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FROM GIG ECONOMY TO GIG EDUCATION

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Modern economy has benefited from gig economy idea, where, instead of hiring permanent employees, a company assigns each task to the person who is the most efficient in performing this task. This way, each task is performed in the best possible way -- by a person who is the most suited for this job. Why not extend this idea to education? Every student deserves the best possible teacher in every topic. So why not have a teacher who is the best in town in explaining quadratic equations teach quadratic equations to all the students from the town? In this paper, we describe this proposal and its logistics in some detail.

WHAT IS GIG ECONOMY

Traditionally, a company would hire employees, and these employees would perform all the necessary tasks. For example, our university would hire not only instructors to teach, it would also hire janitors to clean the rooms, cooks to prepare food at the university cafeterias, nurses to help students at the health center, police officers to maintain order, etc.

The advantage of this approach is that the university has a complete control over all these auxiliary activities. However, this approach also come with disadvantages: a university, by definition, knows how to teach students, However, it does not have experience neither in cooking food, nor in supervising food services. As a result, such services were costly and often not of very high quality.

The situation improved a lot when our university -- as well as many other places -- decided to outsource auxiliary services. As a result, these services are now run more professionally, and -- since there is a competition for the corresponding contracts -- the cost of these services went down, often drastically.

Our university was just a small example. Outsourcing is a general trend in economy, when a service which is auxiliary to the main mission of the company is often outsourced to a company that specializes in this particular types of service.

There is one minor disadvantage of outsourcing: when everyone was working for the same company, all job tasks and all payments were easy to monitor and easy to handle through the same company-wide system. Now, many services are outsourced to different companies, companies that use different financial and other systems. As a result, outsourcing requires a lot of paperwork -- actually, until a few years ago, the

need for all this paperwork was one of the main factors limiting further outsourcing, even when potentially such an additional outsourcing was beneficial.

What happened a few years ago was a proliferation of easy-to-use and flexible computer-based systems that made such outsourcing easy. As a result, instead of outsourcing to a company, it has become feasible to *outsource* to an individual for each individual task -- namely, to the individual who is the best for the given job.

This makes sense, and to some extent, this has happened before. For example, most people do not sign a contract with a dealership to possible repairs of their car: every time the car has a problem, we find the best repair folks and contact them. Who we contact depends on the level of repairs: if it is a small thing, it is often easier to go to some folks who are the closest – or who are the fastest. On the other hand, if we are talking about serious repairs, then we probably do not care that much about distance and repair time, we go to a shop which has the best quality for this type of repairs -- and for different types of repairs, different shops may be the best.

Similarly, in the US, a person can select a medical doctor – and this person can select different doctors depending on a situation. Usually, we all have regular doctors to whom we go for annual check-ups and for serious problems. However, when a person has a severe debilitating cough on Saturday, it is easier to go to one of the clinics which are open on weekends to get a prescription for the corresponding medicine than to wait until Monday for a regular doctor's visit. Similarly, if a person has a skin problem or a foot problem, this person goes to a specialist -- not to the regular doctor.

In the university, sometimes we need to teach a special topics course for a topic in which none of the faculty is a specialist. In this case, we hire a specialist -- e.g., a person working at a local company -- to teach just this one course.

In the past, such person-to-person contracts were limited to individuals, they were not typical for economy as a whole. Nowadays, the situation has drastically changed, such arrangements are ubiquitous -- because newly designed computer systems make such arrangements easy.

For example, when many of our professors go to out-of-town conferences, they use Uber to get from the airport to the conference hotel and back. Similarly, when one of us (VK) was invited to spend a month in Hannover, Germany, he did not reserve a hotel room for his stay -- he used Airbnb which connected him to people willing to rent their apartment.

Uber is not a company with employees, it is, in fact, a network that connect requests for transportation with drivers willing to help. These drivers may have different jobs, this is just their way to supplement their living. Similarly, people who rent apartments via Airbnb are not employees of this company, and this rent is not their main income.

This is what is called *gig economy*, when instead of hiring employees or outsourcing its tasks to another company, the company hires individuals for individual tasks; see, e.g., (Mulcahy, 2016), (McGovern, 2017), (Sundararajan, 2017), (Mizrahi, 2018).

Economists' studies show that overall, gig economy improves productivity. This is easy to explain. For each task, we want the most efficient way to perform it. If we only give the tasks to people within the company -- be it the main company or the company to which we outsource -- we are limiting the pool of possible workers. In many cases, for a given task, the best person to perform it is outside the company -- and in the gig economy, this very best person is who will be assigned for this task.

This is somewhat related to how faculty positions are filled in the US: by law, the university is required to hire the best applicant, irrespective of whether the applicants are from the US or from any other country.

MATHEMATICAL MODEL

The mathematical model behind gig economy is what is called an *assignment problem*; see, e.g., (Burkard et al., 2012) For each task t and for each person p , we know the efficiency $E(t,p)$ of person p performing this task. We want to assign, to each task t , a person $p = a(t)$ so that the overall efficiency -- i.e., the sum of all the values $E(t,a(t))$ is the largest possible.

In situations in which there are no limitations, the solution to this problem is straightforward: each task is assigned to the best person to perform this task: $E(t,a(t)) = \max_p E(a,p)$. This is exactly what gig economy provides.

FROM GIG ECONOMY TO GIG EDUCATION

The same logic can be applied to education. For each topic, each student deserves the teacher who is the best in teaching this topic. For example, among all the teachers in a city, there should be one or two who are the best in teaching quadratic equations. So why not have this exceptional teacher or teachers teach quadratic equations to all the schools of this city?

The same assignment problem works here, and shows that this will lead to an increase in efficiency.

Such a gig arrangement is not possible at present, because most of the schools in the school district follow practically the same week-by-week schedule, but why not add flexibility? At the beginning of the semester, the Quadratic Equations teacher teaches non-stop in the first school, meanwhile students in other schools study something else, then she moves to another school etc. At the end, with all this reshuffling, every student will still study all the topics from the program -- but this time, each student will learn

each topic from a teacher who is the best (at least the best in the city) in explaining this particular topic.

This idea of *gig education*, when teachers are not employed by individual schools, but rather by the whole school district, may sound unusual, but it is a natural continuation of a general tendency. In the distant past (and even now in small rural schools), we used to have one teacher teaching everything, from history to mathematics. Nowadays, teachers specialize: we have math teacher, science teachers, history teachers, etc. So why not go further and subdivide this even more: why not have one teacher for linear equations, another for quadratic equations?

To some extent, we already have this at a university level: each instructor teaches a few classes, and sometimes, when there is a topic in which another instructor is a good specialist, that second instructor gives a guest lecture. Why not go further and make similar arrangements between universities -- at least in big cities where there are many options. Some universities in the US already have such agreements: e.g., Harvard and MIT have a long-standing agreement that Harvard professors teach some humanities classes to MIT students and MIT professors teach some technical topics to Harvard students. There is a similar arrangement between several schools in Texas Medical Center in Houston: e.g., professors from Rice University teach statistical methods to students from Baylor School of Medicine.

We believe that a transition to such gig education will be as beneficial to teaching as gig economy is to economic efficiency and prosperity.

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