Reading Summaries:
Theory of Income II

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Note

This document contains the summaries of readings for Theory of Income II taught by Professor Stokey.

Contents

1 Deterministic Dynamic Programming

1.1 **Prescott (AER, 2002): Prosperity and Depression

Prescott investigates the differences in output per capita among developed countries. He points to two distinct channels: labor tax (for France) and low productivity (for Japan).

Motivation There is a wide range of output per capita among developed countries.

Research Question Why are France and Japan "depressed" relative to United States, i.e. output per working-age person is 30% less than the U.S. level?

Methodology Growth model with (1) technology (aggregate production function and capital accumulation equation) and (2) utility function for the stand-in household that depends on the paths of consumption and leisure and three types of taxes (consumption, labor income, and capital income)

Key Element Differences in output per capita can be accounted by: (1) exogenous level of technology, (2) capital factor, (3) labor factor, and (4) productivity.

Main Results (1) and (2) are assumed same across countries; (3) accounts for France due to its higher intratemporal (consumption-leisure) tax wedge; and (4) accounts for Japan, which is poorer due to lower productivity (the most important factor according to the author)

1.2 *Rogerson and Wallenius (JET, 2009): Micro and macro elasticities in a life cycle model with taxes

This is one of the first papers reconciling micro and macro elasticities.

Puzzle Labor elasticity is important because it determines distortions introduced by taxes and employment response to fluctuations in productivity. Micro elasticity is *estimated* to be between 0 and 0.4, whereas the macro estimate *implies* an estimate between 2 to 4.

This Paper Authors find that there is little relationship between micro and macro elasticities of labor supply. This is because micro elasticities estimates only capture the intensive margin, whereas the macro elasticities must also capture the extensive margin.

Motivation Prescott (AER, 2002) and others have argued that labour taxes explain a large share of the differences between time devoted to work in continental Europe versus the US (Europeans work about 70% of the US counterparts). People critique saying that plugging in micro labor elasticity invalidates Prescott's conclusion.

Research Question Are low micro labor elasticity consistent with high macro estimates?

Methodology

- ▷ Model of life cycle labor supply that allows micro and macro estimates of labor supply
- ▷ Calibrate the model to replicate features of life cycle labor supply
- ▷ Study how tax and transfer policies affect hours work in the steady-state

Key Element Non-linearity in the mapping between time at work and labor services actually provided. A less important element is the heterogeneity across cohorts (young vs. old): productivity depends on age

Main Results Macro elasticities are unrelated to micro elasticities – micro elasticities in the range [0.5, 1.25] can coexist with macro elasticities in the range [2.25, 3].

1.3 *Keane and Rogerson (JEL, 2012): Reconciling micro and macro elasticities

This is a pseudo-summary of the literature on micro and macro labor supply elasticities along with a few new suggestions.

Motivation Labor supply elasticity is important in understanding impact of labor tax on labor supply, yet there's a lot of controversy.

Research Question How can we reconcile these micro vs macro views on labor supply elasticities?

Methodology Survey of methodologies, focusing on two main ones:

1. Extensive vs. Intensive Margins (Rogerson & Wallenius, JET 2009). See previous section.
2. Human Capital (Imai & Keane, 2004). Elasticities should capture how labor supply varies with wages *and* human capital, whereas measured micro elasticities only capture how labor supply varies with wage.

Key Element Return to an hour of work is not only the after tax wage but also includes *human capital* (HC), define as the expected present value of increased earnings in all future periods.

Main Results Since HC decreases with age, labor supply elasticity differs across ages. The tax change affects HC depending on whether it's temporary (in which case it does not affect HC) and it's permanent (in which case it does).

SAMPLE QUESTION:

Problem. In their paper "Micro and Macro Labor Supply Elasticities: A Reassessment of Conventional Wisdom" (JEL 2012), Keane and Rogerson discuss two main attempts at reconciling the discrepacny between micro and macro elasticities. Briefly describe the two approaches and the key model feature that accomplishes the task in each.

Solution. The authors discuss two approaches. The first approach, by Rogerson & Wallenius, involves a convex labor schedule of the form $e(a)\max\{h-f,0\}$ where $e(a)$ is the productivity that varies with age (a) and f is the up-front cost of entering the labor market. This allows the agents to optimally decide to enter the market (extensive margin) and also decide how many hours to work (intensive margin). The micro elasticities only capture the intensive margin, and this mechanism allows the two elasticities to be virtually unrelated.

The second approach, by Imai and Keane, argues that elasticities should capture how labor supply varies with wage *and* human capital; the measured elasticities only capture how labor supply varies with wage. In their model, the wages are given by

$$w_{t+1} = \left(1 + \kappa \sum_{j=0}^{t-1} h_{t-j}\right) w_1$$

where w_1 represents the initial wage upon entering the market. In this setup, a unit increase in h_t raises the wage by κw_1 in all future periods, so the return to an hour of work now consists of the after-tax wage *plus* the expected present value of increased earnings in future periods.

1.4 *Greenwood, Rogerson, and Wright (QR, 1993): Putting home economics into macroeconomics

Basic idea is that investment in standard RBC is too volatile while consumption too smooth. Introducing home production allows more substitution into and out of market activity in response to shocks, so it helps relieve this puzzle.

Motivation The significance of home production in economic activity has long been reocgnized, but its relevance for business cycle research has only been recently investigated.

Research Question How does an RBC model with home production perform? Can it improve the fact that investment in standard RBC is too volatile while consumption in standard RBC is too smooth?

Methodology Introduce home production function into the model and expand household choices for allocating output. Then calibrate the resulting model. Finally, simulate the model to analyze its business cycle properties.

Key Element The original household choice was allocating output between consumption and investment; now they divide among consumption, investment in business capital, and investment in household capital.

Main Results Incorporating home production outperforms standard RBC in matching (1) volatilities of makret output, consumption and investment relative to market output, hours worked in the market relative to either market outpu or productivity and (2) correlations between investment in household and business capital. It still overstates the correlation between market hours & productivity and home & market investment.

SAMPLE QUESTION:

Problem. In their paper "Putting Home Economics into Macroeconomics" (FRB-QR 1993), Greenwood, Rogerson, and Wright develop a model with home production. Briefly describe why they want to construct such a model and the key model feature that accomplished the task.

Solution. The primary motivation for their paper is that investment in standard RBC model is too volatile while the consumption is too smooth. Furthermore, the significance of home production in economic activities has long been recognized, but its relevance for business cycle research has only been recently investigated.

The authors introduce a home production function into the model and expand the household choices for allocating output. Specifically, the household now divides output between consumption, investment in business capital, and investment in household capital. Since home production allows more substitution into and out of market activity in response to shocks, investment is less volatile to the standard RBC model.

1.5 *Greenwood, Hercowitz, and Krusell (AER, 1997): Long-run implications of investment-specific technical change

This shows how declining relative price of capital goods affects long-run growth and short-run fluctuations.

Motivation Paper is motivated by two key observations that suggest that investment-specific technological chance may be a factor in economic growth.

1. Over the long-run, the relative price of equipment has declined remarkably while the equipment-to-GNP ratio has risen.
2. In the short-run, there is a negative correlation between the price for equipment and equipment investment / GNP.

Research Question What is the quantitative role of investment-specific technological change as an engine of growth?

Methodology Add a vintage capital model to a standard neoclassical growth model and matches the model to data.

Key Element Amount of equipment that can be purchased for one unit of output (q) grows with the passage of time according to a Markov process. The law of motion for structures:

$$k_s' = (1 - \delta_s)\, k_s + i_s$$

is thus different from the law of motion for equipment:

$$k_e' = (1 - \delta_e) k_e + i_e q$$

This implies that you have to investment in equipment to benefit from investment-specific technological change.

Main Results The balanced growth path shows that both the stock of equipment and new equipment investment grow at a higher rate than output. Furthermore, approximately 60% of post-war productivity growth can be attributed to investment-specific technological change. After accounting for this rapid improvement in production of capital goods, the productivity slowdown since the 1970s looks even worse.

SAMPLE QUESTION:

Problem. In their paper "Long-run implications of Investment-specific Technological Change" (AER 1997), Greenwood, hercowitz, and Krusell modify a standard neoclassical growth model to investigate the role of investment-specific technological change. Briefly describe why they think such change may be a driver of economic growth and the key element in their model that accomplished the task.

Solution. The paper is motivated by two key observations that suggest that investment-specific technological change may be a factor in economic growth. First, the relative price of equipment has declined remarkably over the long-run while the equipment-to-GNP ratio has risen. Second, there is a negative correlation between the price for equipment and equipment investment/GNP in the short-run.

The authors assume a Markov process for the amount of equipment that can be purchased for one unit of output (q) that grows with the passage of time. This creates a discrepancy in the law of motion for structures:

$$k_s' = (1 - \delta_s)\, k_s + i_s$$

and the law of motion for equipment:

$$k_e' = (1 - \delta_e)\, k_e + i_e q$$

which implies that you have to investment in equipment to benefit from the investment-specific technological change.

2 Stochastic Dynamic Programming

2.1 **Long and Plosser (JPE, 1983): Real Business Cycles

People have recognized salient facts in output movement, and this model essentially says that such co-movement can arise without stricter assumptions about the shocks. This is a "multi-sector" model.

Motivation Outputs in different sectors move together and there is significant deviations from trend.

Research Question Can we explain the above observations with a basic model?

Methodology A basic RBC model with rational expectations, complete information, stable preferences, no technological change, no longed-lived commodities, no frictions, no government, no money and no serial depend in shocks.

Key Element Model transforms and amplifies i.i.d. shocks (both time-series and cross-sectional) into output series that are (1) persistent and (2) co-move.

- ▷ Persistence: next-period production depends on amount produced today + the shock next period, which is unobserved before making production decisions
- ▷ Co-movement across commodities: multiple inputs are used to produce each single output, and outputs from previous periods are used as inputs to produce outputs next period.

Main Results The model can explain persistence and co-movement in consumption plans characteristic of typical business cycles.

SAMPLE QUESTION:

Problem. In their paper "Real Business Cycles" (JPE 1983), Long and Plosser build a basic RBC model with rational expectations, complete information, stable preferences and no serial dependence in shocks. Briefly explain how the model transforms and amplifies these i.i.d. shocks into output series that are (1) persistent and (2) co-move.

Solution. The model successfully transforms and amplifies the i.i.d. shocks into output series that are persistent and exhibit co-movement across commodities. Persistence comes from the fact that the next-period production depends on the amount produced today and the shock next period, which is unobserved before making production decisions. The co-movement across commodities comes from the fact that multiple inputs are used to produce each single output, and outputs from previous periods are used as inputs to produce outputs next period.

2.2 * Greenwood and Hercowitz (JPE, 1991): Allocation of Capital & Time over the Business Cycle

This paper is one of the many early attempts to reconcile the joint movements of expenditures, hours worked, and wages at business cycle frequencies by appealing to models of non-market production.

Motivation Two facts: (1) stock of household capital (durables + residential) is greater than the stock of business capital (non-residential), and (2) Investment in household capital is highly procyclical, leading business investment.

Research Question How is the allocation of capital between the business and household sectors over the business cycle determined?

Methodology A Beckerian model of household production that treats business and household sectors (almost) symmetrically. It's Beckerian in the sense that consumers value market goods and home goods, not directly leisure (so time is split between market and home good).

Key Element The only source of asymmetry between the two sectors is that capital can be produced in the market sector only.

Main Results The model can explain fact (1), but it cannot explain (2) even after increasing complementarity or adding capital adjustment costs. In general, any general equilibrium model with household durables would go against (2) since:

1. Positive technology shock increases optimal levels of B and HH capital.
2. Since capital goods can only be produced in B, the consumption of market goods must be sacrificed, and thus market goods become more scarce.
3. This implies that it's more beneficial to invest in B (to relieve the excess demand), which leads to negative co-movement in B and HH investment.

SAMPLE QUESTION:

Problem. In their paper "The Allocation of Capital and Time over the Business Cycle" (JPE 1991), Greenwood and Hercowitz develop a model featuring household sectors. Explain the motivation behind the paper and the key element that delivers the result.

Solution. The paper seeks to develop a model that explains two stylized facts; (1) stock of household capital is greater than the stock of business capital, and (2) investment in household capital is highly procyclical, leading business investment. To do so, they develop a Beckerian model of household production that treats business and household sectors almost symmetrically, where the only source of asymmetry between the two sectros is that capital can be produced in the market sector only. The model succeeds in explaining fact (1), but it cannot explain (2) even after adding increasing complementarity or adding capital adjustment costs.

3 Asset Pricing

3.1 **Lucas (ECTA, 1978): Asset Prices in an Exchange Economy

SUMMARIZE

Motivation TO-DO

Research Question TO-DO

Methodology TO-DO

Key Element TO-DO

Main Results TO-DO

3.2 *Mehra and Prescott (JME, 1985): The Equity Premium: A Puzzle

SUMMARIZE

Motivation Average real annual yield on S&P500 index is approximately 7%, and the average yield on short-term debt – treasury bill – is less than 1%. These imply that excess return on stock is *too* high and the risk-free rate is low.

Research Question Can the large difference in yields be accounted for by models that abstract from frictions in the economy?

Methodology

1. Quantitative theoretical exercise
2. Calibration of model to match moments of the data
3. Compare implication of the model

Key Element TO-DO

Main Results It cannot match the data – requires impossible high risk aversion. The *equity premium puzzle* is therefore that the covariances of the return with consumption only explains the observed excess return if the agent is implausibly risk averse.

3.3 *Kocherlakota (JEL, 1996): The Equity Premium: It's Still A Puzzle

SUMMARIZE

Motivation TO-DO

Research Question TO-DO

Methodology TO-DO

Key Element TO-DO

Main Results TO-DO