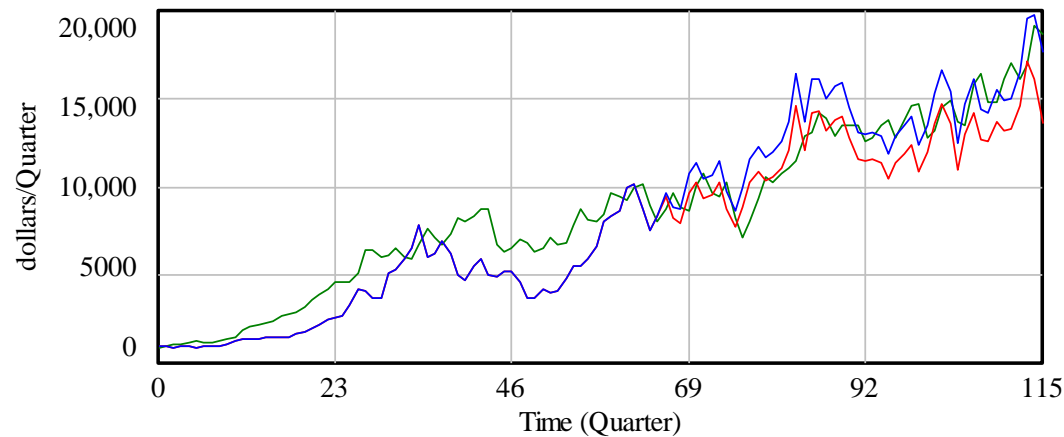
Operating Profit : Max Leverage 1 —————
Operating Profit : Max Leverage 4 —————
Operating Profit : Intel Control —————

Policy Experimentation Analysis

- Stock Buyback

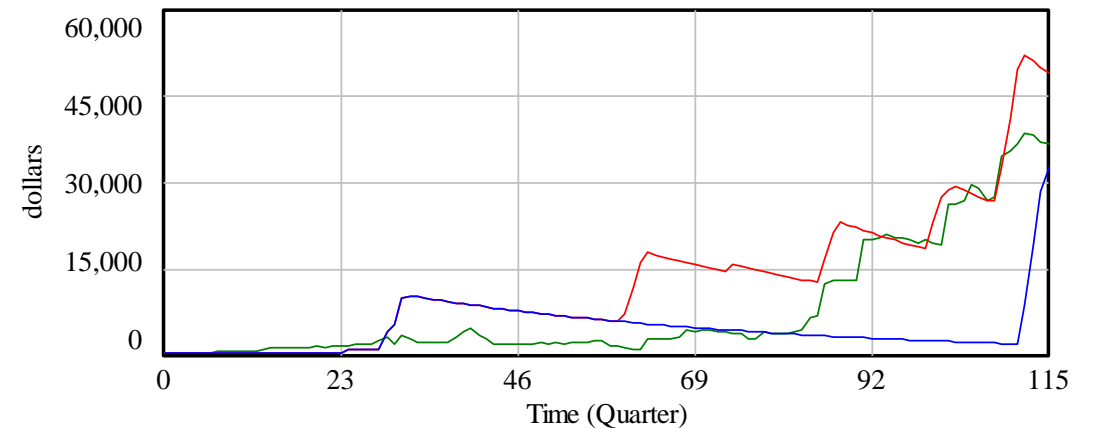
- Control Stock buyback starts at time 55 quarters, and remains relatively intermittent throughout
- Intel used some debt to buyback stock and started borrowing heavily towards the end of the simulation
- No Stock Buyback results in a minor increase in revenue growth, however a much less accumulation of debt

Revenue



Revenue : No Stock Buyback —————
Revenue : Intel Control —————
Revenue : Intel Actual —————

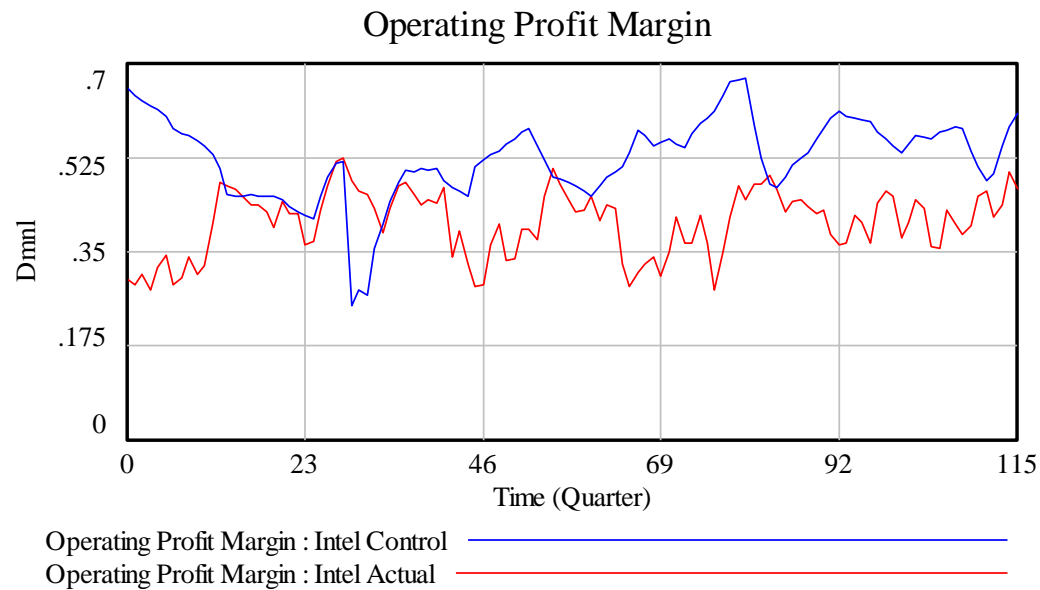
Long Term Debt



Long Term Debt : No Stock Buyback —————
Long Term Debt : Intel Control —————
Long Term Debt : Intel Actual —————

Policy Experimentation Analysis

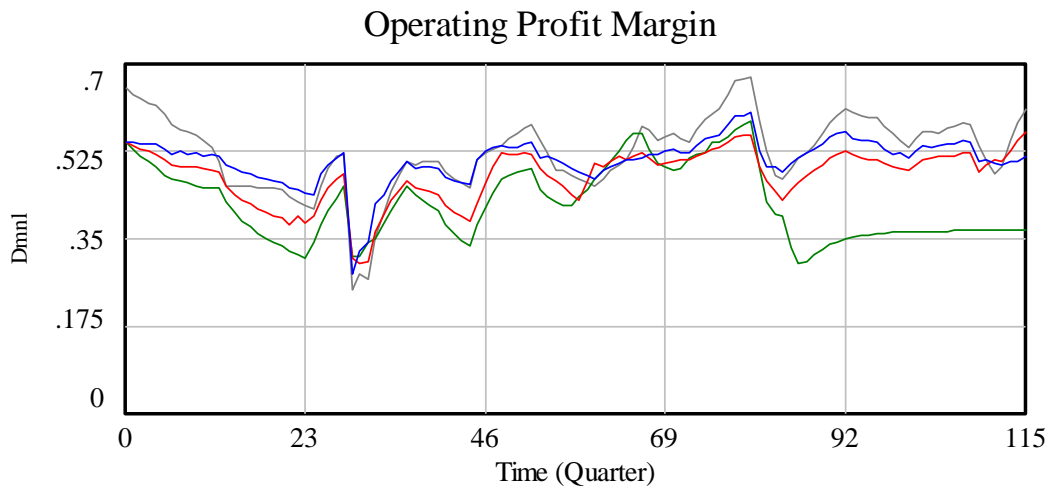
- Profit Margin
 - Set different delays for integration and implementation and optimized (Control Implementation – Integration, 1.93 – 6.36)
 - Long term profit margin has a inverse relationship to Intel’s actual profit margin



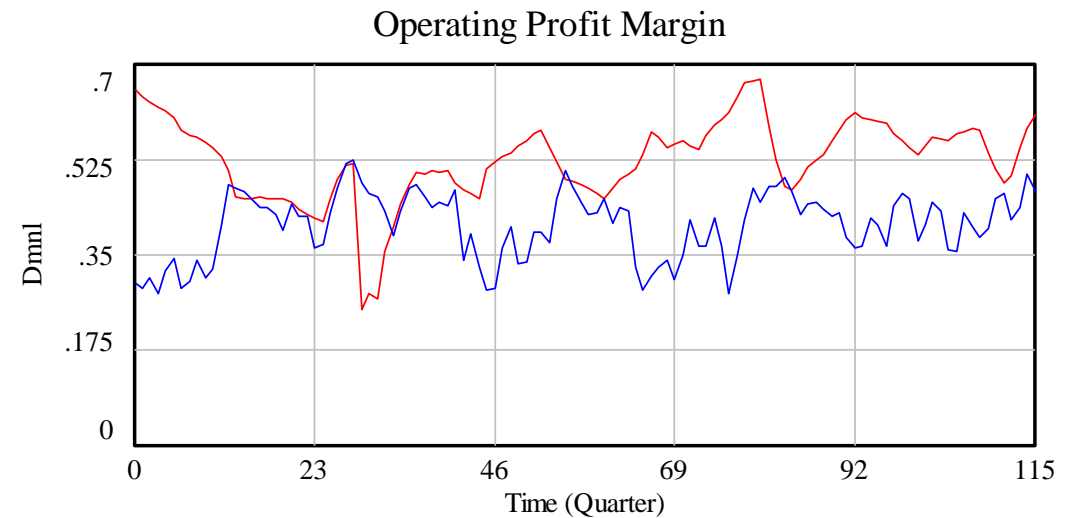
Policy Experimentation Analysis

- Profit Margin

- Control Implementation – Integration, 1.93 – 6.36
- Implementation 1 – 2 – 3 , Integration same
- Profit Margin change is limited by model structure



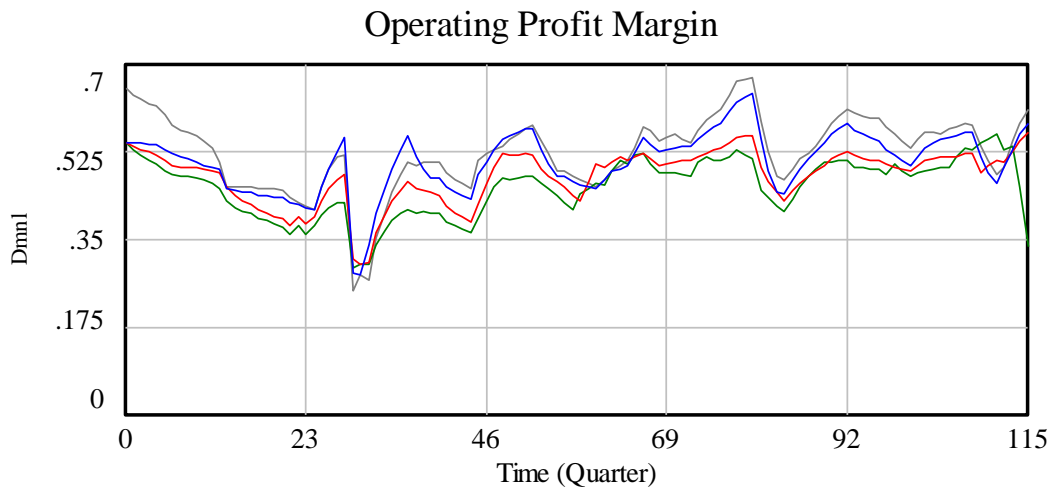
Operating Profit Margin : Delays 1 - 6 —————
Operating Profit Margin : Delays 2 - 6 —————
Operating Profit Margin : Delays 3 - 6 —————
Operating Profit Margin : Intel Control —————



Operating Profit Margin : Intel Actual —————
Operating Profit Margin : Intel Control —————

Policy Experimentation Analysis

- Profit Margin
 - Control Implementation – Integration, 1.93 – 6.36
 - Implementation Same, Integration 4 – 6 – 8
 - Profit Margin is limited by model structure

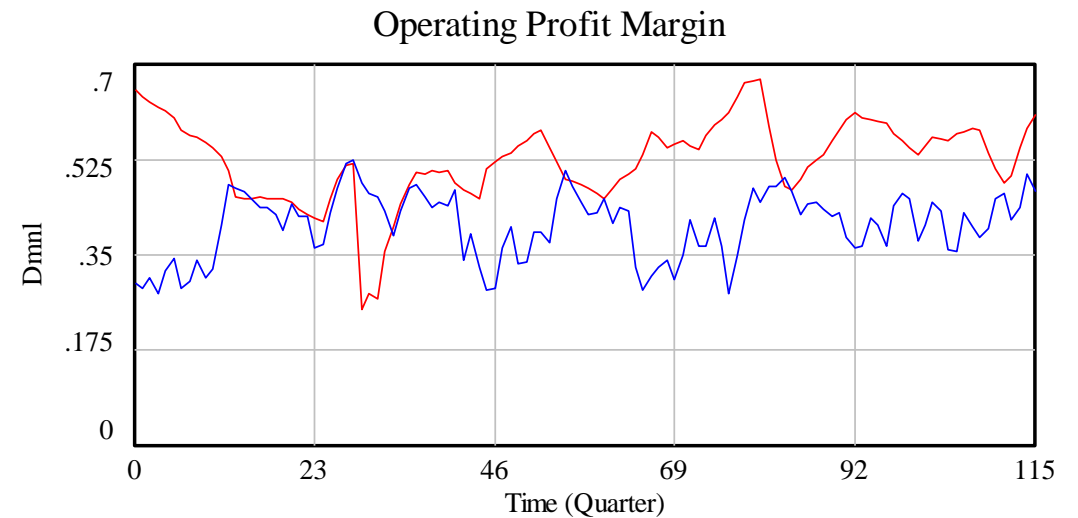


Operating Profit Margin : Delays 2 - 4 —————

Operating Profit Margin : Delays 2 - 6 —————

Operating Profit Margin : Delays 2 - 8 —————

Operating Profit Margin : Intel Control —————

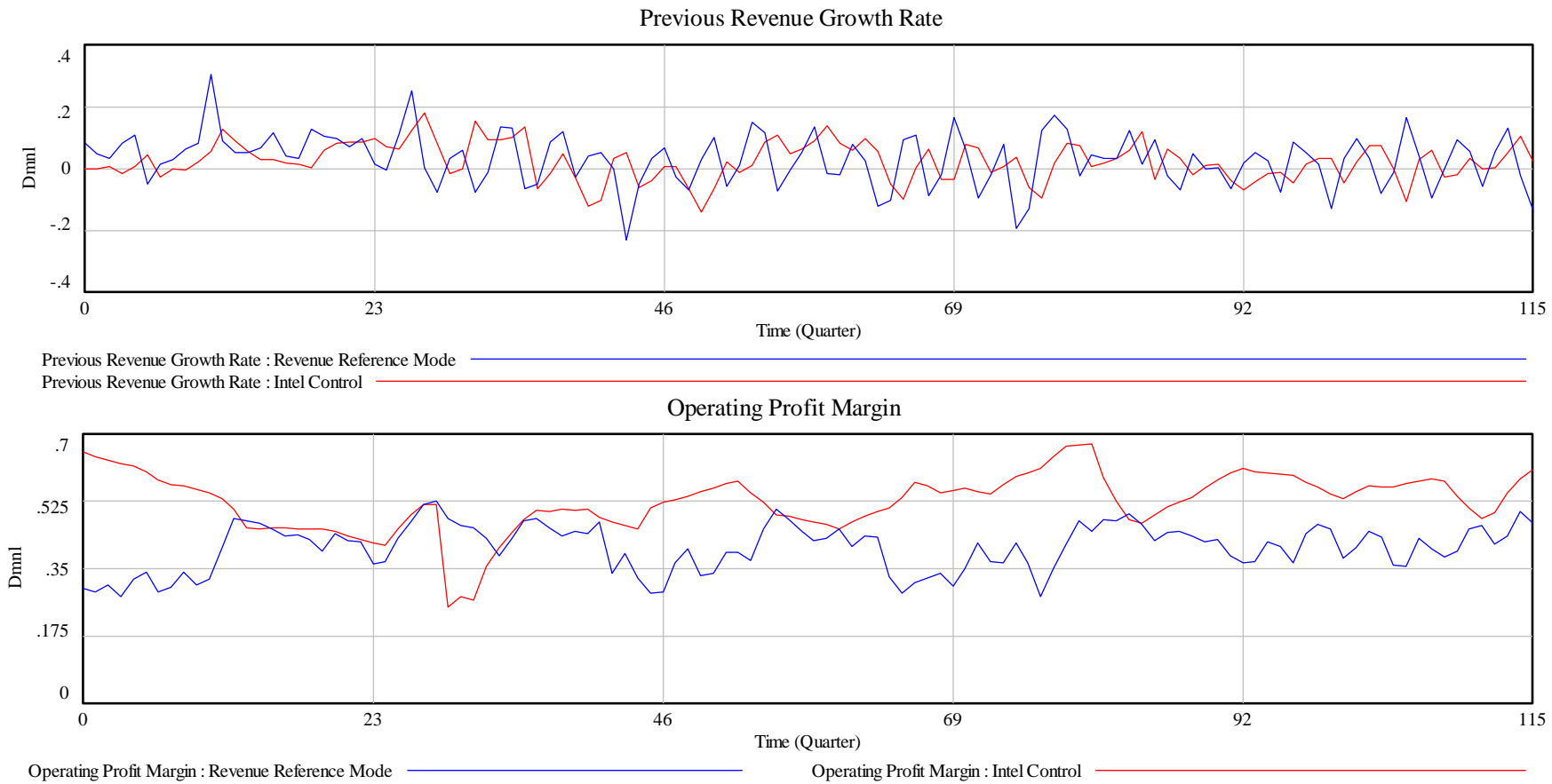


Operating Profit Margin : Intel Actual —————

Operating Profit Margin : Intel Control —————

Policy Experimentation Analysis

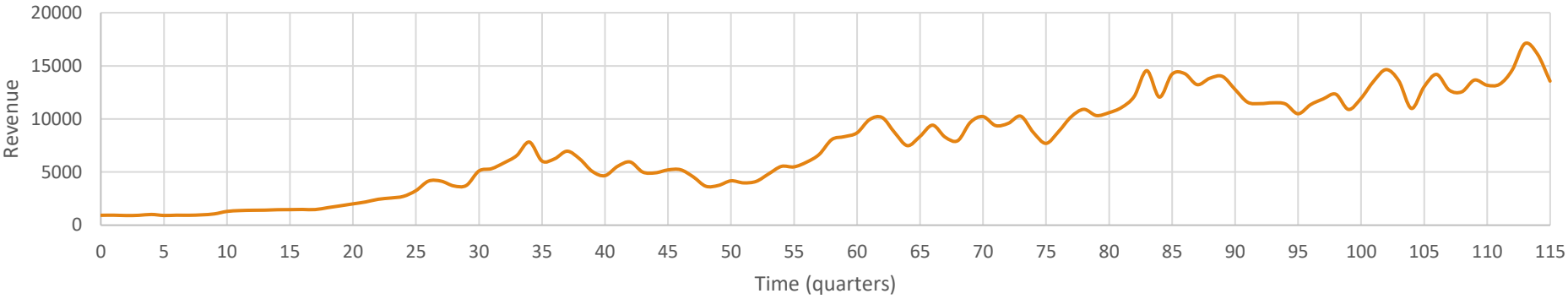
- Profit Margin vs Revenue Growth (Actual vs Control)



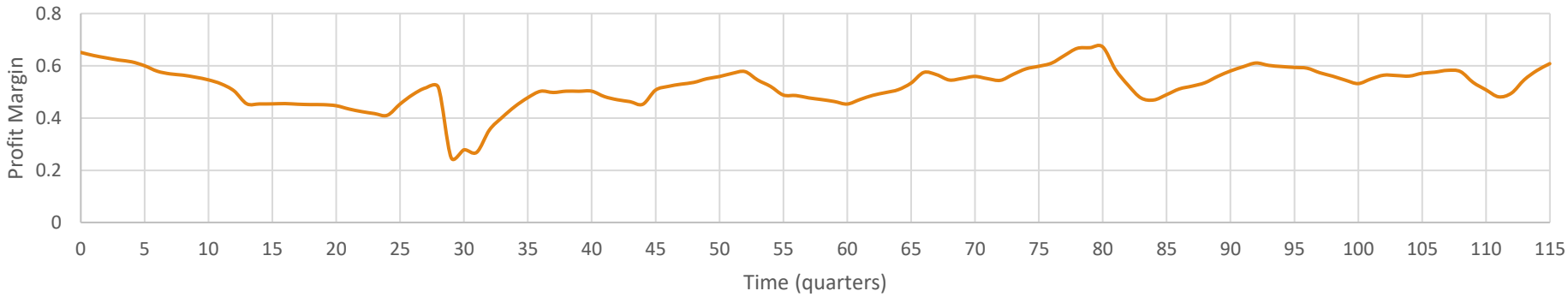
Policy Experimentation Analysis

- Profit Margin vs Revenue Growth (Actual vs Control)

Revenue: Intel Control

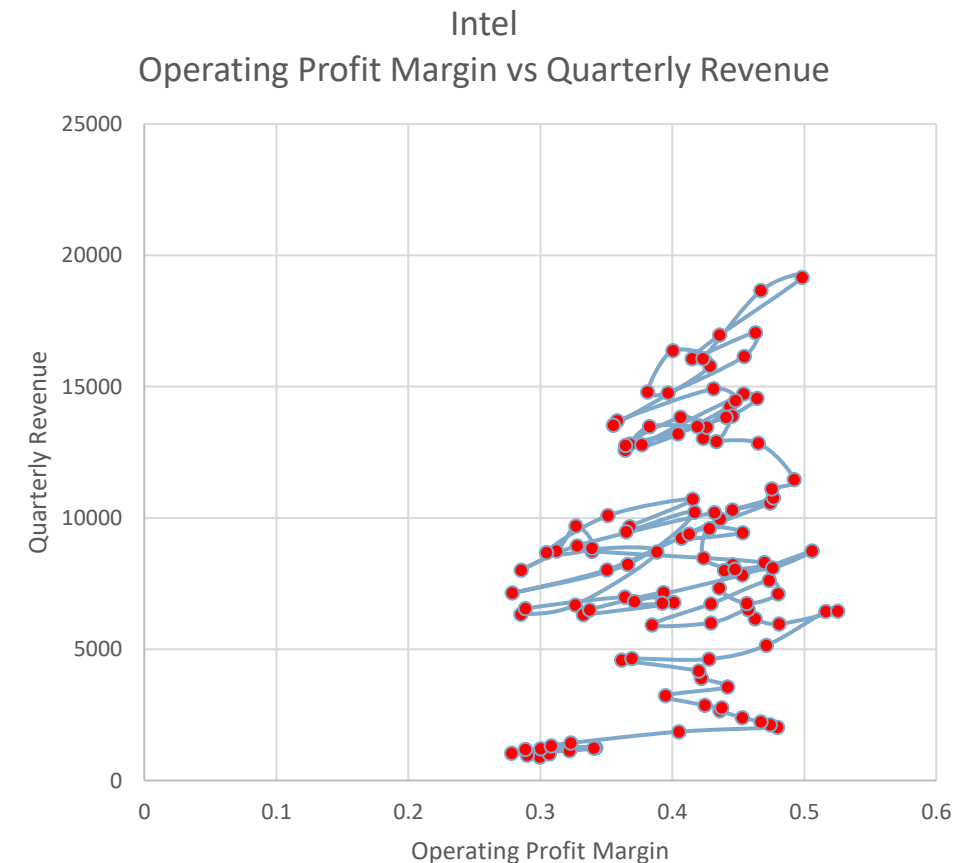


Operating Profit Margin : Intel Control



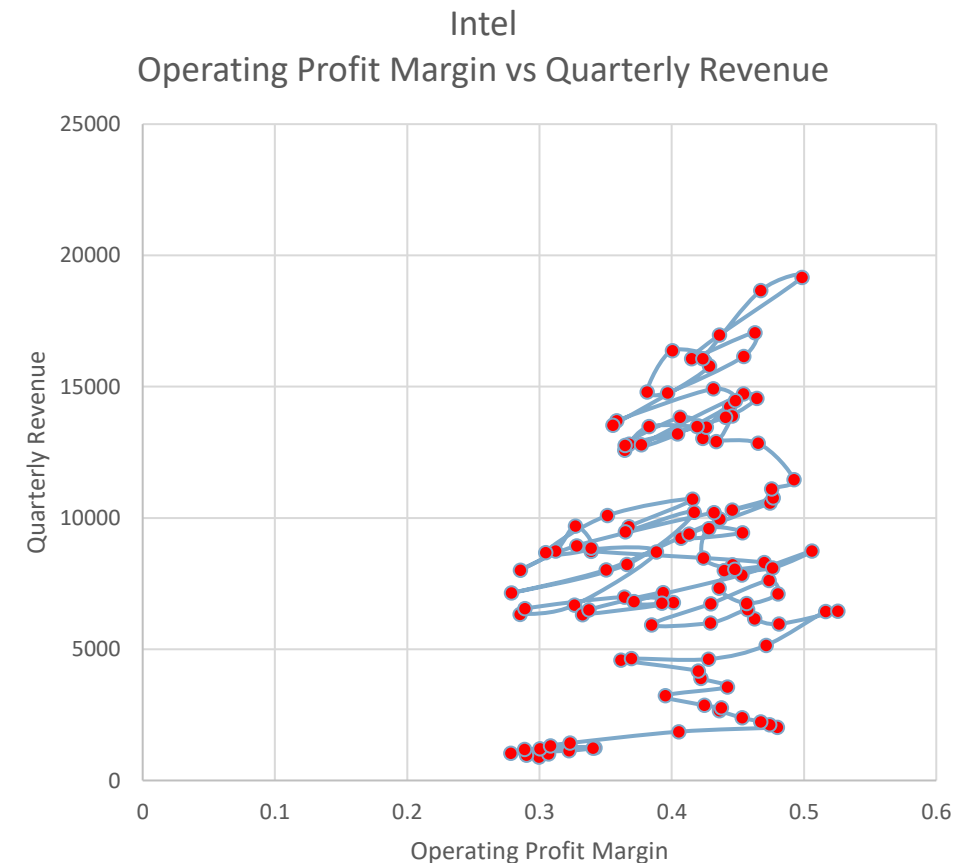
The Growth-Profitability Efficacy Syndrome

- How does company growth impact profitability and vice versa?
 - Dynamic Relationship
- Slowing growth: Change in profit margin is POSITIVE
 - The successful growth rate is limited by the existing levels of management & productive capacity because this defines the maximum rate of effective absorption of new capacity (Penrose, 1959). Ordered plus New Capacity decreases as a proportion of total capacity yielding an improvement in overall efficiency
- Increasing growth: Change in profit margin is NEGATIVE
 - Ordered plus New Capacity increases as a proportion of total capacity causing a lowering of overall efficiency, temporarily.
- Sustainable, profitable growth: Minor change in profit margin
 - Defined by the speed with which the existing levels of management and capacity can effectively absorb new assets.



The Growth-Profitability Efficacy Syndrome

- Why do smart people fail to set growth targets that result in sustainable earnings growth?
 - The growth target decision typically holds the following assumptions:
 - 1. The current profit margin will carry forward or (hopefully) improve.
 - Directors and managers likely never learn the negative impact on margin from high growth due to the delays in feedback. Managers focus on monthly and quarterly performance, however changes in capacity cause efficiency changes with delays of many quarters.
 - 2. The amount of new capacity required to meet the target is determined by the sales/assets ratio as reported in the most recent quarterly results.
 - In reality the Sales/Assets ratio is dynamic, and it reacts to changes in the proportion of Ordered Production capacity and New Production capacity in total fixed assets.
 - 3. The amount of debt financing required to fund the capital expenditures is safe because the current level of profit margin is sufficient to meet the TIE ratio debt covenant.
 - In reality the profit margin rate is dynamic and with high growth, the margin will fall causing a reduction in future growth rate decisions.



Further Exploration

- Additional Calibration and Validation
- Confidence Intervals and Sensitivity Testing
- Further detailed investigation into growth decisions policies
- Sustainable growth, optimized growth
- Outside Investment
- Market Value and Stock Value
- Impact of Share Buyback

Thank you!

Feedback, questions, and discussion is welcome and appreciated!

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