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ECONOMIC INSTRUCTION

Instituting a Monetary Economy in a Semester-Long Macroeconomics Course

Victor J. Valcarcel

The author provides a general model to incentivize student involvement in an economics course on an ongoing basis. Rather than presenting students with a discrete number of diverse experiments to illustrate different economic concepts, he opts for the adoption of a single experiment that lives for the duration of the semester. This approach provides the flexibility to illustrate a substantial number of concepts while forgoing some of the more in-depth analysis typically afforded by more traditional one-day experiments. By instituting an experimental unit of currency that takes on value throughout the semester, many concepts related, but not exclusive, to income, redistribution, intertemporal substitution, and banking can be reinforced with minimal loss of lecture time due to setup and rule exposition.

Keywords *classroom experiments, fiat money, intertemporal trading*

JEL codes *A22, C90, E49*

The use of classroom experiments in economics courses is not a new phenomenon. Chamberlin (1948) is generally regarded to be the first to enact in-class market experiments. In his seminal paper, he outlines the use of playing cards to illustrate, among other concepts, the inefficiencies that arise from the information asymmetries that obtain from a decentralized market. Since then, the use of classroom games and experiments seems to have been gaining a wider reception by the economics profession. However, despite this more recent attention to alternative didactic techniques, "chalk and talk" remains the preferred choice for economics instructors (Becker and Watts 2001b). While experiments are generally praised for increasing engagement and making not only teaching but learning more fun (Kaplan and Balkenborg 2010), there seems to be substantial reticence in incorporating them on a wide scale. Reasons for such resistance from would-be adopters may vary, but three possible explanations are especially salient. First, some instructors may think that large monetary payments are required to conduct experiments (Holt 1999). Second,

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there may be substantial expositional costs. With an increasing number of experiments, time devoted to setting them up detracts from valuable lecture time. Third, more exotic instructional methods—outside chalk and talk—have not been shown to influence multiple choice test scores (Becker 1997). There is, however, mixed evidence on this last point. For example, Emerson and Taylor (2004) found that experiments raised the scores of microeconomics students on standardized tests, and Ball, Eckell, and Rojas (2006) found that computerized experiments improved overall performance on final examinations. While addressing the debate suggested by the third point is beyond the scope of this article, I contend that my suggested technique minimizes, or at least should help attenuate, the first two concerns.

While an official description of what constitutes a classroom experiment may be conspicuously absent from the education literature, I find Susan Laury's definition generous and inclusive: "A classroom game can be almost any interactive exercise that gets students involved in the economic problem that is being taught" (Laury 1999). I suggest that a direct implication of this definition is that there cannot be interactivity without student involvement. Classroom activities foster such involvement and—unlike lectures for which class notes can be reproduced—require attendance (Becker 1997). As I explain below, the original goal of this experiment was to incentivize attendance to both lecture periods and office hours. Increased attendance and student involvement may be implicit of many in-class activities, but I suspect that first and foremost, the original goal of most classroom experiments is to facilitate understanding of a particular concept. My own pedestrian characterization of the orthodox approach would be (1) the student is rewarded with entertaining games that yield particularly insightful conclusions, (2) attendance increases, and (3) the instructor is then given a chance to impart additional valuable information. In contrast, the flow of the technique I suggest is somewhat inverted from the more traditional approach. My experiment suggests a different trajectory. First, I reward the student for *successfully* attending class. Second, I find I am given a chance to impart additional information along the way. Finally, as the semester progresses and nears completion, the student (hopefully) draws particularly insightful conclusions.

Apart from these philosophical differences, my suggested technique differs—more pragmatically—from the orthodox classroom experiment in two important ways. First, the vast majority of classroom experiments are carried out in a relatively short time span, typically one or two meetings. The lifespan of the experiment I suggest here is substantially longer and can encompass the duration of the semester. There are advantages and disadvantages to this approach. A principal advantage is that it diversifies the expositional cost of the setup. This mechanism, however, sacrifices depth—that more traditional games provide—in favor of breadth. Second, most experiments are either incentivized hypothetically (within the construct of the in-class game) or carry the possibility of a small financial gain. With my experiment, I suggest incentivizing class performance itself. This approach would not be without its detractors. For example, Holt (1999, 606) argued against the use of extra-credit incentives as hypothetical payments. He cautioned that "the instructor might not want to base grade increments on trading skills or the cooperativeness of trading partners—factors that are often not related to what has been learned from the course material." His point is well taken. As I hope to crystallize below, the structure of my approach prevents any non-negligible increment to a grade that is not *directly* tied to the learning of the material. Further, associating extra-credit rewards as incentives for the game may raise important issues of fairness. The gravity of inequitable outcomes should increase with the weight of what

this extra credit would represent. Two solutions to this problem come to mind. One is to implement a system in which participation may only lead to a net benefit in the final grade but "opting out," absenteeism, or participating with poor performance should yield absolutely no deleterious impact on the final score. Given that this construct generates opportunities indistinguishable from extra-credit opportunities, a standard scale guarantees that the full possible score is available to a student who opts out of the experiment; thus, the first option is to grade on a standard scale. A second option is to grade on a distribution. If evaluation "on the curve" is imposed in conjunction with this experiment, then a grading redistribution—toward participants and away from those who opt out—could occur. In order to mitigate this redistribution issue, one could consider lowering the weight of the extra credit. As this would *prima facie* diminish the motivation to participate, I always opt for the first avenue.

Finally, based on two surveys conducted in 1995 and 2000, Becker and Watts (2000, 2001a) highlighted some anecdotal evidence of an increase in attention on the teaching of economics. They point to a surge in books which focus on specific teaching methods that include classroom experiments, such as Keenan and Maier (1995), Porter and Riley (1995), Bergstrom and Miller (1997), and Hazlett (1999). There are also a number of electronic and Web resources with examples of classroom experiments. However, there does not seem to be a substantial preponderance of classroom experiments devoted to macroeconomic concepts. Setups and rules, trading structures, and even the spirit of agent-based paradigms seem to, perhaps, lend themselves more naturally to microeconomic and financial application. This is not to say that macroeconomics is not represented in the in-class experimental field. For example, Denise Hazlett (n.d.) offers access to six macroeconomic experiments via her Web site (http://people.whitman.edu/~hazlett/econ/). However, in the well-known Web repository of experiments, *Games Economists Play*, Delemeester and Brauer (n.d.) provide a compendium of games with about 250 economics applications, out of which fewer than 15 percent are directed to macroeconomic concepts. Another famous source of in-class games is Holt's (2005) *Veconlab*—along with a companion book of games (Holt 2007)—where the representation is not so lopsided.

The title of this article suggests that this is an experiment intended only for a macroeconomics course. This might be somewhat misleading. I see the application of this long-lived experiment as non-excludable with regard to the use of more traditional, shorter-lived games. I suspect that experiment-oriented instructors could incorporate both into their teaching portfolios and run them concurrently in a given school term in a noncompeting fashion. I have only devised and applied this game in my teaching of intermediate macroeconomics and money and banking courses and so have only attempted to relate the mechanism to macroeconomic and monetary concepts. The construct of the incentive system is, however, quite generic, and one could presumably refocus on other concepts beyond those I describe below. In fact, I invite the reader to do so. While I leave for others any extensions of this experiment to other undergraduate economics courses, the basic incentive motive would certainly remain, and that alone may be enough for some.

DESIGN

Given that the experiment "lives" for the duration of the semester, and as I mentioned in the previous section, is designed to reward good performance, I have found that it has become

inextricably linked to the construct of the class throughout. Thus, I provide brief background on the structure of the course in which I use this experiment.

Mine is a typical intermediate macroeconomics or money and banking course that enrolls anywhere between 50 and 100 students, with a higher incidence on the larger number. Grading for the course is structured around the standard scale—instituted so that there is no impact to the grade of a student who opts out of the experiment—and it involves traditional exams (two midterms and one final) and anywhere between 10 to 15 unannounced pop quizzes throughout the semester. The number of exams is unimportant. Instead, the construct of the experiment centers around those unannounced quizzes. Absence from a quiz is a zero that can never be made up. However, I typically drop the lowest two quiz scores, so for example, the final composite quiz score is computed from, say, the top 8 scores out of 10 quizzes given (all of this can be varied by the instructor). Once graded, these quizzes are not given back to the student but kept by the instructor or assistant. The format is five multiple choice questions (at two points per question, the score ranges from 0 to 10), which is consistently kept throughout the semester. While the format of these quizzes is not particularly important for the experiment, a sufficient number of them should take place to foster some intertemporal trading. A priori, the weight assigned to these quizzes likely carries more importance to the successful execution of the game. Too low a weight should, in principle, lead to a diminishing of the incentive and could lead students to "not buy into it." However, I have not found an ideal rule of thumb. I typically weigh these fairly heavily (between 20 and 30 percent of the overall grade) so that the composite quiz score is at least as important to the overall grade as any given exam—including the final.

A crucial part of the discussion of a macroeconomics course at the survey, principles, or intermediate level involves explaining what money is. During the first or second class period, I announce our intent to institute a unit of currency for the classroom. The students can be invited to name this currency ("Ecobucks," "Macrodollars," etc.), or the instructor may impose the name—I call ours "Techies." The students are made aware that these Techies are earned by good performance on these pop quizzes. A popular question early on is, "How much is a Techie worth?" This allows the instructor to point out that these Techies are not backed up by anything tangible—yet—and that the whole experiment may be a nonstarter if there is no general agreement to believe the instructor's promise that they will eventually provide value. The instructor can then elaborate on issues of fiat that resonate even later in the semester. Thus, a source of income for the student is instituted by adoption of pop quizzes that pay for good performance and do not pay for bad performance or absenteeism. In this experiment, the instructor acts as the monetary authority, and thus, the sole supplier of the currency.

Another important concept is that of intertemporal lending and borrowing and risk associated with the principal-agent problem. Thus, later on in the semester, I ask for volunteers to become banks. These banks will then be issued (non-interest-bearing) loans from the monetary authority due back to the instructor at the end of the semester.

Once it becomes clear that quizzes provide a source of income, a substantial reduction in absenteeism typically follows. This facilitates the elimination of any maintenance and enforcement of attendance. The payoff is announced only at the time the quiz is given and is allowed to vary from quiz to quiz. The single source of revenue for the student is relatively good performance on these quizzes. Absolutely no make-up quizzes are allowed, so the only way for the student to earn Techies is to be there to take the quiz and to do well on it.

STRUCTURE

The design of the experiment is oriented toward enabling the unit of currency to represent both a benefit and an obligation to the student. Therefore, the structure of the game is centered around the following two functions of the Techie.

Labor Income

On any given day, students are given a pop quiz where the payoff is announced right before the quiz. Pay periods are announced on the course Web site and printed on the body of the quiz. Students are free to collect their earnings any time within the pay period, but they are asked to do so in person in the instructor's office. While specific meetings can be arranged via e-mail, most payments take place during office hours. In fact, the original intent of the exercise was to incentivize the use of office hours. And to a large extent, this has worked. Once the student is at the office to get paid, there is a higher likelihood that he or she will stay to ask questions or address concerns. As an additional externality to this incentive system, I have seen a substantial increase in the demand for office hours outside of the payment motive.

The form of currency must be durable and tangible to retain its function as a store of value. To that end, the use of the instructor's business cards seems to work well. While the possibility of counterfeit exists, transaction costs associated with such enterprises are high enough that it provides enough of a barrier to reduce these motives. I have not seen it yet.[1] Any uncollected earnings outside the deadline are forfeit for the specified period. Thus, the student must be physically present to collect his or her earnings and effectuate purchases. While income is variable (how many Techies the students receive for good performance may change from quiz to quiz), prices associated with the menu of services available to the students are fixed.

Obligations

There are two types of obligations the student has an option to incur: taxes and loans. Initially, I only used loans. Taxes were added the second semester I ran the experiment for added exposition. The mechanism of the experiment does not suffer by doing away with the tax scheme. Cancelling the loan system, however, would render the game substantially more simplified, even simplistic.

Halfway through the semester, the students are given an option to vote between two types of taxes to pay: an income or an excise tax. It is explained to them that an income tax will have redistributive purposes. I announce my intent to collect taxes from those students who have performed well thus far and redistribute them to those students who—either through low performance or absenteeism—happen not to have collected any Techies thus far. Not surprisingly, this option is widely unpopular; none of my classes so far have chosen this scheme.[2] The second option involves an excise tax on a given quiz. While most quizzes constitute a source of income for the student, I announce a tax charge for the option of taking a specific quiz. I emphasize that this quiz is optional, so the student may choose not to take it and take the zero, thus lifting the tax burden. This opens a discussion of the relationship between excise tax and luxury items.

Ex post, the students understand that they paid a tax for the luxury of taking a particularly easy quiz—typically a carbon copy of the previous quiz.

An important goal of the experiment is to introduce students to intertemporal trading. To that end, later on in the semester, I ask for volunteers from among the students who have accrued a larger number of Techies to become banks. The reason for focusing on the highest income students for this purpose is three-fold: One, banks must be "around" and visible to students who might be looking for loans, and absenteeism is likely not prevalent for this type of student. Two, high-income individuals will likely have lower utility for the type of intertemporal trading I implement, thus they would have less incentive to borrow anyway. Three, high-income individuals would have a larger buffer against which to write off bad loans. A high-income individual makes for a highly capitalized bank.

For classes of 50 to 100 students, anywhere between five and eight banks seem to work well. I have gone as low as three banks for classes below 50 students. These banks will then be issued (non-interest-bearing) loans from the monetary authority. Every bank gets the same lump sum number of Techies. Although the number is unimportant, I typically issue 20 Techies to each bank. This original injection of Techies is due back to the instructor at the end of the semester.

This setup fosters some discussion with the student banks. A risk-averse bank might just hang on to these Techies for the duration and return these Techies to the monetary authority at the end of the semester. This strategy presents no loss for the bank, but it affords no gain either. This raises the issue of "sample selectivity." This strategy is no different from not participating. Because the banks are formed by volunteering, it is implied that this strategy is not dominant for any bank (at least at the outset). Thus, the other strategy is for the bank to lend these Techies. At the end of the semester, the bank is to return the original Techies to the instructor. Any extra Techies collected as interest are profits that the bank can keep and apply as part of his or her labor income. However, returning fewer than 20 Techies carries dire consequences, such as a 7-percent reduction from the final grade for every unpaid Techie. At this point, concepts of asymmetric information can be highlighted. Banks are provided with different ideas on how to bridge this information gap to help reduce moral hazard and adverse selection issues. Some of the suggestions that have been raised in the past involve the following:

Credit rationing: The banks are encouraged not to lend too many Techies to any given student at first.

Credit rating: The banks could ask the borrower to have the faculty reveal the individual's past quiz performance to the bank.[3]

Credit gouging: The banks are encouraged not to push unusually high interest rates or stipulate extreme terms of repayment, as that can lead to an increasing pool of bad borrowers. The instructor can suggest that a bank that holds too many unpaid loans at the end of the semester was itself irresponsible and may have to share the penalties to be levied.

Explicit term contract: The banks are encouraged to present borrowers with loan terms that are simple to understand with deadlines and terms explicitly stated. For example, a simple loan contract template can be provided by the instructor during class or via the course Web site. The banks can bring these signed contracts to the instructor at the end of the semester in place of the missing Techies as proof that the bank is not at fault. In this case, the penalty is passed to the bad borrower.

DESCRIPTION OF THE PROCESS

A typical term in my current institution involves two weekly 80-minute class meetings spread over 15 weeks. Excluding a week-long spring break and two periods reserved for midterm examinations leaves 28 periods to distribute, say, 10 quizzes.[4] Table 1 shows a timeline of the evolution of the experiment for the most recent term it was conducted.[5] The bottom panel in table 1 shows how many Techies each quiz pays—which is only revealed to the students as the quiz is taken—and how many Techies are required to purchase each quiz—which, for the first half of the semester, is posted on the course Web site at least one week (often longer) prior to the "deadline-to-buy."

During the first week of the semester, the students are presented with the idea of getting paid for performance on pop quizzes. This generates many (often vocal) questions as to how much is each quiz worth, how many quizzes are to be expected, what the quizzes actually pay, etc. No specific details are given at this stage, and instead, two words are heavily emphasized: the word "experiment" and the word "optional."

I typically give the first couple of quizzes within the first 10 class periods. Deadlines to collect payment for these first quizzes are explicitly stated on the course Web site. At this stage, I also announce the prices and deadline to buy these first two quizzes.

While the idea of the payment system begins disseminating from week one, generally, the student is introduced to the actual tangible Techie when he or she comes in to collect the first payment or effectuate the first purchase. Thus, while essentially the experiment is set in motion early on, the midpoint of the semester is a good time to fully reveal the mechanism and anchor student expectations. By this time, the students have had a chance to collect some labor income, banks have been established, taxes have been announced, and the class as a whole typically begins to get quite comfortable with the monetary environment. It is at this time that a *Menu of Services* is announced and disseminated via the course Web site. This menu provides a list of options to buy quizzes and percentage increases in exams. Buying a quiz involves replacing any given score to a perfect one. For example, "buying Quiz 3 for two Techies" would involve the student physically bringing the two currency units to the instructor's office, upon which the current score is replaced by a perfect 10. While there is a much larger gain for the student to replace a zero than replacing, say, a six, the price is fixed only for purchase of a perfect score.[6] Missed quizzes, that is, zeros due to absenteeism, are not for sale. While all quizzes are equally weighted, they get progressively more expensive to buy and yield lower payouts as the semester progresses.

Within this menu of services, an announcement of what expected future earnings any of the remaining quizzes will yield is provided. This is necessary so that the students and banks can formulate better expectations of their income potential, thereby reducing risk-loving tendencies that might be unwarranted. Importantly, there are firm deadlines associated with buying most items. The staggering of these deadlines is vital in incentivizing the loaning process.

Once the menu is posted, some loans begin to take place fairly quickly. As an example, refer to the timeline described in table 1. Consider a student who has two Techies—say as of Tuesday, April 3—and had low scores on Quiz 3 and Quiz 5. The deadline to buy Quiz 3 for three Techies by April 5 is two days away, and the deadline to buy Quiz 5 for four Techies by April 19 is two weeks away. The student has two options: He or she can miss the first deadline and forgo the option to buy the cheaper Quiz 3, save the two Techies, and hope to secure two more Techies (by

TABLE 1
Sample Timeline

JAN	Thurs 19 Course begins	Tues 24	Thurs 26	Tues 31						
FEB	Thurs 7	Tues 7 *Quiz 1*	Thurs 9	Tues 14	Thurs 16	Tues 21 *Quiz 2*	Thurs 23 *Quiz 3 & 4* *DL TO BUY Q1–Q2*	Tues 28 *Quiz 5*		
MAR	Thurs 1 Midterm 1	Tues 6	Thurs 8	Tues 13 No class	Thurs 15	Tues 20	Thurs 22	Tues 27	Thurs 29	
APR	Tues 3	Thurs 5 *Quiz 6* *DL TO BUY Q3–Q4*	Tues 10	Thurs 12 *Quiz 7*	Tues 17	Thurs 19 *DL TO BUY Q5–Q7*	Tues 24	Thurs 26 Midterm 2		
MAY	Tues 1	Thurs 3 *Quiz 8 & 9*	Tues 8 *Quiz 10* *DL TO BUY Q8–Q10*							
	Quiz 1	*Quiz 2*	*Quiz 3*	*Quiz 4*	*Quiz* 5	*Quiz 6*	*Quiz 7*	*Quiz 8*	*Quiz 9*	*Quiz 10*
QUIZ PAYOUT	10 pts = 2 T 8 pts = 1T	10 pts = 2T 6 or 8 = 1T	10 pts = 3T 8 pts = 2T 6 pts = 1T	10 pts = 3T	10 or 8 = 3T 6 pts = 2T 4 pts = 1T	10 pts = 3T 8 pts = 2T 6 pts = 1T	10 pts = 2T 6 or 8 = 1T	10 pts = 5T 8 pts = 2T 6 pts = 1T	10 pts = 3T 8 pts = 2T 6 pts = 1T	10 pts = 1T
PURCHASE PRICE	2 Techies	2 Techies	3 Techies	3 Techies	4 Techies	4 Techies	4 Techies	5 Techies	5 Techies	5 Techies

Note: DL = Deadline; pts = Points; T = Techies; Q = Quiz.

earning them with a perfect score on Quiz 7 or by borrowing them from a bank)[7] to buy Quiz 5 before the second deadline of April 19. A second option is to borrow one Techie to buy Quiz 3 before the first deadline of April 5. In essence, what the student is doing is borrowing against his or her future income—that is, he or she must earn Techies on later quizzes to pay back the loan.

In addition to loans, a secondary exchange market typically ensues where Techies start getting exchanged for actual dollars. The usual suppliers of Techies are students on the opposite spectrum of the class distribution. Those students who are confident in achieving a good grade without the need to buy services might end up selling some Techies. Also, those students who will be dropping the course are happy to supply any surplus of Techies they might have. As the monetary issuer, the instructor does not enter or participate in any way. Instead, I emphasize to the class that I am not here to monitor these exchange markets but only to keep track of the total number of Techies I inject into the economy, as well as monitor lending practices by banks. Otherwise, everyone in this economy is free to transact. Transactions are motivated by two factors: the staggered sales of quizzes by the instructor and a limiting factor on the maximum benefit any student can count on. Although I have never seen this, presumably, a student who initially earns some Techies could try to abuse the system by rolling on debt—borrowing to pay off outstanding loan debts and iterating the process. Banks might prevent much of this practice through the mechanisms suggested above. Even in the presence of irresponsible banks, this is avoided by instituting what amounts to a transversality condition. The students are made aware that there is a final deadline in which to make purchases (typically the last day of class but prior to the final exam period). Thus, at the end of the semester there are either no Techies floating around (they are all back with the instructor through purchases of the benefits outlined in the menu of services), or whatever Techies remain provide no value past the final day of classes.

SUMMARY OF LEARNING OUTCOMES

This section outlines some of the more successful discussion points the experiment has yielded. I present these in a rough chronological order of initial exposition to the student. However, some of these concepts continue to be refined and elicit ongoing elaboration throughout the semester.

Fiat Money

I first propose the experiment to the class within the first couple of periods. After declining to elaborate on any of the details of the payment structure, I simply suggest to the students that the Techie system may provide value to them but that opting out is perfectly permissible and will have absolutely no deleterious effect on their grades. I mention that there is historical evidence of some students choosing not to participate.[8] This allows me to point out that the success or failure of the experiment lies solely on whether a substantial portion of the class chooses to participate. Absent any valuation or pegging, participation ultimately relies on an implicit trust on the instructor's promise. Without this "leap of faith," the Techie system cannot get off the ground, and it renders the experiment a nonstarter. In essence, the monetary economy is not instituted without enough students "buying into it."

This trust runs on an individual level; the students individually trust the instructor. However, as the semester progresses and the payment system begins to be revealed, an implicit agreement

among students that these Techies are desirable begins to take place as well. Students begin demanding Techies, not only on the instructor guarantee, but also on the belief that other students will value them as well—a point that is typically raised by the students themselves a bit later on in the course, especially as trading begins to unfold.

At the end of the semester, the students are asked to anonymously opine whether these Techies exist as a medium of exchange, as a payment system, or as a unit of currency that begins on a promise from the issuer. They overwhelmingly conclude "all of the above."

Excise versus Income Taxes

As previously mentioned, the students are given an option to choose incurring an excise tax or an income tax. The difference between the two fosters some discussion of the redistributive characteristic of taxes. To date, my students have never chosen the income tax. Some have argued that college-age students may favor progressive taxation for the purposes of redistribution and that presumably people believe in a "safety net" for those less fortunate in an economy. Parallels could be discussed on the premise that some students may have more natural ability to perform well in economics courses than others. This can promote a dialogue on the merits of income redistribution and how equitable it would be to enact grade redistribution. Anecdotally, some students have pointed out in the past that there is no contest between the two options, given that the choice is between a tax on a single quiz—which can actually be voluntary as the student could choose to take the zero and not pay the tax—and a mandatory tax imposed on a potentially larger number of quizzes. Having finished the semester, one particularly alert student once suggested that given the few number of grade categories available, most grade redistributions would necessarily be too high a tax burden:

> If in order to see another student raise his D to a C, I have to give up my A for a B, wouldn't it be like bringing a rich person into low-middle class in order to get someone else above the poverty line? (Anonymous student)

While one might consider this complaint representative of the majority of the student population, it could be possible that those students who may see their grades reduced through redistribution might be more outspoken than those who may stand to gain from this tax scheme.

Transversality Conditions

As mentioned previously, an exchange system of Techies for actual dollars (unmonitored by the instructor) typically ensues as the students begin internalizing the experiment more and more—especially after I post the *Menu of Services*. Most semesters, typically during an office visit, I invariably get at least one student who confides that he or she has figured out what the equilibrium exchange rate in this secondary market is (e.g., last term at least two students traded one Techie for $5 as of three weeks from the last day of classes). Generally, what is meant is the rate that particular student traded at last.

Toward the end of the semester as we discuss the concept of financial bubbles, I pose a question to the students: "Given that we seem to have established these Techies to be in high demand and that they seem to become more and more desirable as the semester progresses, under what conditions could we have a Techie bubble?" In principle, even for those students who

feel they have secured a top grade, demand for Techies could be sustained by an increasingly favorable exchange rate. This question fosters discussion that the mere fact that the instructor imposes a final date, beyond which Techies do not provide value, ensures that the exchange rate cannot increase indefinitely. It also precludes students from continually taking on more debt to pay off previous outstanding loans. Thus, at the end of the semester, either no Techies remain in the economy, or any Techies leftover cannot be used to purchase any benefit. Students generally reach the conclusion that the possibility for grades to be revised upward beyond the end of the semester could bring about a Techie bubble.

The vast majority of Techies return to the instructor.[9] An interesting extension would be to relax this transversality condition and allow for trading to take place during interim periods and across subsequent semesters.

CONCLUSION

This article suggests a single experiment to be carried out over the length of a semester in which a source of income for the student is instituted by adoption of pop quizzes that pay for good performance and do not pay for bad performance or absenteeism. This approach provides the flexibility to illustrate a substantial number of concepts while forgoing some of the more in-depth analysis typically afforded by more traditional one-day experiments. There are a number of advantages to this approach. First, the length of the experiment allows for a diversification of the setup and exposition throughout the term, thereby significantly reducing loss of lecture time. Second, by instituting an experimental unit of currency that takes on value throughout the semester, many concepts related, but not exclusive, to income, redistribution, intertemporal substitution, and banking can be reinforced. Third, in more traditional experiments (as in a trading pit game), the incentives system can be divorced from understanding the material, so that, for example, students particularly adept at trading can be rewarded for their skill independently of their command of the material. My incentive system here is more directly congruent with understanding of the topics of the course, at least those that are covered by the quizzes. Finally, I find that the concept of a Techie runs so naturally with the content of the course that it provides a nice anchor for the students throughout the semester. A popular comment is that their conceptual understanding of the Techie evolves over the semester.

While quantification of the effects of this experiment on standardized tests inside and outside of the course is left for future work, data collection is under way. I have had numerous suggestions from students and colleagues on possible extensions from the introduction of lotteries, computerization and turning the Techies into e-money, to even the setting up of options to bet on the likelihood a quiz is given a certain day. An extension I am currently considering is to accept Techies issued in previous semesters as payment in the current term.[10] Other interesting future work could involve the adoption of this experiment for different sections of undergraduate macroeconomics courses within a department and allow the trade to take place across classrooms. That would necessarily entail a more direct intervention in, and monitoring of, the exchange market, from the instructors involved.

While some suggestions are interesting and many are problematic, in my experience, the level of student investment has certainly increased since the experiment's inception. I constantly hear the term Techie bandied about. Even as I step into the classroom and while I am setting up, I often

hear students talking to each other about how many Techies they got on the last quiz, what they plan to buy, speculating on what the next one will pay, and so on. Everyone may get something a bit different from the Techie experience, but I take it as a good sign that it seems to ubiquitously become part of the lexicon within my student population.

NOTES

1. While the instructor may not monitor the flow of trade of these Techies from student to student, it is relatively simple to keep track of the total amount of Techies he or she issues. This basic monitoring makes it more difficult for students to introduce a meaningful amount of counterfeit.
2. It has been suggested that many college-age students may favor progressive taxes that clearly redistribute wealth, and thus, the negative student response to this proposition that I consistently experience would seem counterintuitive. I conjecture that while student aversion to the redistributive purposes of an income tax is likely variable across the student body, an actual redistribution of the grade is likely perceived as too high a tax burden.
3. This option can be raised by the instructor for expositional purposes only. Implementation may be legally problematic and not recommended as it may not be allowed in some universities' bylaws.
4. At times, I favor giving two quizzes on the same day (one in the beginning and one at the end of the period). I also tend to pool more quizzes in the second part of the semester. These are entirely preferential and in no way are essential to the construct of the experiment. As mentioned earlier, both the number of quizzes given and their timing can be varied by the instructor. So long as there are enough quizzes given and staggered deadlines-to-purchase that are explicitly communicated to students, the intertemporal condition that fosters trade is motivated by the experiment.
5. This table is, of course, never shown to the students.
6. The instructor could sell "partial" increases in a given assignment rather than selling a perfect quiz score. This might have some implications for pricing and might alter some borrowing behaviors, but it would not ultimately change the spirit of the exercise.
7. He or she could also earn one Techie with a six or an eight score on Quiz 7 and borrow one Techie from a bank.
8. In the last term the experiment was conducted, 98 percent of the students who finished the semester collected Techies at least once, and 83 percent made at least one purchase. These participation rates are calculated out of the total number of students successfully enrolled by semester's end. It excludes those students who drop the course within the university-mandated deadline as well as any student who remains enrolled but had unexcused absences in at least two of the three exams.
9. Over the past five times I ran the experiment, an average of 96 percent of the Techies issued—including the injections to banks—found their way back to me by the end of the semester.
10. This would then support an exchange rate system that "lives" beyond the end of the semester with implications for institutional aspects of currency, long-term speculation, and bubbles.

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