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Explaining "In the Aggregate" Concepts with Clickers

Concepts such as the marginal propensity to consume can lead some students to respond, "But that's not how I would behave!" Using clickers (or any classroom response system) to illustrate economic concepts can help those students see that even if their individual behavior does not match economic theory, "in the aggregate" the theory holds. This paper offers several clicker questions that can be adapted to small and large classrooms, at any level of instruction to help students see past what they personally would do to the larger lessons about typical economic behavior.

Martha L. Olney[†]

†University of California-Berkeley

1. Introduction

Higher incomes yield higher consumption. An increase in domestic interest rates alters exchange rates. Insurance increases moral hazard risk. When counterintuitive – or, to an economist's mind, perfectly intuitive – economic concepts are introduced, students sometimes respond with "But that's not how I would behave!" Using clickers to illustrate economic concepts can help those students see that even if their individual behavior doesn't match the predictions of economic theory, "in the aggregate" the theory holds. This paper offers several clicker questions that can be adapted to small and large classrooms, at any level of instruction to help students see past what they personally would do to the larger lesson about typical economic behavior.

The general approach to illustrate "in the aggregate" concepts is straightforward. Come up with a scenario and offer students several response options for how they would each behave, and then calculate or graph the "market" behavior based on all responses. Next, alter the scenario (change income, wealth, price, interest rates, or any other relevant external factor) and offer students the same several response options for how they would each behave. Again, calculate or graph the "market" behavior. Point out two things: one, that the market has shifted, and two, that not every individual had to respond the same way in order for the market in the aggregate to shift. It is this last point that is so very important because that is what directly addresses the "But that's not how I would behave!" objection.

The remainder of this article discusses the literature on active learning and clickers, and then sets out several examples which can be directly adapted to the classroom. The first few examples are for principles of macroeconomics classes: marginal propensity to consume, the spending multiplier, and interest rates and exchange rates. The final examples are for principles of microeconomics classes: supply and demand, moral hazard, and tradable permits.

2. Clickers and Active Learning

Teaching that incorporates methods of active learning promotes student understanding and retention. Active learning – as distinct from passive learning – refers to activities that get students thinking, talking, or doing, not merely the more passive activities of listening, reading, or near-verbatim note-taking. Neuroscience confirms that active learning enhances learning, retention, and memory retrieval (Bransford et al. 2000) by generating a moderate amount of the stress hormone cortisol. This creates a memory imprint that subsequently yields an optimal level of memory retrieval (Voss et al. 2011; Kaufer 2011).

A meta-analysis of 225 studies of science, technology, engineering, and mathematics (STEM) courses comparing the effects of active learning with traditional lecture[1] found improvement in student exam scores and a decrease in failure rates (Freeman et al. 2014). Even a majority of those economists who stick with traditional no-interaction lecture as their primary mode of instruction believe that students do not learn best from lecture (Goffe and Kauper 2014).

One way to incorporate active learning into a classroom, large or small, is with clickers. For those new to clickers (more generally, a "classroom response system" (CRS)), an excellent overview of the use of clickers can be found at the Starting Point: Teaching and Learning Economics portal (Calhoun et al. (n.d.)). Clickers are small electronic devices about the size of an older iP

1 Here, we mean lecture with no audience interaction.

hone or TV remote. Some brands offer five multiple-choice options (A through E); others offer alpha-numeric keypads. The brand used at my institution is iClicker+, which is available online for about $40 new or $20 used. Faculty order clickers through the campus bookstore along with the rest of the course's book order. The clicker company provides the faculty member with a complimentary base that plugs into a computer USB port or an electrical outlet that displays the number or percent distribution of student responses.

Alternatives to purchased clickers operate through a student's smartphone and sometimes require a paid subscription (Jain and Farley 2012; Imazeki 2014). At my institution, the wifi is not strong enough to handle 500 or more signals submitted simultaneously, so cell-phone based systems are not an option in large classes. Imazeki (2014) notes this possible problem, as well as noting that students will have their cell-phones out and available, inviting distraction. Indeed many faculty ban laptops and cell phones altogether because the electronics are distracting to the student and those seated near the student, or because taking notes by hand encourages careful listening and more synthesis than does typing up a near transcript of the instructor's words (Young 2006; Fried 2008; Mueller and Oppenheimer 2014).

Studies in a number of fields support clickers as a means of introducing active learning into a classroom (Salemi 2009; Martyn 2007; Caldwell 2007; Osterman 2008). Evidence is mixed as to whether clickers per se increase student test scores (McDaniel Mohr 2013; Johnson and Robson 2008; Hayter and Rochelle 2013), though in many studies it is not obvious if the counterfactual is traditional lecture with no student interaction or the variety of ways faculty currently incorporate interaction into the classroom. Regardless of the effect on test scores, students report increased engagement in courses utilizing clickers (Ghosh and Renna 2009; Hayter and Rochelle 2013; Trees and Jackson 2007; Elliott 2003).

Caldwell (2007) offers an excellent set of suggestions and "best practice tips" for those new to clickers. Watts and Schaur (2011, Table 2) report that instructors allocate very little time to clicker activities in principles classes: a median of 0 percent and a mean of 6 percent of class time. In my experience, clickers need not use up very much class time to be effective. In a 50-minute, 700-student principles class, I typically ask four to six clicker questions per day, each of which takes 30 to 45 seconds from the time I display and read the question aloud to when I call the end of polling. A total of two to four-and-a-half minutes of clicker activities per day – four to nine percent of class time – can make a big difference in student engagement.

Of course, clickers are an electronic upgrade to the "show of hands" technique (Caldwell 2007; Liu et al. 2008). But clickers have advantages over older non-electronic methods. Privacy is enhanced because no one – including the faculty member – can see anyone's individual vote during polling, though the base records each individual's vote and the faculty member can subsequently see who cast which vote. Moreover, no longer is time required to count hands in a small class or try to accurately discern proportions in a large class. One quick look at the base and the faculty member knows immediately and in real time exactly what percent of the total vote is choosing each of the five alternatives.

Questions of a wide variety can be posed with clickers. Salemi (2009) suggests five types: (1) Sampling Student Opinions, (2) Asking "Are you with me?" Questions, (3) Acquiring Economic Data from Students, (4) Peer Instruction Activities, and (5) Games and Simulations. Quizzes are a standard choice and can be used not only as formative assessments (Ghosh and Renna 2009) but also to facilitate just-in-time teaching (Simkins and Maier 2004). Encouraging students to discuss their answer with their peers can be effective (Ghosh and Renna 2009); in my experience this is especially true when a glance at the clicker base indicates students are not quickly converging to a correct answer.

Experiments are another use of clickers. Bostian and Holt (2013) describe an experiment using clickers to illustrate perception bias and the winner's curse. Brouhle (2011) describes the use of clickers to teach students strategic behavior in oligopolies. Bergstrom (2009) uses clickers to play interactive games and gather information about student preferences. Liu et al. (2008) use clickers in an applied microeconomics classroom experiment that replicates the experience of pit-market trading.

Of the many types of clicker activities others propose, the suggestions in this paper are closest in spirit to experiments. But in contrast to the experiments described in the literature, the activities I describe below are generally quicker and easier to set up than many experiments, largely because students are simply making choices based on their own preferences. Yet even without the setup other experiments often require, these activities still do a great job of illustrating key economic concepts.

3. Examples

A. Macroeconomics Example 1: The Marginal Propensity to Consume

The first example illustrates the marginal propensity to consume (MPC). When we assert, "The MPC is 0.6 which means consumers will spend 60 percent of any change in disposable income," students may object (or perhaps worse from a pedagogical perspective, simply think) "That's not what I would do." This clicker question uses each student's individual behavior to derive an aggregate MPC driving home several aspects of the concept of the MPC.

Start by asking students this question:

> Clicker Question: Suppose your paycheck increased by $300 per month. Each month, what would you do with the additional $300?
>
> A. I would spend the entire $300.
>
> B. I would spend $200 - $299 and save or pay off debt with the rest.
>
> C. I would spend $100 - $199 and save or pay off debt with the rest.
>
> D. I would spend $1 - $99 and save or pay off debt with the rest.
>
> E. I would save or pay off debt with the entire $300.

Grab a calculator (or pull up a pre-filled spreadsheet) to compute the "marginal propensity to consume" for the class. From the clicker base, you can see what percentage of the class gave each answer. Multiply the percentage by the value (for A and E) or the midpoint of the range (for B, C, and D), sum, and divide by the change in income The result is the MPC for the class.[2] Table 1 provides an example of the calculation, resulting in an MPC of 0.40.

2 If you have done this with a show of hands, you'll multiply by the number of hands for each option and then divide by the total number of votes cast.

Table 1 - Calculating the Aggregate Marginal Propensity to Consume

Answer	**% of Class (giving that answer)**	**Calculation**
A.	4	0.04 * 300 = 12
B.	12	0.12 * 250 = 30
C.	42	0.42 * 150 = 63
D.	32	0.32 * 50 = 16
E.	10	0.10 * 0 = 0
	Total change in C	12 + 30 + 63 + 16 + 0 = $121
	Marginal Propensity to Consume	**$121 / $300 = 0.40**

Unpacking the exercise is the most important step. Point out the following:

1. The students' answers were based entirely on their own preferences, or what they would actually do in the real world. You did not prejudice or influence their answers in any way.

2. Not everyone gave the same answer. There is a range of behaviors in the class. Saying "the economy's MPC equals 0.40" is consistent with having some people who spend everything and some people who spend nothing.

3. On average for "the economy as a whole" (that is, for the entire class), the change in consumption is $121. Did anyone answer "$121"? No. The average change for the economy as a whole is not telling us what each person will do. In fact, it may not tell us what even one person will do.

I have used this question in my 700-student principles class for several years. The class MPC has been almost the same each year: between 0.32 and 0.33. I have also used this question with a 30-student class. The answer is less stable with 30 students than with 700, but nonetheless this approach still illustrates the same conceptual points.

B. Macroeconomics Example 2: Is the MPC the same regardless of the source of the change in take-home pay?

For students who are ready to go beyond the textbook, you can use clickers to get them thinking about some of the implicit assumptions economists invoke when using the MPC. This next question gets students thinking about whether the size of the MPC depends upon the source of the change in disposable income. Following immediately upon the previous question, ask them if their answer to the previous question depended upon whether the source of the $300 per month increase in their paycheck had been a raise or a tax cut. You can clarify whether the tax cut was designed to be temporary or on-going, though to get the important take-away from the question it is not necessary to do so.

Clicker Question: You receive an extra $300 per month in your paycheck. Would your decision about spending it or saving it depend upon why your paycheck went up – due to a raise, or due to a tax cut?

A. I'd spend more if it was a raise.

B. I'd spend more if it was a tax cut.

C. It wouldn't matter; money is money.

In my experience, more students answer A (raise) than B (tax cut). For example, in Fall 2014, 42 percent of students said they would spend more if it was a raise, 11 percent of students said they would spend more if it was a tax cut, and 47 percent of students said it wouldn't matter and they would spend the same amount whether the paycheck bump was due to a tax cut or a raise.

Again, unpacking the exercise is the most important step. This one is a bit more challenging conceptually than the MPC exercise. Point out the following:

1. In macroeconomics, we talk about changes in "disposable income," equivalent here to thinking about changes in our paychecks. Paychecks can change from month to month either because of a change in what we are earning (equivalent to income, Y) or because of a change in taxes paid (equivalent to net taxes, T).

2. Most economic models assume that 100 percent of people would respond with answer C: the source of the change in disposable income is irrelevant. But is this a good assumption? For those who answered C, clearly yes. If the percentages who answered A and B had been closer to the same (say, both about 25 percent), then again, the assumption that the source of the change in disposable income is irrelevant would be a reasonable assumption; the behavior of the folks who answered A would offset the behavior of the folks who answered B. But for my students, and I suspect for yours, the assumption that the source of a change in disposable income is irrelevant is a bad assumption.

3. Where you go next depends on which point you want to make.

    a. Ricardian Equivalence? Ask the students who answered A to explain why they would spend less if the paycheck bump was due to a tax cut. Undoubtedly at least one student will wander down the path of "because the government will just raise taxes later to make up for it, so I don't want to get used to spending the money."

    b. Policy Effects? Ask the students what would boost consumption spending more: a cut in taxes that increases disposable income or an increase in spending that increases income. For my students who overwhelmingly chose A over B, the answer is an increase in spending. What does this tell us about the effectiveness of different types of fiscal policy?

    c. Balanced Budget Multiplier? For advanced students, you can use this as a launch point to discuss the balanced budget multiplier. When we calculate the response to a change in government spending which affects income, we use the same MPC as when we calculate the response to a change in taxes. But the implication of my students' answers is that an equal size increase in government spending and taxes will boost the economy by more than a factor of 1.

C. Macroeconomics Example 3: The Spending Multiplier

How does a change in spending wind its way through the economy? This activity illustrates the interconnectedness that gives rise to the concept of the spending multiplier. It takes more time and more set-up than any of the other examples in this paper. In a class of 30 students, I used the full period for this exercise. In a class of 700 students, I rush them through the first stages and get through the exercise in about 15 to 20 minutes. The activity has five steps: [1] give each student an occupation, industry, income, tax level, and initial consumption spending, [2] have them allocate their income among several spending categories, [3] suggest a policy change or economic shock, [4] interview students about their spending reaction, and [5] display throughout the activity a histogram of clicker responses depicting spending reactions.

Each student is given a sheet of paper that shows an occupation and industry, monthly income, taxes, and consumption spending. I have a set of about 30 occupation, industry, income, taxes, and consumption combinations (see Table 2) that I mail-merge with the daily class handout so that there are 30 variations of the handout. Students then allocate their monthly consumption across nine spending categories: housing (rent or mortgage), food (prepared/eaten at home), eating out & travel, transportation (bus, subway, gas, car insurance, car payments), other durable goods (electronics, appliances), miscellaneous shopping (big box stores, department stores, and so on), health care (including health insurance premium), education, and bank or brokerage or lawyer fees. In a class of 30 students at a residential liberal arts college, this allocation took quite a bit of time because few students had lived on their own and so we spent quite a bit of time discussing local rents, insurance costs, and so on. In a class of 700 students where many students live off-campus, I can rush them through this step.

Table 2 – Occupation, Industry, Income, Tax, and Spending Data for Multiplier Exercise

Occupation	**Industry**	**Initial Income ($)**	**Initial Net Taxes ($)**	**Initial Spending ($)**
contractor	construction	6,000	1,000	4,500
worker	construction	2,500	500	1,500
worker	construction	3,000	800	1,600
worker	auto industry	3,800	800	2,500
worker	auto industry	3,800	800	2,800
factory owner	auto industry	17,000	2,000	11,000
worker	consumer durables industry (not autos)	3,500	500	2,800
worker	consumer durables industry (not autos)	3,500	500	2,500
factory owner	consumer durables industry (not autos)	12,000	2,000	8,000
doctor	health care	12,000	2,000	6,000
nurse	health care	6,000	1,000	4,500

Occupation	Industry	Initial Income ($)	Initial Net Taxes ($)	Initial Spending ($)
aide	health care	1,700	200	1,450
aide	health care	1,700	200	1,400
teacher	education	4,500	500	3,200
teacher	education	4,500	500	3,800
administrator	education	7,000	1,000	5,200
aide	education	1,700	200	1,500
hotel worker	hospitality industry	3,500	500	2,500
hotel worker	hospitality industry	2,500	600	1,600
hotel owner	hospitality industry	6,000	1,000	4,000
restaurant owner	hospitality industry	4,800	800	3,600
server	restaurant industry	1,500	200	1,400
server	restaurant industry	1,500	200	1,200
worker	financial industry	4,800	800	3,200
worker	financial industry	5,500	1,000	4,000
CEO	financial industry	120,000	20,000	60,000
worker	retail	1,700	200	1,400
worker	retail	1,700	200	1,300
worker	retail	1,900	200	1,500
worker	retail	1,700	200	1,450
worker	farming	2,300	300	1,700
owner	farming	6,000	1,000	4,000

After students have had a chance to allocate their income across the spending categories, put up a slide with these instructions:

Listen for the event.

- *Does the event affect you? (What's your occupation & industry?)*

How will you react?

- *Is your income rising? Falling? Unchanged?*
- *Will you increase your C? Decrease C? Keep it the same?*
- *Which components of your spending will you change?*

Be ready with your answer!

Next, open a clicker question and keep it open throughout the exercise. Make the histogram of answers visible to everyone. As long as the clicker question is "open," students can change their answer. The histogram of answers updates in real time.

Clicker Question: How will you react?

A. I increased my consumption spending.

B. I kept my consumption spending the same.

C. I decreased my consumption spending.

Now have some fun! Run around the room with the microphone, interviewing students. You have to be willing to go with what the students say and play off of that. My favorite example starts with a drop in housing construction.[3]

"Who here works in the construction industry?" Me! Me! "Developers have stopped building houses and just laid off all their workers. What happened to your income?" It went down. "Ooooh, that hurts. What will you do to your spending?" I'll have to cut back. "Ouch. What category of spending do you think you'll cut?" Well, I don't want to give up my home or my car, so I guess we'll have to cut back on travel.

Make sure at this point that everyone in the construction industry has thought about what they will do and has clicked in A (increased spending), B (spending unchanged), or C (decreased spending). In addition, remind everyone else in the class that they should also have clicked in A, B, or C by this point. Point out the histogram on the screen: you'll see a small percent of students who have reduced consumption spending (answer C) and most of the student responses still on answer B (kept my consumption spending the same).

"All right. Jane cut back her spending on travel when she was laid off. Who here works in the travel and hospitality industry?" Me! Me! "There are fewer people traveling. What's going to happen to you?" I'm either going to lose my job or they'll cut my hours. "Oh, that's too bad! What will you do to your spending?" I'll have to cut back. I guess I'll cut back on eating out.

The histogram will be moving. Many of the students who work in hospitality will have changed their answers from B to C. Some of those in the restaurant industry see what's coming and will also change their votes. Vote changing happens in an ongoing way, not at a particular moment, so students will be watching the histogram change moment by moment.

Who here works in the restaurant industry?" Me! Me! "There are fewer customers in restaurants. What's going to happen to you?" I'm going to have fewer tips and they'll cut my hours. "Oh, that's too bad! What will you do to your spending?" I'll have to cut back. I guess I'll cut back on shopping. No more Target trips for me."

Depending on how much time you have, how much fun you and the students are having,

3 Other events I have used are a financial crisis that means banks aren't lending and bank employees are laid off, and the federal government authorizes spending additional money on highway construction. I suggest using examples relevant to your local economy.

and how their answers are unfolding, you can go on quite some time with this example. With each round, the share of students who have answered, "I decreased my spending" will rise.

There are a number of ways to expand the activity. You can include a discussion of unemployment insurance (UI): who is covered, how generous the UI benefits are in your state, what occupations or industries are exempt, and so on. You can include a discussion of how easy it might be for those who are laid off to find replacement jobs and thus how long the reduction in spending might last. You can incorporate into the discussion each student's initial saving rate – calculated from the income, tax, and consumption data provided to each student – because workers who have been saving may be able to sustain their consumption spending by drawing down assets. You can ask whether the laid-off workers are willing and able to take on additional credit card debt in order to sustain their consumption spending. You can distinguish between imported and domestically-produced goods and services to illustrate the difference between open- and closed-economy multipliers.

The activity does not require a lot of unpacking. Students are now aware that workers in some industries and occupations are more vulnerable than others. The restaurant owner, for instance, may answer that she is laying off most of the servers but will keep the restaurant open by relying on herself and her family members to cook and wait tables. The CEO in the finance industry is almost never affected unless your initial event is a financial crisis. The key takeaway: Students have seen that one person's spending is another person's income, and that changes in income lead to further changes in spending. The evolving histogram of clicker responses has reinforced how the spending changes unfold over time, not all in one moment.

D. Macroeconomics Example 4: Interest Rates, Wealth Allocation, and Exchange Rates

Explaining the relationship between interest rates and currency exchange rates can make everyone's head swim. You can use clickers to get students through the first step: the connection between interest rates and movement of funds between two countries.

This question takes some set-up for the students to get their head in the right space. Many students have never had the experience of thinking about how a saver reacts to higher interest rates. For today's undergraduates in particular, the federal funds rate has been essentially zero since they were in elementary or middle school. I make sure students understand that the interest rate (the rate of return) measures how much they are earning on their financial assets: stock and bonds. And I make sure they understand that a higher interest rate is a good thing if you are a saver who owns financial assets.

I start by telling them explicitly and in writing on a slide, "Put yourself in the shoes of savers (wealth-holders) when thinking about interest rates and exchange rates." Because that sentence by itself means little to beginning students, I elaborate, again both verbally and on a slide.

> *Interest rates measure the <u>cost</u> of borrowing if you are a borrower. But if you are a saver, interest rates measure what you <u>earn</u> from your financial assets, the "rate of return" on your assets.*

And to be very sure that the students get the point, I elaborate further, both verbally and on a slide.

> *Higher interest rates deter borrowers (it is more costly to borrow). But higher interest rates entice savers (the return from saving is higher).*

Before asking the clicker questions, I ask a few informal, probing questions to be sure these

initial ideas are clear. The clicker questions then illustrate the effect of a change in interest rates.

Clicker Question: You are an American who has $500,000 in financial wealth. Some of it is in American stocks and bonds. Some of it is in European stocks and bonds.

If rates of return (interest rates) are the same in both the U.S. and Europe, how will you allocate your $500,000?

A. $100,000 in U.S. stocks & bonds; $400,000 in European stocks & bonds

B. $200,000 in U.S. stocks & bonds; $300,000 in European stocks & bonds

C. $300,000 in U.S. stocks & bonds; $200,000 in European stocks & bonds

D. $400,000 in U.S. stocks & bonds; $100,000 in European stocks & bonds

E. $500,000 in U.S. stocks & bonds; $0 in European stocks & bonds

The point of the exercise is to point out the changes that happen when interest rates rise, so this first question is just establishing the base. Notice that the question simply asks students what their personal preferences are in the allocation of wealth. There is no need to provide the students with any additional information. By letting students simply choose how they would allocate their wealth, they will be more willing to believe that the predictions of economic theory do not depend on people being educated economists or behaving in any prescribed way.

Grab a calculator (or, prefill a spreadsheet) to calculate the typical portfolio. It is quickest if you multiply the percentage of students with each response by the dollar amount in European (not American) stocks and bonds. Using the responses I received in Fall 2014, Table 3 contains sample calculations.

Table 3 – Calculating the Average Portfolio Allocation

Answer	**% of Class (giving that answer)**	**Calculation**
A. $100K U.S., $400K European	10	0.10 * 400 = 40
B. $200K U.S., $300K European	13	0.13 * 300 = 39
C. $300K U.S., $200K European	31	0.31 * 200 = 62
D. $400K U.S., $100K European	18	0.18 * 100 = 18
E. $500K U.S., $0K European	28	0.28 * 0 = 0
	Total European Portfolio	40 + 39 + 62 + 18 = **$159K**
	Total U.S. Portfolio	$500K – 159K = **$341K**

Unpacking the result is important. First, point out the bottom line result. With these results, the typical portfolio has $159K in European stocks and bonds and $341K in American stocks and bonds, about a 30/70 mix between European and American assets. Next, point out that no

individual gave these particular answers: the "typical" or average result is not the experience of all individuals nor, in this case, is it the experience of any one individual. Instead, the result tells us "on average for the economy as a whole" how financial wealth for this (classroom) economy will be allocated between the two sets of assets.

Now, change the interest rates in one of the countries and re-ask the same question. You can change interest rates for either continent. Because the goal is for students to see how a relative change in interest rates leads to a reallocation of financial assets, I think it is important to keep the event as simple as possible. Therefore I do not recommend making the scenario more complicated by raising interest rates in the U.S. by more (or less) than they are raised in Europe.

Clicker Question: Rates of return (interest rates) rise in the U.S. but do not change in Europe.

After rates of return (interest rates!) rise in the U.S. but not in Europe, how will you allocate your $500,000?

A. $100,000 in U.S. stocks & bonds; $400,000 in European stocks & bonds

B. $200,000 in U.S. stocks & bonds; $300,000 in European stocks & bonds

C. $300,000 in U.S. stocks & bonds; $200,000 in European stocks & bonds

D. $400,000 in U.S. stocks & bonds; $100,000 in European stocks & bonds

E. $500,000 in U.S. stocks & bonds; $0 in European stocks & bonds

You only need a few students to reallocate their wealth in order to make the desired point. Even if most of your students do not change their portfolio allocation – those who initially chose allocation "E" with all wealth in American stocks and bonds, for instance, will not change their allocation – there will be some who shift some of their wealth out of European and in to U.S. stocks and bonds. The results for my Fall 2014 class are in Table 4.

Table 4 – Calculating the Average Portfolio Allocation After Interest Rate Change

Answer	**% of class (giving that answer)**	**Calculation**
A. $100K U.S., $400K European	7	0.07 * 400 = 28
B. $200K U.S., $300K European	5	0.05 * 300 = 15
C. $300K U.S., $200K European	4	0.04 * 200 = 8
D. $400K U.S., $100K European	30	0.30 * 100 = 30
E. $500K U.S., $0K European	54	0.54 * 0 = 0
	Total European portfolio	28 + 15 + 8 + 30 + 0 = **$81K**
	U.S. portfolio	$500 – 81 = **$419K**

Once you calculate the new portfolio, you can again begin by asking if anyone in the class answered "$419K US and $81K European." Of course the answer is "no"; that was not one of the five options. The behavior "in the aggregate" is about the average for the economy as a whole, but does not describe the behavior of any one individual. You can then ask if everyone in the class is a professional investor. Again of course the answer is "no"; we are capturing the behavior of a group of people who may or may not be making informed choices. It is not that some people's choices are "wrong" or "irrational" or any other word with negative connotation. The point to underscore here is that any macroeconomic average reflects a wide variety of possible behaviors by individuals in that economy.

The next thing to point out is the effect of the rise of U.S. interest rates. Did everyone in the room re-allocate wealth? No. Did some people in the room re-allocate wealth? Yes. On average, is there a re-allocation of wealth? Yes. Does it matter that not everyone re-allocated their wealth? No. Some people did, and so the increase in U.S. interest rates causes, in the aggregate, increased demand for U.S. assets and decreased demand for European assets.

The ultimate goal here is to show how a change in domestic interest rates affects exchange rates. The specifics of what you say next depend upon how you model the determination of foreign exchange rates. I focus on the determination of the "price of foreign currency": the dollar price of one euro, the dollar price of one peso, or the dollar price of one remnibi. By framing exchange rates in this way, I can draw on students' (presumed) comfort with basic supply and demand.

What we found with the clicker exercise was that an increase in U.S. interest rates relative to European interest rates caused the macroeconomy (which means, some but not necessarily all people in the room) to re-allocate wealth away from European stocks and bonds and toward U.S. stocks and bonds. That is, there are now more people with euros who want to exchange those euros for dollars, which I show as an increase in the supply of euros, shifting the supply curve to the right. The result is a decrease in the dollar price of the euro: it will cost fewer dollars for each euro.[4] Higher U.S. interest rates make the dollar stronger.

You will find it advantageous to refer back to the clicker exercise a number of times, perhaps over several class sessions. Many students find this material difficult. Reminding them of the class's behavior when interest rates changed can help to solidify the concepts.

E. Microeconomics Example 1: Supply and Demand

Many instructors use clickers to illustrate the model of supply and demand. My approach again relies on the simplest set-up possible: students need to know only their own personal preferences and budget. I find that letting students answer in what seems to them to be a completely random and uncontrolled way, yet all the while illustrating "in the aggregate" textbook concepts, makes the economic concepts all the more believable.

To derive a demand curve with a clicker which has a limited set of options (A – E are the iClicker options) requires asking students to choose the maximum amount they would pay for an item, not what their quantity demanded is at each of various prices. As a result, it's important to choose an item where the quantity demanded cannot be more than one. I try to pick an example that is relevant to the students in that particular term: a ticket to the Obama inaugural

4 Alternatively and equivalently, the movement can also be shown as an increase in demand for dollars, raising the euro price of one dollar.

in January 2009, a 50-yard line seat to the football team's Big Game, the most recent iPhone, or perhaps a semester's tuition and fees.

The first question is used to illustrate that demand curves slope down. I do not give students any limits or other framing to the question. Their willingness to pay is based on their personal preferences and knowledge of their family's budget.

Clicker Question: Keeping in mind how much money you and your family have, what is the maximum price you are willing to pay for a new iPhone 6 with a 4.7" screen, 16 GB memory, and a 2-year required service contract?

A. $ 300 (or more)

B. $ 199

C. $ 100

D. $ 50

E. I wouldn't buy one even if it was free

Now, walk the students through the construction of the demand curve. You will use either the percentage distribution of answers (as I do below) or the raw number of answers, both of which you can see on your clicker base. Using the Fall 2014 answers for my class, I start at the top price: "19 percent of us are willing to pay $300 (or more). Another 48 percent are willing to pay a maximum of $199. If you are willing to pay $300 will you buy a phone if it costs $199?" Yes, they'll call out. "Right. So 19 + 48 = 67 percent of us are willing to buy a phone if it costs $199. Another 18 percent are willing to pay a maximum of $100. If you are willing to pay $199 are you willing to pay $100?" Yes, they will call out. "Correct! So 18 + 67 = 85 percent of us are willing to buy a phone if it costs $100. And 7 percent of us are willing to pay a maximum of $50. If you are willing to pay $100 or $199 or $300, will you buy a phone if it costs $50?" (It pays to repeat this point. Why you are adding the responses can otherwise be a mystery to the students.) Yes, they will mutter. "Good! So 7 + 85 = 92 percent of us will buy a phone if it costs $50. And then there are some of us who won't buy a phone even if it is free."

Next you want to graph these responses to show the class demand curve. The important take-away is that with nothing but their personal preferences and knowledge of their family budget, the class has illustrated that demand curves slope down: as the price goes down, the quantity demanded rises.

Now change the circumstances. Keep the set of possible answers the same. It is important that you not change the options A-E. Trust the process: even if some students give perverse answers, the class as a whole will illustrate the concepts. The possible changes I have used are

- (Income effect) If your family's income was 4 times as big as it is, what is the maximum price . . .
- (Wealth effect) If your income was the same but you had another $200,000 in savings, what is the maximum price . . .
- (Price of complement) If the monthly data plan was free, what is the maximum price . . .

- (Price of substitute) If a Samsung Galaxy with 16 GB memory cost $600, what is the maximum price. . .
- (Preferences) If you became convinced the iPhone 6 was completely, totally, awesome, what is the maximum price. . .

In each case, enough of the answers will change so that the demand curve shifts. For example, in my Fall 2014 class, I received the responses in Table 5.

Table 5 – Deriving Demand Curves

	Initial Answers		Income Increase		Complement Cheaper	
Answer	**% of Class (giving that answer)**	**Total Q_D**	**% of Class (giving that answer)**	**Total Q_D**	**% of class (giving that answer)**	**Total Q_D**
A. $300 (or more)	19	19	56	56	59	59
B. $199	48	67	27	83	27	86
C. $100	18	85	7	90	9	95
D. $50	7	92	3	93	3	98
E. Not even if free	8		7		2	

You can derive a supply curve in a similar way. Here the question is what is the minimum price the student would sell the product for. Again, because of the limitations of clickers, be sure the product you choose allows for a quantity supplied of zero or one. For instance, I have asked "If you received a FREE 50-yardline alumni-section ticket to the football team's Big Game, what is the minimum price you would sell it for?" The price options I offered were "More than $200, $200, $100, $50, and $20." Student preferences vary, and thus so too will their answers to the question. Here, when aggregating the answers, start with the lowest price. If someone is willing to sell their ticket for $20, they will also be willing to sell it for $50. If someone is willing to sell for $50 (or $20), they will also be willing to sell it for $100. The aggregating of answers will illustrate that the supply curve slopes up.

Next change the cost of the item to the seller to show how the supply curve shifts: "If instead you had paid $100 for a 50-yardline alumni-section ticket to the football team's Big Game, what is the minimum price you would sell it for?" Not all of the students will change their answers. Some students might click random responses. It doesn't matter. The collective results will still show that with higher costs of production, the supply curve shifts to the left.

F. Microeconomics Example 2: Moral Hazard

This is a very quick example that simply relies on student behavior to illustrate the concept of moral hazard in insurance markets. Again, they see that even if an individual's behavior doesn't match the predictions of economic theory ,in the aggregate the predictions are accurate for the class as a whole. The first question sets up the no-insurance baseline. The second question allows you to show how behavior changes in the presence of insurance. Be sure the options A-E are the same for both questions.

Clicker Question: Suppose that, if you lose your cell phone, your parents have made it clear that you will pay to get a new one. How careful are you not to lose your cell phone?

A. Extremely careful
B. Very careful
C. Somewhat careful
D. Not too careful
E. Ah, my parents are on me all the time about my carelessness!

Clicker Question: Now, suppose you have insurance on your cell phone. If you lose the cell phone, you get a new one for free, probably within hours. Your contacts and music are all downloadable from the cloud. How careful are you not to lose your cell phone?

A. Extremely careful
B. Very careful
C. Somewhat careful
D. Not too careful
E. Ah, my parents are on me all the time about my carelessness!

In Fall 2014, my student answers clearly showed a shift toward less care – more moral hazard risk – in the presence of insurance. The distribution of replies is in Table 6.

Table 6 – Student Responses to Moral Hazard Question

	Student pays for new cell phone	**Insurance covers new cell phone**
A. Extremely careful	68	6
B. Very careful	25	13
C. Somewhat careful	4	41
D. Not too careful	1	38
E. Ah, my parents are on me all the time about my carelessness	2	3

G. Microeconomics Example 3: Tradable Permits

Illustrating tradable permits with an activity that works in a class of 700 students has been a challenge. Caviglia-Harris and Melstrom (2015) describe an in-class tradable permits game that takes place in a classroom of 20 to 40 students in which each student is given an initial pollution-abatement cost for a hypothetical company. My experience suggests class size contributes

to the success of their activity. In my 700-student class, I had devised a clicker activity along similar lines in which students were to think of themselves as business owners with randomly assigned costs of pollution abatement based on the last two digits of their student ID numbers, and who were choosing between polluting with permits and abating pollution. That example was so far outside their experience and the setup was so complicated that in my 700-student class, I chalked it up as a pedagogical failure.

The example I offer here for illustrating tradable permits draws on an institutional characteristic that may not apply at all institutions: when students enroll in classes during "Phase I" – two months before the term begins – they are initially limited to signing up for just 10 units. Students are given a 4-hour appointment window during Phase I during which they select two or three classes. Students fill in their schedule, typically 15-18 units in total, during "Phase II" which is held only after everyone has had the chance to sign up for 10 units. If your campus doesn't have a units restriction during pre-registration, perhaps there is some other cap that students face and which you can exploit in a similar manner. Because the example draws on their own needs and preferences rather than some assigned set of preferences and costs, the setup is quick and the example works well in a class of 700 students.

The setup is as follows. First, I define the negative externality: if everyone were to sign up for 18 to 20 units during Phase I of enrollment, there would not be enough seats remaining in decent classes for people with late appointments. Moreover, many students at my institution "shop and drop," signing up for more courses than they plan to complete, anticipating dropping one to two courses before the drop deadline, creating another negative externality. My students all have a strong understanding of the negative externality, knowing how hard it is to get into popular classes such as Economics 1.

Next, I point out the individual cost associated with the cap: each student needs to take time to plan their course schedule, prioritizing the classes that they need the most and those that are most popular. Students know well what sort of research they need to do to prepare for Phase I: checking online records of enrollment patterns for popular classes, determining how frequently needed classes are taught, and so on. We discuss the difference between impacted and non-impacted majors, so Economics and Engineering majors (impacted) face higher costs of preparing for Phase I than do French majors (not impacted).

Finally, I introduce the language of cap and trade. The "cap" is the ten-unit limit that applies in Phase I. The "trade" does not currently exist, but I invite students to pretend that it does. "Pretend there is a market in which they can buy or sell permits to sign up for units. A student who wants to sign up for 12 units rather than the capped 10-unit maximum during Phase I would have to buy a permit for 2 units from a student who was content to sign up for no more than 8 units during Phase I."

We then turn to clickers to derive the demand and supply curves for the market. There are six questions – three to derive the supply curve and three to derive the demand curve – with three different prices. A sample clicker question follows.

Clicker Question: If you could sell units for $100 each, how many units would you sell? (Remember: if you sell 4 units, you can only sign up for 6 units in Phase I.)

A. 0

B. 1 or 2 or 3

C. 4 or 5 or 6

D. 7 or 8

E. 9 or 10

In the subsequent five slides, change the price to $50 and then $10. Next, change "sell" to "buy" and use the same three prices: $100, then $50, then $10. It is important that the prices be sufficiently different that not all students will have the same reaction to each price: $19, $20, and $21 as the three prices would not work.

I underscore the point that if a student is selling units when the per-unit price is $100, they should not also plan to buy units at that same price. From the reported results it is clear that not all students understand this point. But the clicker results still illustrate how cap-and-trade works even with some students planning to both buy and sell units at a particular price.

After each slide, use your calculator or a pre-filled spreadsheet to determine the average number of units supplied or demanded at each price.[5] Use the midpoint for each category. For instance, the average number of units sold at a price of $100 is 0*0.14 + 2*0.69 + 5*0.12 + 7.5*0.02 + 9.5*0.03 = 2.42 units. Table 7 shows my results from Fall 2015.

Table 7 – Calculating Cap-and-Trade Supply and Demand Curves

	Percent of Students Giving Each Answer					
	How many units would you sell?			**How many units would you buy?**		
# of units	**P = $100**	**P = $50**	**P = $10**	**P = $100**	**P = $50**	**P = $10**
0	14	30	70	69	45	13
1 or 2 or 3	69	61	26	23	39	22
4 or 5 or 6	12	7	3	6	12	29
7 or 8	2	1	1	1	2	13
9 or 10	3	1	1	1	2	24
Average	**2.42**	**1.74**	**0.84**	**0.93**	**1.72**	**5.14**

5 You could use the raw number of responses instead of the percent distribution. Then you will be deriving the total number of units offered for sale or demanded at each price. The equilibrium price is unaffected.

You can depict the demand and supply in a graph. With these data, the supply curve has three (P, Q) points: ($100, 2.42), ($50, 1.74), and ($10, 0.84). The demand curve has three points: ($100, 0.93), ($50, 1.72), and ($10, 5.14). The equilibrium price is about $50 with an average trade of 1.7 units.

The final step is to ask students what will happen to supply, demand, and the equilibrium price if the administration changes the cap – the number of units that students can sign up for during Phase I. I ask students, "If you were initially a seller of units and the cap is reduced to six units, at each price ($100, $50, $10) are you willing to sell more units, the same, or fewer units than when the cap was ten units?" The dominant answer is 'fewer.' I draw a second supply curve to the left of the original supply curve. And then I ask the students, "If you were initially a buyer of units and the cap is reduced to six units, at each price ($100, $50, $10) are you willing to buy more units, the same, or fewer units than when the cap was ten units?" The dominant answer is 'more' and so I draw a second demand curve to the right of the original demand curve. The effect on the equilibrium price is clear: the price of each unit traded rises.

To complete the activity, we then discuss what changes in behavior they would expect to see at a higher per-unit price in the trade. They recognize that many more students will be willing to incur the costs of carefully planning their course schedules and prioritizing which classes they truly need and plan to complete. They will incur the costs rather than pay the higher price to purchase a "permit" to over-enroll in units.

4. Conclusion

The general method described here – asking students what they would individually do in some circumstance and then aggregating their behavior – can be replicated for any number of concepts. In this paper, I have described how to use this method successfully to illustrate the marginal propensity to consume, the spending multiplier, interest rates and exchange rates, supply and demand, moral hazard, and tradable permits. While the descriptions here reference clickers, you could implement the method with color-coded cards or a simple show of hands. The method works well in classes of any size. The principles were illustrated when I used it in classes of 30 but the responses are more stable in classes of 700. And finally, the method can be used at any level of instruction. I teach university students, but the same method would work well with students at any K-12 grade.

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