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Coverage of the Services, Information Technology, and Digital Industries in Principles of Microeconomics Courses

Supply-side examples in principles of microeconomics textbooks typically involve manufacturing processes. While these examples may adequately establish the market structure and model in question, they often lack relevance in today's economy and students' future careers. The focus on manufacturing presents an opportunity to incorporate examples from other industries such as services and information technology. While these industries are typically saved for advanced economics courses, relevant examples are essential in principles courses that are many students' only formal exposure to economics. We review the coverage of industries in principles of microeconomics textbooks and offer ideas for incorporating updated industries into course materials.

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We dedicate this paper to the late Robert Exley "Bobby" McCormick (1946-2023) who provided comments on the initial outline of this paper and encouraged us to pursue this line of inquiry. We thank the Editor, Brian O'Roark, and two anonymous reviewers for their feedback and guidance. Finally, we thank Daniel K. Benjamin, for whom we were teaching assistants while in graduate school at Clemson University in the early 2000s, for inspiring us to always strive for excellence in teaching, to treat our students as paying customers, and to take their feedback seriously.

1. Introduction

Much of the content covered in introductory microeconomics courses has barely evolved in over a generation. Courses typically begin by introducing the discipline of economics and its methods, covering demand, supply and equilibrium, then the efficiency and/or equity implications from policies that deviate from that equilibrium. Most instructors then spend time discussing marginal costs of production, the short-run and long-run supply curves, the profit condition, and market structures. We have generally followed this approach in our courses, but have noticed a new pattern in the feedback we receive from students. Here are some examples:

> "I enjoyed this class but all the examples come from manufacturing. Most of us will go into other industries like tech or consulting. You should incorporate more of those examples."

> "The concepts were interesting, but the examples and applications were just plain silly. Why should I care about the production of widgets and gadgets?"

On day one of principles courses, many professors describe the purpose of economic models. In our case, we present four desirable properties of these models. They are: 1) simple, 2) general, 3) useful in predicting or understanding behavior, and 4) testable. While assumptions play a role in all four properties, we focus mainly on the first – the simplicity of models. Specifically, models should be as simple as possible to address the question at hand. Consider the following question that could be raised in a principles of microeconomics class after the basic demand and supply model is introduced:

> All else constant, what would we expect to happen to the equilibrium price and quantity (up or down) in the market for unleaded gasoline in the state of Texas if a hurricane destroys a significant number of oil refineries in the Gulf of Mexico?

This question is relatively simple and can be answered using a basic demand and supply model by shifting the supply curve to the left (a decrease in supply), revealing an increase in equilibrium price and a decrease in equilibrium quantity. Even though several of the assumptions of the model do not apply to the industry posed in the question (see Levin et al., 2022), the model can still be applied to the question at hand. The simplicity of our model does not limit the example underlying the presentation of the model, but rather it limits the complexity of the questions that the model can address. As our questions become more complicated, so do our models. Advanced economics courses, such as industrial organization, allow us to answer more complicated and interesting questions. Earlier courses in the economics curriculum, however, should not be limited to the applications of their more simplified models, and the examples illustrating these models should be relevant to today's economy.

We wonder if, whether due to tradition or a desire for simplicity, we have ignored opportunities to expand the models to include more topical and relevant examples. These examples might require a small expansion of the most basic model but would benefit the students by expanding their ability to see economics in their worlds and to apply its toolkit more broadly. This is particularly important in principles of economics courses since for many students (e.g., non-economics majors), principles will be their only exposure to the subject. Students should leave these courses with a firm understanding of economic principles and how these principles apply to the real and modern world. Particular voids in introductory microeconomics classes seem to be services (especially consulting, marketing, finance, and accounting) and the information technology industries. In the period from 2005-2022, manufacturing decreased from 13% to 11.1% of US GDP, while professional and business services increased from 11.1 to 13.1% of GDP, and information increased from 5.0 to 5.5% (U.S. Bureau of Economic Analysis,

2023a, U.S. Bureau of Economic Analysis, 2023b, U.S. Bureau of Economic Analysis, 2023c). As many students show an interest and expect to work in these service sectors, and as these sectors gain a larger share of our national production, they should be more represented in the classroom.

In the next section, we survey the examples in principles textbooks and support the idea that these growing industries are generally absent from the standard set of examples. The following section adds some suggestions on how to add IT and services industries to introductory courses.

2. Supply-side Examples in Principles Textbooks

We begin by reviewing supply-side examples that are presented in principles of microeconomics textbooks. Madsen (2013) conducted a similar review of the coverage of the financial crisis in principles of macroeconomics textbooks. More recently, Ihrig and Wolla (2020) demonstrate significant variation in how principles texts treat the way the Federal Reserve implements monetary policy.

We include all textbooks by major publishers (Cengage, Pearson, McGraw Hill, and McMillan) with a publication date of 2021 or later. We also include *CoreEcon,* a free online textbook and teaching resource, and Mateer and Coppock (2023). There are many differences among the 14 textbooks in our list: some include more real-world applications, others have a single example that they follow through the entire text, and others have a strong applied economics focus describing recent research and frontiers of the discipline. Most of the textbooks have robust online tools that support the textbook, but we did not review that content.

We narrow our review to industry and company coverage starting in chapters that cover producers - typically starting with the production function, short-run cost curves, long-run cost curves, and market power. However, we do comment below on relevant examples covered in other chapters.

Table 1: Coverage of Industries in Principles of Microeconomics Textbooks

14 Textbooks Sampled

	Worked-out Examples					Other In-text Examples				
	Traditional Manufacturing and Natural Resources	Services	Tech	Retail	Other	Traditional Manufacturing and Natural Resources	Services	Tech	Retail	Other
Production Function and Short-Run Cost Curves	9 (69%)	2 (15%)	0 (0%)	1 (8%)	1 (8%)	13 (62%)	3 (14%)	3 (14%)	0 (0%)	2 (10%)
Long-Run Cost Curves and Economies of Scale	5 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	11 (55%)	1 (5%)	5 (25%)	0 (0%)	3 (15%)
Competitive Supply	7 (78%)	0 (0%)	2 (22%)	0 (0%)	0 (0%)	17 (63%)	7 (26%)	2 (7%)	1 (4%)	0 (0%)
Monopoly and Market Power	2 (50%)	2 (50%)	0 (0%)	0 (0%)	0 (0%)	10 (30%)	6 (18%)	12 (36%)	2 (6%)	3 (9%)
Natural Monopoly	0	0	0	0	0	0 (0%)	3 (30%)	3 (30%)	0 (0%)	4 (40%)
Price Discrimination	1 (20%)	2 (40%)	0 (0%)	0 (0%)	2 (40%)	4 (15%)	9 (35%)	2 (8%)	4 (15%)	7 (27%)
Monopolistic Competition	2 (67%)	1 (33%)	(0%)	(0%)	(0%)	5 (21%)	4 (17%)	6 (25%)	7 (29%)	2 (8%)
Oligopoly	3 (50%)	1 (17%)	2 (33%)	(0%)	(0%)	25 (60%)	3 (7%)	10 (24%)	2 (5%)	2 (5%)

Note: Percentages are based on row (not column) totals within each concept and category of coverage.

The left column of Table 1 lists the key concepts (typically broken into chapters or sections of chapters) for which we identify examples that are incorporated into the text. In reviewing the written text of each concept, we identify three types (or levels) of approaches that the authors used to incorporate the examples into the discussion of each concept:

1. Examples used to build models. These are summarized as 'worked-out examples' in Table 1 and listed in bold in Online Appendix Table 1. When introducing the concept of a production function, for example, a text may list numerical input and output values of an example good being produced in a factory, and then plot those values in a graph.

2. Discussions of other examples in the main text. After establishing the basic model, authors may discuss industries or companies that satisfy a particular market structure to help further illustrate the model.

3. Textbox examples outside the main text/discussion. Authors will often utilize stand-alone textboxes outside the main text to illustrate concepts.

We initially excluded simple lists in the text. Many texts provide lists of industries that meet various market structures (e.g., perfect competition, monopoly, oligopoly, monopolistic competition). To be included in our table, the example was initially meant to be integrated into a discussion. The reason was that including simple lists would clutter our review and that they fall outside the scope of what this paper encourages, which is for instructors to directly incorporate real-world and relevant examples into the discussions of economic concepts. However, in some of the textbooks, the discussion of the models itself was based on a generic item (either something like 'widgets' or 'quantity produced'), so we expanded the table to include listed items.

Table 1 shows that in each topic, except for price discrimination, at least half of the worked-out examples come from traditional manufacturing and natural resources. In other in-text examples, more examples are drawn from services and technology industries, but traditional processes still dominate the examples in the discussions of production processes and competitive markets. For a more detailed listing of the examples used in the books, please see Online Appendix Table 1.

The main takeaways of our review are highlighted by two stand-alone textboxes found in Mankiw's (2023) textbook. This textbook has been regarded as one of the most dominant players in the principles of economics textbook market for over 20 years (Madsen, 2013). In the introductory chapter (Chapter 1) of the 10th Edition (2023), "Ten Principles of Economics" there is a stand-alone textbox with the Netflix logo with the following caption: "Many movie streaming services set the marginal cost of a movie equal to zero". However, there is no further explanation of this statement in the chapter and no presentation of the concept of zero marginal cost pricing in the remainder of the entire textbook.[1] In Chapter 2 ("Thinking Like an Economist"), there is an *In the News* article from the New York Times, "Why Tech Companies Hire Economists", but very little coverage in the text on how to apply microeconomic concepts to the tech industry. These two discussions of the tech industry in Mankiw's text exemplify many of our findings from other texts. That is, updated examples from the modern economy seem to be afterthoughts and detached from the central discussion of the text. When using examples to develop models, we find that textbooks rely mostly on simplified manufacturing processes.

There are some notable exceptions. The most significant coverage of these questions is in Chapter 16 of Cowen and Tabarrok's *Modern Principles of Microeconomics,* 5th edition (2021). In this chapter, the authors discuss platform service providers, such as Facebook, Amazon, Google, Visa, and Uber, and the role they play in competing "for the market," instead of "in the market." They also discuss why the prevailing product is not necessarily the best one, how music is a network good, and why these platform services may give away goods for 'free'. There are also some parallels between their coverage of Uber's services and our gig economy example below. Section 13.5 of Krugman and Wells (2021) discusses the role of market power in stifling innovation and expanding dominance into new products and the importance of monopsonistic power in retailing, as when Amazon or Apple lowers the amount they pay sellers who distribute

[1] Indeed, the statement itself is vague. First, it is the streaming of a movie that has zero marginal cost (not the production of the movie itself). Second, it is not clear what is meant by "set" the marginal cost of a movie. Marginal cost is not "set" by the firm, rather it is a function of the cost of production.

on their platform.[2] Finally, Mateer and Coppock (2023) stand out from the other textbooks for its long and rich set of examples in every chapter, and many of these examples are drawn from those industries that are typically underrepresented. Thus, there are some exceptions to the general argument of our paper, and some textbooks do mention the industries and models that we discuss further below. However, none of the textbooks we examined goes into the level of detail we do by integrating the updated examples directly into the presentation of the models and standard content of a principles course.

3. Ideas on How to Integrate Services and I.T. Industries into Principles of Microeconomics Courses

In this section, we offer some suggestions of example firms and industries to incorporate into the development of models that are presented in principles of microeconomic courses. After each example, we offer some discussion prompts that can serve as short answer questions on exams or class/group discussions. Several of these prompts are designed to extend the example presented and to get students to think of additional applications of the models.

Short-Run Cost Curves in a Competitive Market

The short-run cost curve structure of a firm in perfect competition with U-shaped average costs is typically presented by working through a production function with one variable input (usually labor) and other fixed inputs (usually capital). The production function exhibits the property of diminishing marginal product and inputs are multiplied by a hypothetical price to calculate the following variables for incremental increases in output: quantity (output), fixed cost, variable cost, total cost, average fixed cost, average variable cost, average total cost, and marginal cost. Typically, a hypothetical short-run manufacturing process is used to establish the properties of these cost curves – for example, the cookie factory that produces an output of cookies per hour in Mankiw's text in Chapter 13. While the presentation of a simplified manufacturing process seems appropriate as a first step, we find that students are receptive to a follow-up application from the services industry (financial or consulting) – an industry that many students pursue in their future careers.

Consider a simplified example of an economic consulting firm producing reports for clients. In these reports, there are many charts based on economic and statistical analyses. For this exercise, we have students think about the short-run cost curve properties for producing the charts – specifically the number of charts the firm can produce per day.[3] To produce more charts in a given day, the firm must employ more research assistants - for example, part-time economics students at a local university who can input data into spreadsheets, manage datasets, crunch numbers, and format the charts. This labor is the variable input in the short run. Fixed inputs include office space, IT infrastructure, other capital inputs, and salaried staff such as the project managers overseeing the production of the charts. In the short-run, the production function must exhibit diminishing marginal product and the cost curves must have the usual U-shaped properties with marginal cost intersecting the minimum of both average variable and average total costs. Table 2 shows cost data for this consulting firm.

[2] Section 14.1 of Stevenson and Wolfers (2023) cleverly covers all market structures within a range of more to less market power, not as the usual four discrete structures. By presenting it this way, the authors place a lot of importance on how all markets exist somewhere within the spectrum, from no market power to full market power, and that real situations can be placed on that spectrum even if they do not fit the definition of a monopoly, oligopoly, perfect competition, or monopolistic competition.

[3] At this point, we reemphasize the use of assumptions in keeping the model as simple as possible. Here, we assume that each chart is equal in terms of quality and the rigor required to produce each chart.

Table 2: Measures of Costs for an Economic Consulting Firm

Quantity (Charts per day)	Fixed Cost ($)	Variable Cost ($)	Total Cost ($)	Marginal Cost ($)	Average Fixed Cost ($)	Average Variable Cost ($)	Average Total Cost ($)
0	150	0	150	--	--	--	--
1	150	50	200	50	150.00	50.00	200.00
2	150	90	240	40	75.00	45.00	120.00
3	150	124	274	34	50.00	41.33	91.33
4	150	154	304	30	37.50	38.50	76.00
5	150	188	338	34	30.00	37.60	67.60
6	150	230	380	42	25.00	38.33	63.33
7	150	283	433	53	21.43	40.43	61.86
8	150	351	501	68	18.75	43.88	62.63
9	150	438	588	87	16.67	48.67	65.33
10	150	547	697	109	15.00	54.70	69.70
11	150	682	832	135	13.64	62.00	75.64
12	150	850	1000	168	12.50	70.83	83.33

In the long-run, of course, all costs become variable. Our hypothetical consulting firm can purchase or lease bigger office space, hire more project managers, and make more capital investments. Although the consulting firm application is simplified[4], this exercise helps students understand that output decisions faced by office managers in the services industry are like those in manufacturing.

Discussion Questions and Extensions:

- Consider consulting firms that face short-run costs similar to those presented in Table 2. How would the adaptation of remote work by consulting firms – especially during/after the COVID-19 pandemic – impact the firm's fixed, variable, and marginal costs? **Comment**: Office space is likely less of a binding constraint in the short run as many companies move to a work-at-home or hybrid environment. This may allow the firm to employ additional labor (the variable input) more easily in the short run, possibly delaying the onset of diminishing marginal returns as output increases. Moreover, if the firm reduces (or eliminates) office space, this is reflected as a reduction in fixed costs for any given short-run time period (i.e., a day in the example above).

- In Table 2 above, what is an explanation for why marginal cost first decreases at low levels of production before it rises? **Comment**: This is a challenging question, especially for a principles-level class, but we think it's a worthwhile discussion. As the firm increases output from two to three charts per day, this can allow for the specialization of tasks of the research assistants (the variable input). For example, one research assistant can specialize in data entry, while another on formatting the charts. Eventually, however,

[4] Arguably, it is not any more simplified than the manufacturing counterpart example.

the marginal cost must rise due to diminishing marginal product.

- Describe a short-run production process of a business in today's economy that exhibits the standard U-shaped cost curves. What inputs are fixed and what are variable? What is the short-run time horizon in consideration? **Comment**: This question is open-ended with endless possibilities. Answers can range from part-time summer gigs (e.g., mowing lawns) to a production process in a larger firm. The key is for students to carefully consider variable and fixed inputs and how they are appropriately allocated given the time-horizon in question.

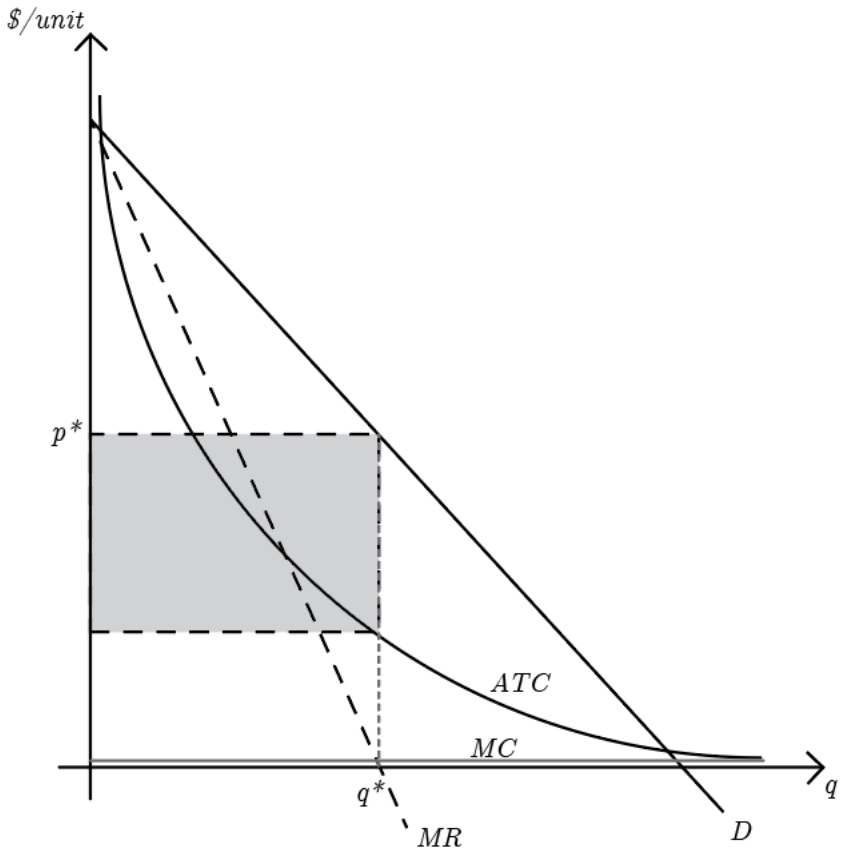
Zero Marginal Cost Pricing

Of the recommendations presented in this section, we assert that zero marginal cost pricing is the most straightforward and obvious opportunity for instructors to apply a modern market that is familiar to all students. Varian (2003) and Shapiro and Varian (1999) discuss the production of digital content and how it can be considered a natural monopoly due to the extremely high fixed costs and zero marginal cost. However, the application of digital content and streaming does not necessarily have to be in the context of natural monopoly. If the instructor prefers, it can be integrated directly into coverage of the general monopoly model or monopolistic competition. Indeed, streaming platforms are granted monopoly power for certain content (e.g., movies and series that are exclusive to a particular streaming company) via copyright laws. From a more broadly defined market perspective, however, streaming companies do face competition (making the discussion relevant to monopolistic competition). Regardless, any large streaming company, such as Netflix, has some element of market power and faces a downward-sloping demand curve.

In our review of principles textbooks, we find that proper treatment of zero marginal cost pricing is lacking. Pricing models for streaming platforms (such as the Netflix example in Mankiw discussed in the section above) are, at best, treated as stand-alone discussions with little application to an actual pricing model. Figure 1 shows the standard textbook treatment of a monopolist in the short run but with zero marginal cost.[5]

[5] This graph was not found in any of the texts in our review, which is why it is offered in this paper.

Figure 1



The quantity of subscribers is shown along the X-axis. Profit maximization occurs where marginal revenue is equal to marginal cost. The profit-maximizing quantity and price are shown at q* and p*, respectively. Students need to note that this occurs at the unit-elastic point on the linear demand curve. Raising prices above the unit elastic point (where marginal revenue is positive, above marginal cost, and demand is elastic) will lower revenue and profits. This should follow intuition from the graph since each additional subscriber lowers marginal revenue but has no impact on marginal cost.

We often introduce this topic (before showing the graph in Figure 1) by posing the following question: What would happen to Netflix's revenues if they raise the price of subscriptions? Most students will say "Revenues will rise, of course." After working through the graphical analysis above, students will understand that the answer depends on the elasticity of demand that the firm faces at current prices. This provides more substantive context to the article cited in Mankiw's Chapter 2: "Why Tech Companies Hire Economists". While demand elasticity estimation is usually outside the scope of a principles course, an overview of how future courses, such as econometrics, will build upon and apply the skills that are established in principles is provided. Many students who choose to take these future courses get excited about building upon the applications presented here.

Discussion Questions and Extensions:

- Ava is a YouTube content creator. She uploads videos and conducts livestreams about her travels and daily life. YouTube creators may allow for "channel memberships" where subscribers pay for premium features like members-only videos, loyalty badges, and chats that are highlighted during livestreams. YouTube allows the channel creator to select the monthly membership price.[6] Ava is considering raising the monthly price her members pay from $9.99 to $14.99 per month. What microeconomic factors determine if this is a good idea for Ava? **Comment**: Like the Netflix question above, the answer depends on the elasticity of demand at current prices. If Ava collected data the last time she raised the price, she could note if monthly revenue went up or down. If revenue went up, then there's evidence she was pricing on the inelastic portion of the demand curve (ignoring a shift in demand). Another consideration is whether the marginal cost of an additional member is truly zero when accounting for Ava's opportunity cost of time. Some creators, for example, may spend extra time responding to comments and messages from their members.

- Under what condition is short-run profit maximization equivalent to short-run revenue maximization? **Comment**: These two are equivalent when the marginal cost is zero and constant as represented in Figure 1.

Independent Contracting (Gig Economy)

Although the markets for factors of production are introduced in some textbooks, not all instructors cover it in an introductory course. The factor of production most often covered is the labor market. The labor market is interesting and complex enough that most universities offer an upper-level course devoted to it, being too complicated to cover fairly in a few lectures. Also, many workers do not face marginal hourly options in the labor market; they typically agree to a salary based on an expected set of tasks to be completed, with their marginal product of labor being hard to measure. Others, even when paid hourly, agree to a set number of hours and have their schedule set by their employer.

Independent contracting—where workers can choose how many hours to work, when, and how—creates a new opportunity to derive a supply curve for labor. In this labor market, the worker's choices are made on the margin of every work assignment accepted, and students are typically familiar with many of the technological improvements making the content very accessible, both as buyers and sellers. Independent contracting work is very popular—14% of workers in California report these earnings (Bernhardt et al. 2022)—and some students in the classroom will likely have personal experiences that they can bring to the conversation. Although the BLS does not have a measure of a 'gig', they added a contingent worker supplement to their reports to better understand flexible work arrangements (BLS, 2019).

Recent technological improvements in independent contracting, largely seen in apps like Uber, Lyft, or Doordash, create connections between buyers (those in need of rides or delivery services) and sellers (those willing to provide rides or make deliveries). The gains from trade created by these technologies are arguably immense. In the past, there may have been many potential buyers in these markets and many individuals willing to sell the services, but without a way to connect them, all that potential welfare was lost. The new technologies ease the connection between the two parties, all while taking their cut, but also improve the welfare of both parties.

[6] For information about YouTube memberships and their features see here. For current YouTube membership pricing levels see here.

Students may first be led to consider the choice of the potential sellers in this market. In most labor markets, workers must sign up for a minimum number of hours a week worked on a schedule determined by their employer. Thus, there is no clearly defined upward-sloping individual supply curve, and the worker chooses between limited possible leisure and consumption combinations. With the entry of easy access to independent contracting, individuals who might be willing to drive for a few hours a week if they have the time available may now choose to work, and they may choose to stop at any time. On the other hand, the earnings are less predictable. Without experience or knowledge of the market, new independent contractors have little knowledge of what their earnings might be, even if guaranteed a floor. Over time, however, knowledge of the market and the technology can allow a worker to get a more informed sense not only of the expected earnings, but of how these might vary within a day, throughout the week, and depending on the location in the city.[7]

Figure 2

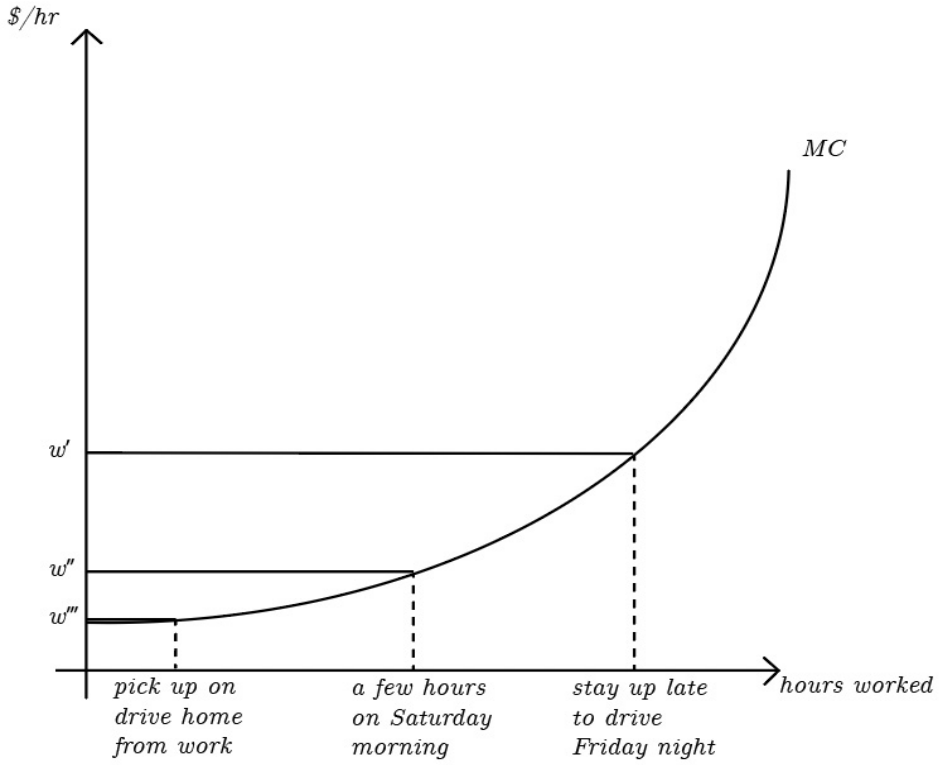
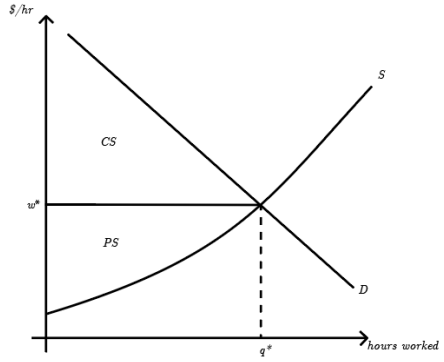


Figure 2 shows the marginal cost curve of an individual who has been working as an independent contractor transporting passengers using one of these services. Over the last few months, John has driven for a couple of hours a week. He often finds it easy to pick up a passenger on the way home from work who is heading in the same direction. He usually does not mind driving around on a Saturday or Sunday morning. He has noticed that driving people home on Friday nights after sporting events and concerts can be easy due to the convenience of the location and availability of riders. He uses this information to predict expected earnings based on the time of day and the day of week.

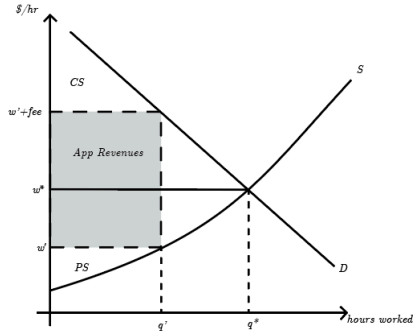
[7] Many discussion boards and online platforms teach workers how to use the system and its technology to maximize earnings.

He can use this info to estimate expected earnings, and he can decide, based on the expected earnings in each period, whether to work. He can then match those expected earnings to his willingness to work. Students can then estimate a supply curve. The first activity in this conversation is to guide students through estimating an individual supply curve for labor on these apps based on the expected earnings on the apps. First, students can simplify the situation to one where they pay a single fixed price. At such a price, they can trace out their willingness to work as the hourly wage increases.[8]

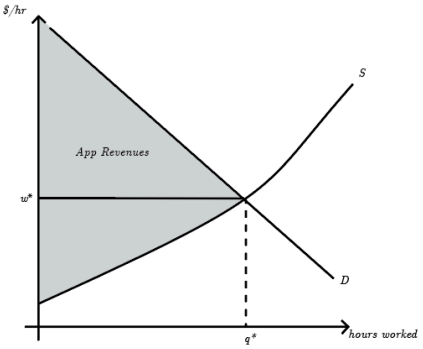
Figure 3



Panel A: Market for Rideshares with no frictions and perfect information



Panel B: Market for Rideshares with App connecting buyers and sellers for a fee



Panel C: Market for Rideshares where App can perfectly Price Discriminate

[8] If the course has discussed the horizontal summation of individual MC curves into a market S curve, then that additional step could be added.

This is also an opportunity to examine the market for ride shares and price discrimination, as shown in Figure 3. Panel A shows an unrealistic but simple market for ride shares where all buyers and sellers have complete information and there are no obstacles to making trades. In this world, buyers and sellers will easily and freely connect, an efficient number of rides will take place, and there is no market for a third party to ease trade by better connecting buyers and sellers. We all know that the market for rides isn't frictionless; it is difficult for interested sellers to find buyers and vice versa, without some information-collecting and connection-generating mechanism. The number of trades that take place without this third party is 0, and the entire space of potential consumer surplus (CS) and producer surplus (PS) is a foregone opportunity.

Panel B shows an app entering this market to connect buyers and sellers. This arbitrageur will only participate in the market when they can make a profit by collecting a fee from every connection. The buyer pays more than the seller receives, and the app's profit is that difference. However, that fee makes the price the buyer pays greater than the marginal cost of producing that ride, discouraging production below the socially optimal amount. The maximum amount of CS and PS from the ideal market in Panel A cannot be attained, but there are more gains from trade in this space than in a world where these trades cannot take place at all.

But the situation becomes more interesting. The app can use this information to price discriminate and absorb a lot of the riders' consumer surplus. By learning from their past choices, the app can see how different users respond as they raise the price. They learn that some riders are not very responsive to prices and charge them higher prices for the rides. They also adjust these prices to the time and location to extract more surplus from the riders. Given enough information and practice, the app could ultimately extract nearly the riders' full willingness to pay. As there is no opportunity for resale in this space, the app can perfectly price discriminate and charge a different price to each rider in each situation.

The app can extract the producer surplus from the drivers in the same way. Instead of paying a set wage for any driving time, the app can vary how much it offers drivers. The app can adjust how much it offers based on the time, distance, location, and demand in the market. The app can also use information on the drivers' previous behavior. Some drivers (often called ants) are known to the app to always accept any ride. Over time, the amount that these drivers get offered for rides falls as they are perceived to be willing to accept even very low pay. Other drivers (cherry-pickers) are known to the app to be more selective, and as a result, are rewarded with higher pay. By using this form of wage discrimination, the app can absorb an increasing proportion of the gains from trade. Such a situation is shown in Panel C. The app's ability to perfectly price discriminate means that it can extract all the consumer and producer surplus. Despite this lowering the welfare of the traders, it is a social improvement as the gains from trade in Panel C (though fully transferred to the app) are higher than those in Panel B.

One way to integrate the idea of a gig economy in a principles course is to use an extended example throughout an entire semester. John, described above, can be modeled first as an example of increasing marginal costs, and how these increasing marginal costs define his supply curve of labor. Students can then trace John's labor supply in response to increases in demand, and how the higher earnings encourage his increased participation by moving along the supply curve. The welfare implications of dynamic pricing can be examined: more drivers joining the market when prices rise to generate a more efficient outcome than the shortage created when prices cannot adjust. Finally, the topic can be revisited in the context of price discrimination as described above.

Discussion Questions and Extensions:

- Consider the market for ride-sharing. How much would the app have to earn to

participate as a driver in this space? How much more would they have to offer you to work more hours? What hourly pay would induce you into full-time work as a driver? **Comment:** Students can work in groups to graph their responsiveness to potential earnings in a ride-sharing market. Students can compare how differently-shaped supply curves describe different individuals' varying responsiveness to price. After each student traces their supply curve, the group can horizontally sum their supply curves.

- How does the equilibrium price and quantity of ride shares respond to demand shifters? The local hockey team is playing a big game tonight. What should happen to the price and number of rides when the game ends? **Comment**: Students can examine how different potential riders might respond to the price change, with some being willing to drive, walk, or wait, while others are happy to pay the higher price. Students can also examine the response of drivers to a higher equilibrium price by examining examples such as John in Figure 2, or their supply curves from the previous problem.

- Onboarding drivers is a fixed cost to ride-sharing apps. Suppose Uber is trying to recruit more drivers. They are promising to any driver that completes at least 50 rides, minimum guaranteed earnings of $1200. For example: if you drive 50 rides and those rides pay, say $10 each, with $2 each in tips, you'd earn $600. Uber is promising to pay you the extra $600 when you complete that 50th ride, to reach that $1200 guarantee. How will the drivers respond? Would this investment be worth it for the app? **Comment:** This example could be a better fit for more advanced students, as the information is best expressed using a budget constraint. Students might want to consider why the app is willing to engage in these guaranteed earnings. It largely could be if after those 50 rides. they can learn enough about the driver to induce them to participate in a way where the app extracts most of their producer surplus. Or maybe their research has shown that riders who complete 50 rides are likely to remain as drivers, while those who drive only a few times are less likely to form an attachment to the app.

- Dills and Mulholland (2018) show that the entry of ride-sharing apps is associated with fewer crashes, DUIs, and fatalities. Does this impact qualify as a positive externality? If so, could an argument be made to support subsidies of ride-sharing services? **Comment:** Including academic journal articles and current research in applied microeconomics can inspire students to take more economics courses and show them how the discipline is broader than the topics covered in a principles course.

4. Conclusion

Our review of introductory microeconomics textbooks confirms our anecdotal evidence (much from comments and input from our students) that course materials have been too slow to adapt to an evolving economy. Attempts to modernize course materials are often afterthoughts or stand-alone examples presented outside the core development of economic models. We feel this is a mistake. Instructors have many opportunities to integrate updated economic examples and phenomena directly into their course lessons, even at the introductory level. We present several ideas and examples in this paper. We hope that instructors will not only consider using these ideas, but also (and perhaps more importantly) develop their own framework and approach to making economics courses as relevant as possible to the modern economy.

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