

Final Exam

Answer All Questions: Time = 3 hours
Use MIT ID Only (no names) – Calculator OK

1) (25 points) We began our discussion of cities by sketching three alternative theories of city formation: Random Growth Theory, Increasing Returns Theory (Marshall's three reasons for industry agglomeration) and Natural Advantage Theory (a city forming where a river meets the ocean.)

(a) (15 points) For much of the last century, the main migration routes within the U.S. have been from the North and the East to the South and the West. In the 1950 Census, Phoenix, Arizona, a city in the southwest desert, ranked as the 99th largest city in the U.S. In the 1990 Census, Phoenix ranked as the 9th largest city in the U.S. Over the same time, Boston dropped from 8th to 20th and Providence dropped from 37th to 100th. Explain what role, if any, *each* of the three theories has in explaining Phoenix' rapid rise in population rank.

ANSWER: The main answer is Natural Advantage – in particular the year-round warmth and sunshine. That advantage speaks to much of Arizona, however, and so Increasing Returns (Marshall's three reasons) are important as well – i.e. that's why activities congregate around Phoenix rather than being spread throughout the region. The data do not support Random Growth Theory. At a general level, the sustained population growth over 4 decades does not look anything like the random year-to-year fluctuations of that theory. Similarly, because of these year-to-year fluctuations, the theory predicts a stable ordering of cities by size and yet Phoenix moved up 90 places in the ranking – a very “unstable” movement.

(b) (10 points) Over time, technology can cause a location's characteristics to become more or less of a “Natural Advantage”. Discuss at least two examples of technology that might help explain the population shifts described in (a) above.

Answer: Several technological advantages are:

- Air conditioning that allows you to enjoy the southwest warmth in the winter without dying in the summer heat.
- Better highways, email, cheap long distance telephone calls, jet airplanes – all of which allow someone to live in Phoenix without being largely isolated from friends and production sites elsewhere in the country.

2) On December 15, 2003, the Associated Press carried a story on IBM moving software jobs overseas which said in part:

IBM documents obtained by The Wall Street Journal said about 4,700 programming jobs could be shifted overseas to save costs, a growing high-tech industry trend known as ``offshoring."

a) (13 points) Adapt the Ricardian theory of comparative advantage to construct a simple numerical example showing why IBM made this move and how the U.S. will gain from this “offshoring”. Note that the standard Ricardian production function – output per week or month of labor – is probably not exactly what you want. If there are reasons why the theory of comparative advantage cannot be applied here, explain why.

b) (12 points) In the case of textiles, we can assume that Indian producers and U.S. producers use quite different production functions. In the case of knowledge-based services –e.g. computer programming or a radiologist interpreting a patient x-ray - it is likely that Indian producers and U.S. producers use very similar production functions. Explain what this fact implies for the convergence of wages in knowledge-based services vis-à-vis manufacturing. In your answer, make reference, where appropriate, to relevant assumptions in the Ricardian Comparative Advantage and Factor Price Equalization theories.

3) (a) (12 points) Below is a partial table of investment projects being considered in 2003 by the Orbit Automobile Company.

Project Name	Initial Investment	Net Present Value assuming $r = 7\%$ Used for illustrative purposes only.	Internal Rate of Return
New Assembly Line	\$73.5 million	\$28.2 million	12.3 %
High Speed Truck Transfer Terminal	\$7.9 million	\$3.6 million	17.1%
Updated Computer System to Connect All Production Facilities	\$9.2 million	\$2.9 million	8.8%

The full table contains 73 projects, their initial investment, their NPV (calculated for illustration assuming 7% interest) and their IRR.

Use your knowledge of investment decision making and the relevant parts of this table to explain how you would construct Orbit’s demand curve for investment funds, that is, the

amount of funds that Orbit would want to borrow at different interest rates. The vertical axis of this demand curve should show the rate of interest in the economy (which can be at any level – the table used a 7 percent interest rate for illustrative purposes). The horizontal axis should be measured in dollars borrowed for investment. Note that not all parts of the table may be needed for this curve.

Answer: The demand curve for investment is formed using the decision rule:

For a given interest rate = R , undertake all projects whose internal rate of return is higher than R . As R falls, most projects (with lower internal rates of return) pass this test and so demand for investment funds increases giving the curve the normal downward slope. In constructing this demand curve, the Net Present Value (arbitrarily calculated at 7% is not needed).

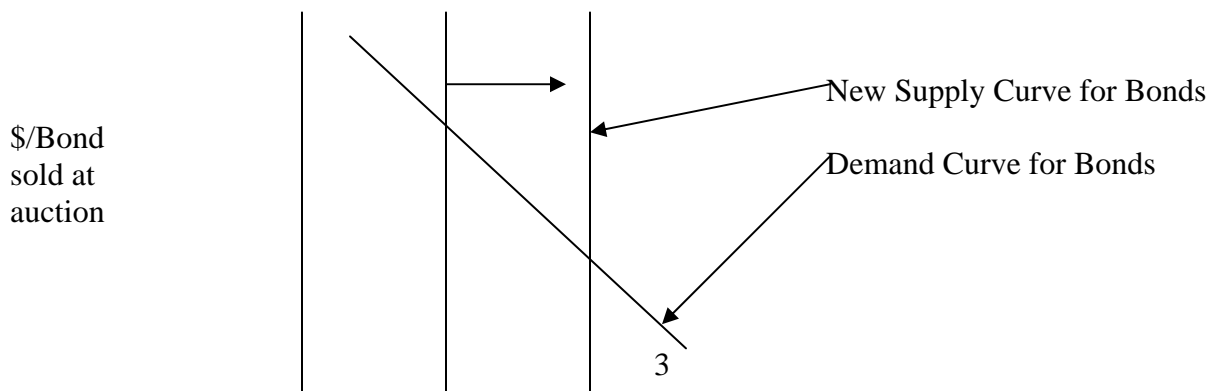
(b) (13 points). As you know, the federal government is projected to run large budget deficits over the next 10 years. This will require the federal government to sell large quantities of new government bonds to finance the deficit. A number of economists worry that selling all these bonds will “crowd out” private investment – i.e. the borrowing will cause the level of private investment to fall below what it would be if the government bonds had not been sold.

Recall that the bonds we have discussed have two main features:

- They promise to pay a certain redemption value at a certain future date – say \$10,000 on December 17, 2013.
- They are sold at auction and while no interest rate is explicitly mentioned, the interest rate can be determined once we know the sale price and the redemption value.

Using these features, an appropriate supply and demand diagram for bonds and the diagram you have constructed in (a), explain how the government’s need to sell large numbers of bonds might “crowd out” private investment.

Answer: The description begins with a supply demand diagram illustrating the bond auction:



When the government increases the supply of bonds it must sell, the price of the bond at auction falls. Using the facts above, the falling price of bonds translates into a rising interest rate that bonds pay. Going back to the diagram in (a), a higher interest rate will cause firms to undertake fewer projects than they would have undertaken at the lower interest rate. The projects that are dropped is the investment that has been crowded out.

4) (25 points) States often justify public university budgets on the grounds of economic development. The university provides a heavily subsidized education to its citizens who, in turn, help build the state's economy. Similarly, the university produces research that also can help build the state's economy.

At the same time, there is a risk that both the research and certain kinds of education – for example medicine and law – will involve large positive externalities that will not be captured by the state that finances them.

From the state's perspective, describe the potential externality each case raises - both research and educating lawyers and doctors. Describe the likely outcome if each externality is large and is left unchecked. Then describe the kinds of policies the state might pursue to capture the externality.

Answer: Research can cause externalities if it is used by companies outside of the state and so the jobs created, etc. have no impact on the state's economy. Educating doctors and lawyers can create externalities if these highly mobile people leave the state as soon as they finish their degrees, thereby benefitting the economies of the states to which they move.

If these externalities are severe and undealt with, the state legislature may decide that there is no benefit to funding research or educating doctors and lawyers and so may just stop doing either.

Possible ways to capture some of these benefits are, on research, to be sure that the university share in all patents and licensing arrangements so that the university's budget (or the state) benefits no matter where the research is used. In the case of doctors and lawyers, one way to capture some of the benefits are to charge a high tuition for these kinds of education – higher than the university charges for standard undergraduate education where people may be less mobile. Alternatively, one might charge high tuition (presumably financed by loans) but then forgive parts of a loan on a year-by-year basis for every year the graduate continues to work in the state.
