

Consider two firms, Chipz and Comps-R-Us. Chipz produces memory chips to be used in computers and sells them to Comps-R-Us. Comps-R-Us then builds the computers and sells them to consumers. The chips produced by Chipz are *specific* to Comps – in other words Chipz only produces chips compatible with the Comps’ computers and Comps can only use Chipz’ chips.

This question addresses whether or not Chipz has the incentive to make cost-reducing investments. There is a *hold-up problem* because the investment is *sunk* – once it is made it cannot be recovered – and because the firms negotiate on the price of chips once the investment is made, so part of the benefits will go to Comps. When they negotiate the sunk costs of investment are ignored and both firms know that Chipz will be willing to produce at any price that covers its production cost, *even if this does not cover the sunk investment cost*).

The demand for computers is very simple. If Chipz produces memory chips for Comps, Comps’ revenues are \$100 million. Comps’ cost is whatever price it agrees to pay Chipz for the memory chips. As usual, profit is revenues minus costs.

Chipz’ revenues are simply the price it gets from Comps and its costs are the production costs for the chips plus investments that Chipz makes to reduce its production costs. Chips can choose to invest \$0, \$5 million, \$10 million or \$15 million dollars streamlining its production of chips for Comps-R-Us. Depending on the investment level chosen, the production cost for the chips is given by the following table. Assume that the investment made by Chipz once made, cannot be changed.

Investment	\$0	\$5 million	\$10 million	\$15 million
Production Cost	\$80 million	\$68 million	\$60 million	\$54 million

So, for example, if Chipz and Comps agree on a price of \$75 million for the memory chips, and Chipz invests \$10 million dollars, the profits for Chipz is \$5 million (\$75 million revenues - \$60 million production costs - \$10 million investment) and Comps profits are \$25 million (\$100 million revenues - \$75 million for Chipz).

1. What level of investment maximizes the *joint* profits of Chipz and Comps?

2. Assume that Chipz chooses its investment first and then Chipz and Comps negotiate the price of the memory chips. Assume that when they negotiate, they split the gains from trade (ie. the difference between the chip production cost and the revenues from selling the computers). How much money will Chipz choose to invest (Hint – think of this as a 2-stage game and find the equilibrium. In the first stage the investment is made and in the second stage the price of chips is determined.)

