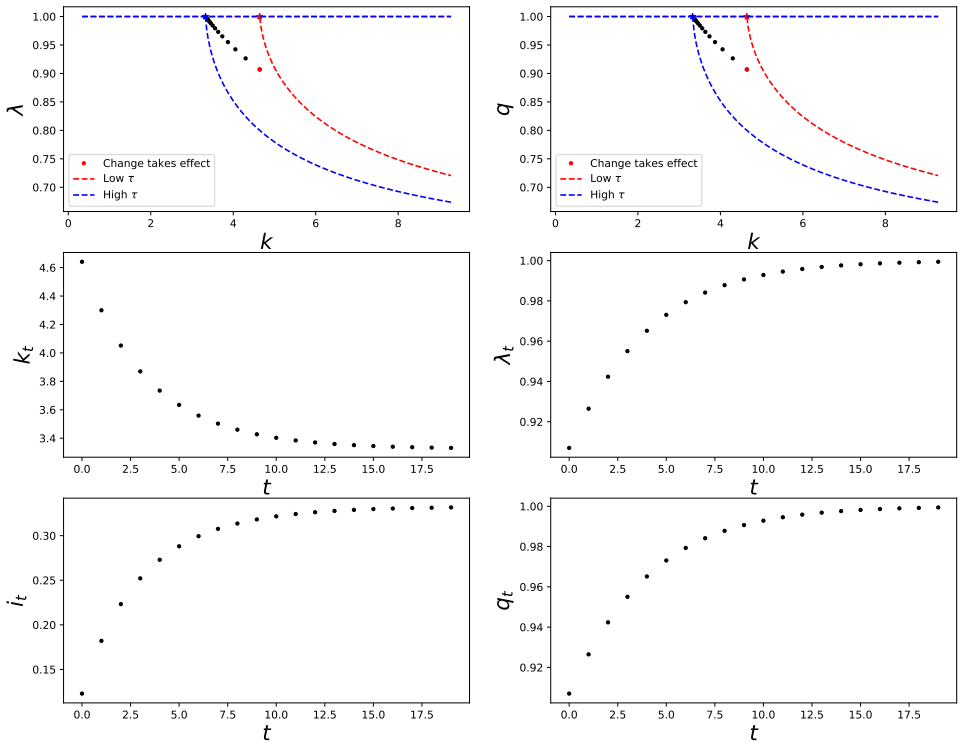

Figure 1 Instant τ increase

Dynamics of Investment in Response to a Temporary $\tau \uparrow$ in the φ Model.

Answer the following questions using an Abel (1981)-Hayashi (1982) φ model of investment.

You are expected to answer the questions not just quantitatively (e.g., with figures or numbers) but also conceptually. That is, you must explain, in intuitive terms, *why* the variables do what they do.

1. Leading up to date t, the economy is in steady state. At date t, the government unexpectedly introduces a permanent increase in the corporate tax rate, $\tau \uparrow$. Show the effects on a phase diagram and show dynamics of investment, capital, share prices, and φ following the tax change. In particular explain what, if anything, happens to λ, the share price of the firm, when the τ is implemented.

   Answer:

   The effects on the phase diagram and optimal dynamics are presented in Figure 1. The figure shows that λ instantly drops when the change is announced.

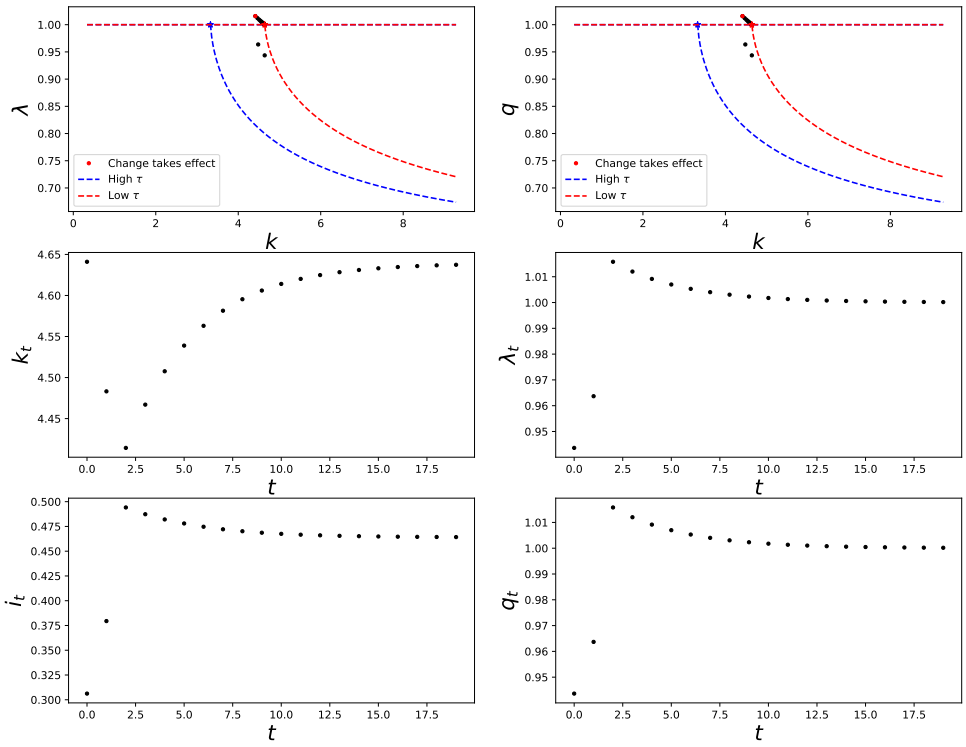

Figure 2 Temporary τ increase

2. Leading up to date t, the economy is in steady state. At date t, the government unexpectedly introduces a *temporary* increase in the corporate tax rate, $\tau \uparrow$. The high τ will last for two years, and then the τ will revert back to its normal level. Show the effects on a phase diagram and show dynamics of investment, capital, share prices, and φ, and the capital stock under two scenarios: (1) costs of adjustment for the capital stock, ω, are high; (2) costs of adjustment are low. EXPLAIN your results.

   Answer:

   The effects on the phase diagram and optimal dynamics are presented in Figure 2.

   The way to think about problems like this is, first, to figure out what the long-run phase diagrams will look like, then to figure out what the phase diagram will look like in the short run. A key point to realize is that the Δk phase diagram at any moment of time is a purely mechanical budget equation, so it is usually fairly easy to figure out what happens to the

Δk locus. A second point is that the tax terms that enter the equations are always the value of those taxes at the current date; any effects of future taxes have to come through their effects on λ or ϱ.

Upon introduction of the temporary increase in τ at date t, λ jumps down by exactly the amount such that if it evolves according to the new equations of motion it will arrive back at the original saddle path at date $t+2$, and thereafter, λ will move on the original saddle path to the old equilibrium level. The point here is that there can be no anticipated jump in λ. When costs of adjustment for the capital stock are low, the initial jump of λ is big; when costs of adjustment for the capital stock are high, the initial jump of λ is small.

λ jumps down because the higher corporate tax makes the rate of profit per unit of capital (marginal or average) smaller.

Dynamics of ϱ: since there is no change in the outside price of capital, ϱ dynamics mimic those of λ.

Dynamics of i: i closely follows the dynamics of ϱ since $i = (\iota(\varrho)+\delta)k = (\frac{\varrho-1}{\omega}+\delta)k$. At date t, i jumps down. Between date t and date $t+2$, i increases gradually. After $t+2$, i gradually goes back to the initial level.

Dynamics of k: k decreases between date t and date $t+2$ and then increases to its original level.

3. Leading up to date t, the economy is in steady state, and a τ of 20 percent has existed since the beginning of time. At date t, the government unexpectedly *announces* that in three years (that is, in year $t+3$), there will be a *permanent* decrease in the corporate tax rate, $\tau \downarrow \bar{\tau}$. Show and explain the effects on a phase diagram and show dynamics of investment, capital, share prices, and ϱ, and the capital stock under two scenarios: (1) costs of adjustment for the capital stock, ω, are high; (2) costs of adjustment are low. EXPLAIN your results.

   Answer:

   The effects on the phase diagram and optimal dynamics are presented in Figure 3.

   Upon announcement of the permanent decrease in τ in three years at date t, λ jumps up and then gravitates to the saddle path dictated by the new τ. At date $t+3$, λ will be on the new saddle path when the permanent τ increase is introduced. Afterwards, λ will move on the new saddle path to the new equilibrium level. The point here is again that there can be no anticipated jump in λ. When costs of adjustment for the capital stock are low, the initial jump of λ is big; when costs of adjustment for the capital stock are high, the initial jump of λ is small.

   Dynamics of ϱ: since there is no change in the outside price of capital, ϱ follows the dynamics of λ.

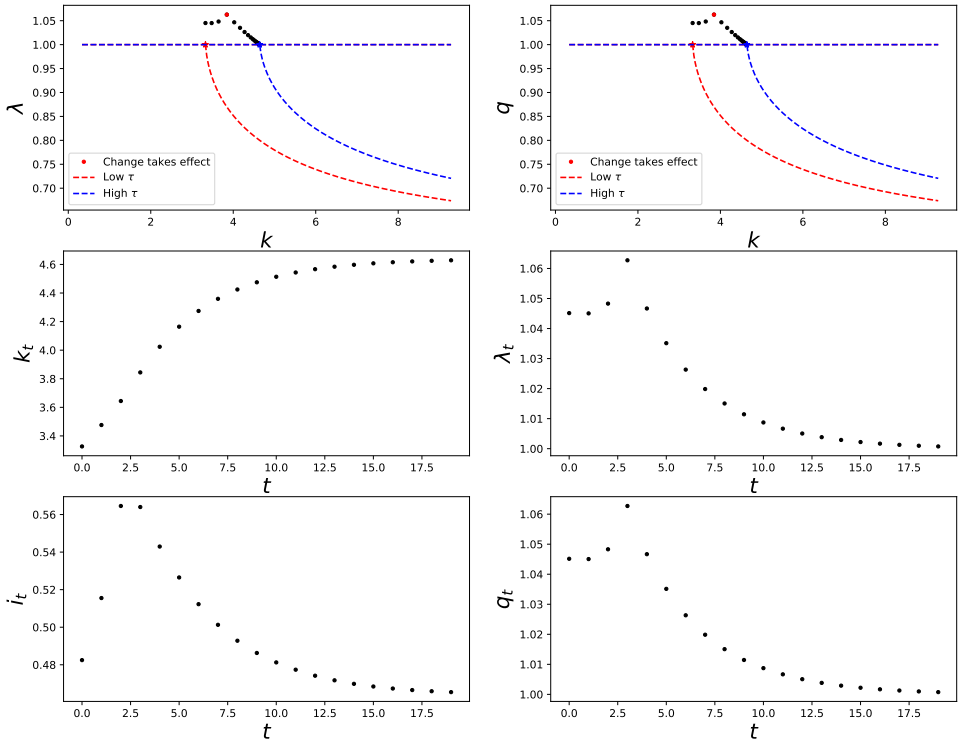

Figure 3 Future τ increase

Dynamics of i: i closely follows the dynamics of ϱ since $i = (\iota(\varrho)+\delta)k = (\frac{\varrho-1}{\omega}+\delta)k$.

Dynamics of k: k increases even between t and date $t+3$ in order to have capital already installed when the change takes effect. This is because of convexity in the adjustment costs: the firm prefers to slowly build up capital in advance rather than making large investments after the change takes effect. After the change, k continues increasing smoothly.

The point here is that if firms know that capital will be much more productive three years in the future, they will have a strong incentive to anticipate purchases of capital even before the change.

4. Do your results have any implications for whether, when lawmakers introduce a bill to increase the corporate tax rate, they will want to make it 'retroactive' (that is, if the τ change ever passes, it would apply to profits made during the period between the introduction of the bill and its passage into law). Is this the same as or different from the implications for the ITC?

   Answer:

   Even a member of Congress is smart enough to know that if a cut in the τ is passed that will not take effect until some future date, firms will increase investment even before the tax change comes into effect so, they can take advantage of lower future taxes. Since Members of Congress generally want investment to be high, they would be willing to pass a future tax cut even if it is not retroactive.

   This implication is different from the ITC because it does not alter the outside price of capital. Therefore, the incentive to postpone future investment until the change takes effect is not present.

5. How would your results to the previous question change if corporations had some accounting tricks they could use, at a smoothly convex increasing cost, to shift "reported" profits between calendar years? (By smoothly conves increasing costs, we mean costs like those for investment in the q model; that is, the marginal cost to move a negligible amount ϵ of reported taxes between t and $t+1$, is tiny (proportional to ϵ^2). (You do not need to make diagrams or do quantitative analysis for this question; intuition is enough).

   Answer:

   If tax-shifting costs were zero, corporations would report all of their profits as occurring in periods where the tax rate is lowest. If costs of tax shifting are very large, they will do little of it.

References

Abel, Andrew B. (1981): "A Dynamic Model of Investment and Capacity Utilization," *Quarterly Journal of Economics*, 96(3), 379–403.

Hayashi, Fumio (1982): "Tobin's Marginal Q and Average Q: A Neoclassical Interpretation," *Econometrica*, 50(1), 213–224, Available at http://ideas.repec.org/p/nwu/cmsems/457.html.