ASIAN JOURNAL OF THE SCHOLARSHIP OF TEACHING AND LEARNING VOLUME 5 ■ NUMBER 1 ■ MAR 2015

COMMENTARY

Rapid growth of Massive Open Online Courses (MOOCs) and the market for university graduates

Aamir Rafique HASHMI[1]

[1] Department of Economics
National University of Singapore

Address for Correspondence: Dr Aamir Rafique Hashmi, Department of Economics, Faculty of Arts and Social Sciences, National University of Singapore, AS2 #06-02, 1 Arts Link, Singapore 117570

Email: aamir@nus.edu.sg

Recommended citation:
Hashmi, A. R. (2015). Rapid growth of Massive Open Online Courses (MOOCs) and the market for university graduates. *Asian Journal of the Scholarship of Teaching and Learning, 5*(1), 23-39.

Rapid growth of Massive Open Online Courses (MOOCs) and the market for university graduates[1]

Abstract

Massive Open Online Courses (MOOCs) have seen exponential growth over the last couple of years. Their growth has now reached a point where some institutions of higher learning have started to offer degrees based entirely on MOOCs. In this commentary, I consider the implications of this development for the market of university graduates. I use a simple labor market model to show that an increase in the supply of university graduates or a skill mismatch between jobs and graduates may lead to more unemployment and/or underemployment among university graduates.

1. INTRODUCTION

The growth of Massive Open Online Courses (MOOCs) over the last two years has been phenomenal. For example, the number of registered users at Coursera, a for-profit provider of MOOCs that works in collaboration with various institutions of higher learning, increased from 2.9 million in March 2013, to 5 million in October 2013 and to 22.2 million in January 2014 [Waldrop (2013); Fowler (2013) and Coursera (2014)]. Presently, most of the enrollees who complete a MOOC get a certificate. This may change soon. For example, Georgia Tech has announced that it will offer, in collaboration with Udacity and AT&T, a fully structured masters programme in computer sciences online for just $7,000[2]. The cost of the same programme on campus is around $40,000. This is just the beginning and it is not hard to imagine that Georgia Tech's competitors will be forced to respond by either offering their own online programmes or lowering the cost of their on-campus programmes.

Although it is difficult to predict the exact future of MOOCs, in this commentary, I consider a number of possible scenarios and reflect on their implications for the market of university graduates[3]. I begin by presenting a simple model of the market for university graduates in Section 2. The model can generate both unemployment and underemployment[4]. The model outcomes depend on the demand for and supply of university graduates and also on the distributions of their skill levels. In Section 3, I use the model to study the implications of the various scenarios for the market for

[1] I would like to thank Lakshminarayanan Samavedham for the invitation to write this article. I would also like to thank two anonymous referees for their very useful comments.

[2] http://www.omscs.gatech.edu [accessed: March 26, 2014]

[3] By university graduates I mean those who have completed the equivalent of a 3 or 4-year Bachelors' Degree.

[4] I define these terms in Section 2.

university graduates. In Section 4, I comment on the plausibility of the scenarios. In Section 5, I describe some other interesting scenarios. I discuss the shortcomings of my model in Section 6 and conclude in Section 7.

2. A MODEL OF THE MARKET FOR UNIVERSITY GRADUATES

Because it is too early to have any credible data on the impact of MOOCs on the market for university graduates, I use a simple model of labor demand and supply to organize my thoughts on the issue. I need a model that is capable of generating unemployment and underemployment in equilibrium because these are the two features of the market for university graduates that are my focus in this article[5]. The basic demand-supply model of labor market is not suitable to study the problem of unemployment because in equilibrium, demand always equals supply and there is no unemployment. The basic model also does not feature underemployment. I show a simple model of labor demand and supply in Figure 1:

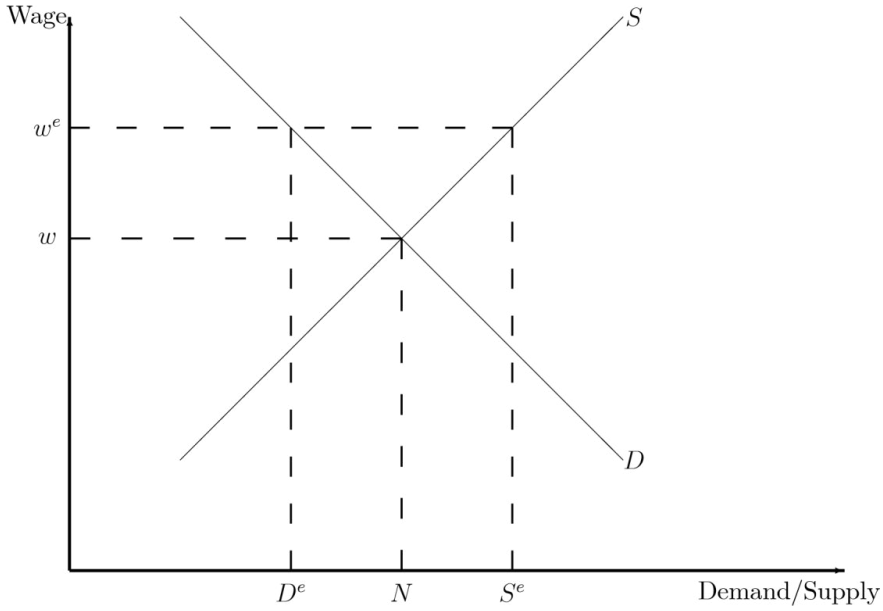

Figure 1: A simple demand-supply model of labor market

[5] In this article, I define unemployment and underemployment as follows. A person is unemployed if she is able and willing to work but cannot find a job. An employed person is underemployed if her skill level is higher than the skill level required for the job that she is doing.

The demand for and supply of labor are measured along the *x*-axis and the wage rate along the *y*-axis. The negatively sloping line labeled *D* is the demand curve and the positively sloping line labeled *S* is the supply curve. Equilibrium occurs where the two lines intersect and demand is equal to supply. The equilibrium level of employment is *N* and wage is *w*. If the market is not in equilibrium and demand is greater than supply, the wage rate will increase to clear the market. If supply is greater than demand, the wage rate will decrease to restore equilibrium. It is easy to see that in this simple model the market clearing wage will always make demand equal to supply and there will be no unemployment. Similarly, by construction, there is no underemployment in this model.

There are a number of economic models that can generate equilibrium unemployment in a labor market[6]. The two most popular classes of models are: 1) search and matching models; and 2) efficiency-wage models. Search and matching models are state-of-the-art tool of analysis in modern macroeconomics but they are complicated and not suitable for a note like this, which is meant for a general audience. The idea of efficiency-wage models is quite simple and can be expressed using the simple demand-supply framework. According to these models, employers prefer to pay their workers wages that are higher than the market clearing wage. They do so to ensure that their workers work hard and do not shirk. Because the wage they offer is higher than the market clearing wage, the supply of labor will be more than its demand and hence there will be unemployment. I show this idea in Figure 1. If firms decided to pay a wage of w^e to their workers, the supply of labor would be S^e and the demand would be D^e. The difference between demand and supply, $S^e - D^e$, would represent unemployment. In its simple form, the efficiency-wage model cannot generate equilibrium underemployment.

In this note, I use an idea similar to that of the efficiency-wage models but generalize it in a way that allows me to apply it to the market for university graduates. Another feature of this version of the model is that it can generate both unemployment and underemployment. I now present the basic ingredients of the model.

In this model, each job requires a certain level of skill. Following Blazquez and Jansen (2008) I assume that only the workers whose level of skill is at least as high as the required level of skill can get the job[7], hence, there is a separate market for each level of skill. If there are more jobs requiring a certain level of skill than the number of workers with at least that level of skill, there will be an excess demand for that set of workers and it will push up their wages. On the other hand, if there is an excess supply of workers of a certain skill level, they will be either underemployed, i.e. do the jobs that require a lower level of skill, or unemployed. The reason is somewhat similar to

[6] See Chapter 10 in Romer (2012) for a textbook treatment of the models of unemployment. For a more extensive review of the state-of-the-art models of unemployment see Rogerson and Shimer (2011).

[7] I implicitly assume that the level of skill is one dimensional and it can be measured accurately. I discuss this assumption further in Section 6.

the one given for efficiency wages, though instead of efficiency wage, I prefer to call it a reasonable wage. For each skill level, there is a reasonable wage. Keeping that wage in mind, firms advertise a certain number of positions. If there is excess supply of workers of that skill level, firms do not reduce the reasonable wage, instead they stop hiring after they have filled all the vacant positions. To sum up, for each level of skill, there is a certain demand and supply of workers. If demand exceeds supply, the wage is pushed up and the market clears. If supply exceeds demand, the wage remains at the reasonable level and all excess workers either take jobs requiring lower levels of skill or remain unemployed. As I show below, this simple model can generate both unemployment and underemployment in equilibrium when there is excess supply of workers or a skill mismatch between workers and jobs.

I now add more structure to the model to get some precise numbers on equilibrium unemployment and underemployment. I assume that the skill level can take any integer value from 1 to 100. There are 100,000 jobs for university graduates in this hypothetical economy. The distribution of the required skill levels for these jobs is Normal with a mean of 50 and a standard deviation of 10. This distribution reflects the needs of the economy in terms of various levels of skill. I plot this distribution in Figure 2.

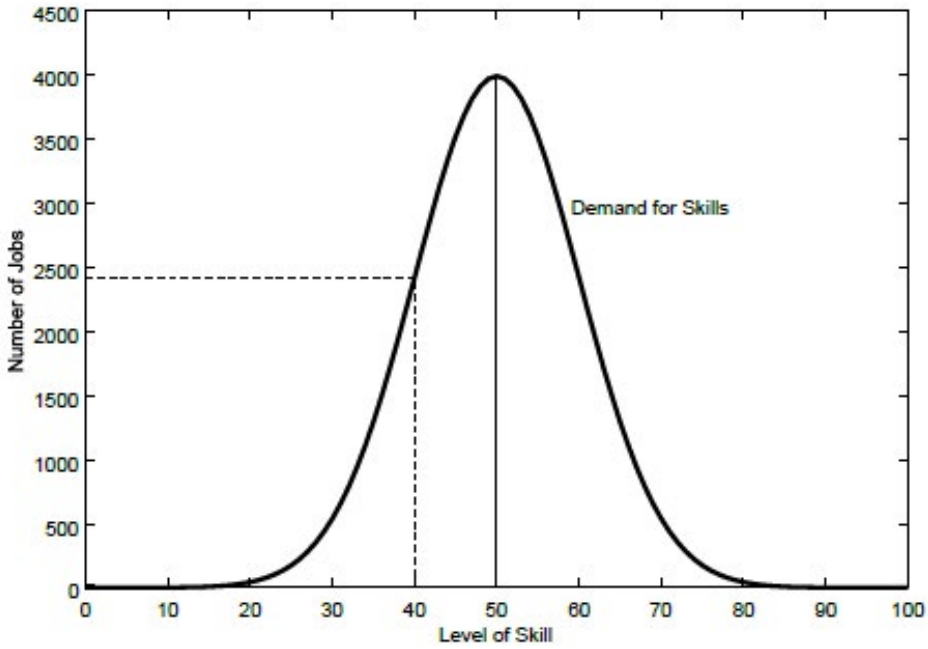

Figure 2: The distribution of demand for skills

The interpretation of Figure 2 is simple. For example, the number of jobs with the required skill level of 50 is about 4000 and with the required skill level of 40 is about 2400. The total area under the curve is 100,000, which is equal to the assumed total

number of jobs for university graduates in the economy. For the following analysis, I shall keep this distribution constant and refer to it as the distribution of demand for skills.

Similar to the distribution of demand for skills in the economy, there is also a distribution of supply of skills. This distribution shows the number of university graduates at each skill level. Once again I assume that the distribution of the supply of skills is Normal with a standard deviation of 10. I do not fix the average skill level of university graduates nor do I fix their total number.

In the next section I consider 6 different scenarios that result from different combinations of assumptions about the number and the skill level of university graduates. Each set of assumptions highlights a different possible scenario as a result of the rapid growth of MOOCs.

3. SIX CASES

In this section, I use the model of the last section to study its implications for different possible scenarios about the future of MOOCs. I consider two possible values (100,000 and 110,000) for the number of university graduates and three possible values (45, 50 and 55) for their average skill levels. Recall that on the demand side I have fixed the number of jobs at 100,000 and the average required skill level at 50. So when the number of university graduates is 100,000, the total supply (i.e. the number of graduates) is equal to the total demand (i.e. the number of jobs in the economy). But when the number of graduates is 110,000, there is excess supply of graduates. Because the average required skill level is 50, when the average skill level of graduates is 50, there is no skill mismatch. When it is 45, there is a shortage of skills and when it is 55, there is an abundance of skills. I now present the six cases:

Case 1: No skill mismatch and supply equals demand

First, assume that there are 100,000 university graduates and their average level of skill is 50. Under these assumptions, the distributions of the demand for and supply of skills will be identical and there will be no skill mismatch in the economy. I depict this case in Figure 3 (see next page):

Note: In the following 6 figures, the solid lines represent the demand for skills and the lines made up of dashes represent the supply of skills.

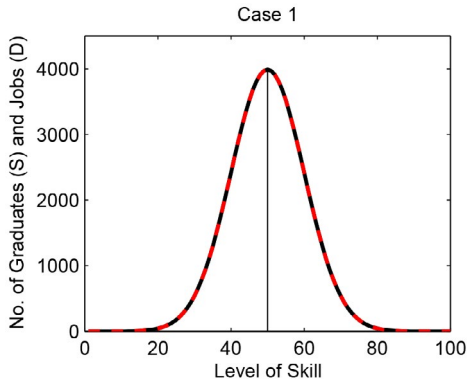

Figure 3

In this economy, there will be no unemployment, all positions will be filled and there will be no underemployment (see Table 1 on p.33). Although this case is unrealistic because in the real world, we do see graduate unemployment, it serves as a useful benchmark.

Case 2: No skill mismatch and excess supply

I now consider the case when MOOCs increase the number of graduates relative to the available jobs. Let us first consider the case when the average level of skill among the university graduates remains at 50 and only their number increases to 110,000. The resulting distributions are in Figure 4:

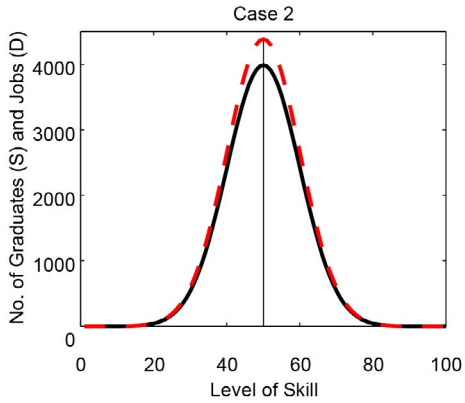

Figure 4

The distribution of demand for skills is the same as in Figure 2. The distribution of supply of skills is centered at 50 but covers a larger area to reflect the higher number of university graduates. The unemployment rate in this case is 9.1%,

there are no unfilled positions and the extent of underemployment is 1.8[8] (see Table 1).

In some sense, this case is trivial because it assumes more graduates than jobs at all skill levels and hence all excess graduates are unemployed. Nonetheless, it makes an important point in the simplest possible way: if MOOCs increase the supply of graduates at all levels of skills, it will generate unemployment even if the average skill level of the graduates is the same as the average skill level required by the economy.

Case 3: Shortage of skills and supply equals demand

Now, let us think about skill mismatch. I assume that, as in Case 1, the number of university graduates in the economy is 100,000, hence total supply is equal to total demand, but their average level of skill is 45[9]. The resulting distributions of skills are in Figure 5:

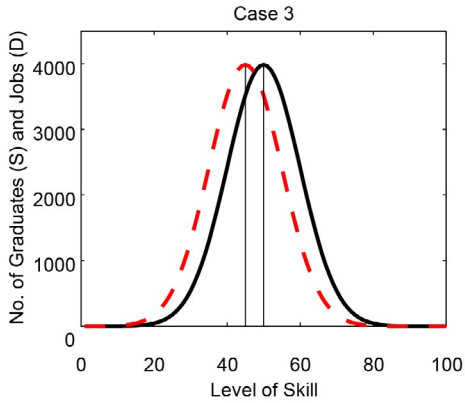

Figure 5

The distribution of demand for skills is identical to the one in Figure 2. The distribution of supply of skills is drawn with dashed lines and is centered at 45, the assumed average level of skill among the university graduates. In this case, the unemployment rate is 19.7% but at the same time 19.7% of the positions

[8] The extent of underemployment is the average of the difference between an employed worker's actual skill and the skill required for the job that she is doing.

[9] The skill level of 45 is half a standard deviation less than the skill level of 50 assumed in Case 1. If we proxy the skill level by the number of years of schooling and use data from Singapore, half a standard deviation is roughly equal to 2 years of schooling and the average years of schooling is 10.3 [based on author's calculations using data from Singapore Department of Statistics (2013)].

remain unfilled. The extent of underemployment is 1.0 (see Table 1). This case shows that a shortage of half a standard deviation of skill can generate a high level of unemployment among university graduates. This unemployment coexists with an equal percentage of unfilled positions because enough graduates with required skills are not available.

Case 4: Shortage of skills and excess supply

I now combine Cases 2 and 3 and assume that the number of graduates is 110,000 with the average skill level of 45. The resulting distributions are in Figure 6:

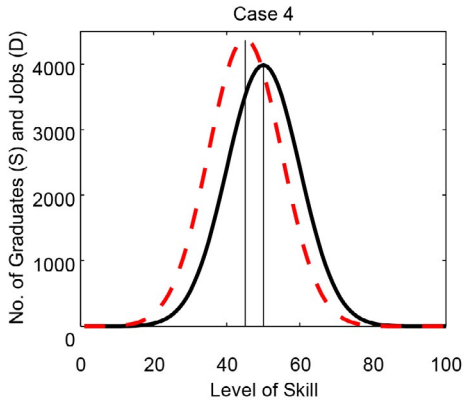

Figure 6

In this case, the unemployment rate is 23.7%, 16.1% of the positions are unfilled and the extent of underemployment is 1.2 (see Table 1).

Case 5: Abundance of skills and supply equals demand.

Another interesting scenario is when MOOCs increase the average skill level of university graduates. In Case 5, I assume that the number of graduates is 100,000 but their average skill level is 55. The relevant distributions of skills are in Figure 7:

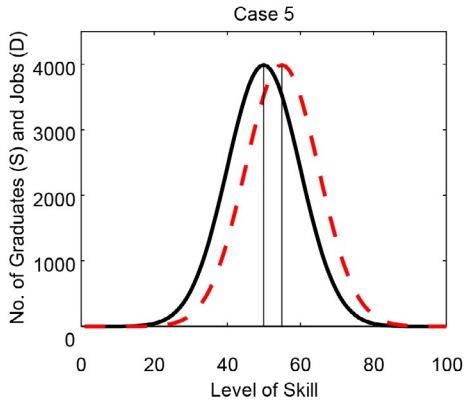

Figure 7

Not surprisingly, there is no unemployment in this case nor are there any unfilled positions. The extent of underemployment is 5.0, which is equal to the difference between the average skill level of workers and the average skill level required for jobs in the economy.

Case 6: Abundance of skills and excess supply

Finally, I combine Cases 2 and 5 and assume that the number of graduates is 110,000 with an average skill level of 55. I plot the distributions of skills for this case in Figure 8:

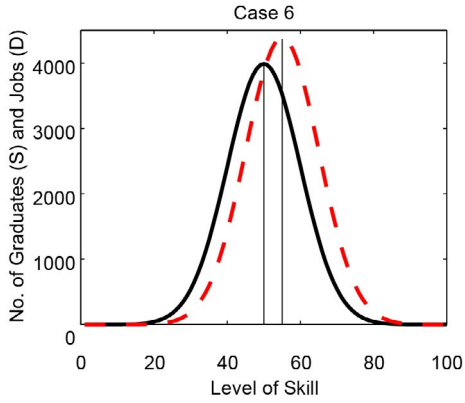

Figure 8

The unemployment rate is 9.1%, there are no unfilled positions and the extent of underemployment is 6.8 (see Table 1).

I summarize the six cases in Table 1:

Table 1: A summary of the 6 cases

Case	No. of Graduates	Graduates' Avg. Skill Level	Unemployment Rate (%)	Unfilled Positions (%)	Extent of under-employment
1	100 000	50	0	0	0
2	110 000	50	9.1	0	1.8
3	100 000	45	19.7	19.7	1.0
4	110 000	45	23.7	16.1	1.2
5	100 000	55	0	0	5.0
6	110 000	55	9.1	0	6.8

Note: In all 6 cases, the number of available jobs is 100,000 and the average required level of skill is 50. The extent of underemployment is the average of the difference between an employed worker's actual skill and the skill required for the job that she is doing.

These cases show that the excess supply of university graduates will lead to unemployment (Cases 2, 4 and 6). If the excess supply is coupled with the shortage of skills, the unemployment rate will be much higher (Case 4). If the excess supply comes together with an abundance of skills they will result in both unemployment and underemployment (Case 6). Even when there is no excess supply, a shortage of skills can lead to high unemployment coexisting with unfilled positions (Case 3). Finally, if there is no excess supply but there is abundance of skills, underemployment will result (Case 5).

4 PLAUSIBILITY OF THE CASES

The plausibility of the above cases depends on how the rapid growth of MOOCs will affect the supply of university graduates and their skill distribution. I discuss these assumptions in turn.

4.1 MOOCs and supply of university graduates

It is a reasonable assumption that the rapid growth of MOOCs will lead to an increase in the supply of university graduates. In fact, one of the main motivations behind the spread of MOOCs is to democratize higher education. Take, for example, the mission statement of Coursera: "Coursera is an education platform that partners with top universities and organizations worldwide, to

offer courses online for anyone to take, for free. We envision a future where everyone has access to a world-class education. We aim to empower people with education that will improve their lives, the lives of their families, and the communities they live in."[10]

This expected increase in the number of university graduates will be on top of the existing trend towards higher completion rates in tertiary education in many rich countries. For example, in OECD countries, the average fraction of population with tertiary education is 23% among 55-64 year olds and 38% among 25-34 year olds (OECD, 2012). In some countries the increase has been much more rapid. In South Korea, for example, the fraction of population with tertiary education is just 13% among 55-64 year olds and 65% among 25-34 year olds. These high completion rates have already created a serious problem of unemployment among university graduates. The former president of South Korea, Lee Myung-bak, once said "reckless entrance into college is bringing huge losses to families and the country alike."[11] The inexorable growth of MOOCs is likely to exacerbate this trend[12].

4.2 MOOCs and the distribution of skills

The effect of MOOCs on the distribution of skills is moot. On the one hand, by offering more choice and flexibility, MOOCs may alleviate the perceived mismatch between the demand for and supply of skills[13]. But on the other hand, they may make the situation worse by creating either a shortage or an abundance of skills. I consider these possibilities one by one.

MOOCs may lower the average quality of graduates. It is possible because most of the people taking MOOCs do so from the comfort of their homes and get fewer, if any, opportunities to develop the soft skills that are so valuable in the job market. For example, people taking MOOCs may not get enough opportunities for discussions with their lecturers or classmates. They may also not get enough opportunities to work in teams or to present their work before their peers. All these factors are likely to lead to a lower overall level of skill. Admittedly, there is no hard evidence to support this assumption. The available

[10] [https://www.coursera.org/about. Retrieved September 13, 2014]

[11] http://www.economist.com/blogs/banyan/2011/11/education-south-korea [Accessed March 27, 2014]

[12] The problem of skill-mismatch leading to unemployment has been studied by, among others, Farrel and Grant (2005) and Pauw et al. (2008).

[13] Edmund S. Phelps, a Nobel laureate in economics, recently wrote: "Business leaders often argue that the widening education gap - the disparity between what young people learn and the skills that the job market demands - is a leading contributor to high unemployment and slow growth in many countries." (Phelps 2014)

research that compares the effectiveness of online education with traditional face-to-face education suggests that both are roughly equally effective (Means et al. 2009). There is also some evidence to suggest that when face-to-face education is combined with online education, the combination of the two is more effective than any one method alone. Because MOOCs are a recent phenomenon, there is no research available that compares the effectiveness of MOOCs to that of face-to-face education. Nonetheless, if MOOCs lower the quality of graduates, it will result in shortage of skills and lead to unemployment coupled with unfilled positions. Cases 3 and 4 above highlight the possible effects of this scenario.

The other possibility is that MOOCs may enhance the average skill level of university graduates. This is especially likely if MOOCs are used to enhance face-to-face teaching. This is one of the main findings in Means et al. (2009) Another recent study under The Simon Initiative at Carnegie Mellon University reached a similar conclusion[14]. The researchers randomly assigned students taking a basic course in statistics to two groups. One group was taught using the traditional face-to-face teaching methods. The other goup was mostly taught using online adaptive methods coupled with some interaction time with the tutors. The researchers found that the students in the online learning group learnt the same material in half the time as compared to the students in the traditional group. Not only this, the online learners showed greater retention of the material in a follow-up study. I have already highlighted the implications of this scenario in Cases 5 and 6 above. The likely effect of the abundance of skills is underemployment. This may already be a problem in the US as Peter Cappelli of the Wharton School concludes in a recent study: "... a reasonable conclusion is that over-education remains the persistent and even growing situation of the US labor force with respect to skills." (Cappelli, 2014)

The third possibility is the most encouraging one. By offering a variety of courses and allowing the students to study in their own free time and at their own pace, MOOCs may actually help remove any skill mismatches that may exist in the labor market. This scenario is more likely if we think beyond MOOCs-based degrees. If a worker needs to learn a particular skill or update her knowledge of an existing skill, MOOCs could provide a cheap and flexible opportunity to do so. Recently the CEO of Coursera, Richard C. Levin, expressed hope that this would be one of the likely outcomes of the rapid growth of MOOCs[15].

It is difficult to predict which of the above possibilities is more likely. In my opinion, the rapid growth of MOOCs will increase the supply of new university

[14] A 5-minute online video that describes the methodology and the main results of the study is available at http://tinyurl.com/SIatCMU. Retrieved September 25, 2014.

[15] Author's conversation with Richard C. Levin after his talk at the National University of Singapore on September 8, 2014.

graduates (Cases 2, 4 and 6). Their effect on the average skill level is not clear and the final outcome could either be a shortage of skills, or an abundance of skills or a closer match of skills to the jobs. Whichever outcome unfolds, the rapid expansion of MOOCs is likely to have non-trivial effects on the market for university graduates.

5 OTHER POSSIBLE SCENARIOS

In addition to the six cases above, I discuss a few other interesting scenarios below.

One possible scenario is that the distributions of the demand for and supply of skills may not be symmetrical. If the economy is producing basic goods, the distribution of demand for skills will be right skewed (will have a longer tail on the right). For more advanced and knowledge-based economies, the distribution of demand for skills will be left skewed (will have a longer tail on the left). Similarly, the distribution of supply of skills may also be asymmetric. For example, if universities churn out more and lower quality graduates, the distribution of supply of skills will be skewed to the right and the level of graduate unemployment will be higher.

So far in this note, I have assumed that the demand for skills is fixed. However, if we think about the labor market of the future, a very real concern is that demand for labor with intermediate levels of skill will likely decrease. Economists call it labor market polarization and it is characterized by the simultaneous growth of high-education, high-wage and low-education, low-wage jobs (Autor, 2014). This will result in a bi-modal distribution of demand for skills. A related concern is skill-biased technological progress. Acemoglu (2002) writes in his survey of the literature on the issue: “The recent consensus is that technical change favors more skilled workers, replaces tasks previously performed by the unskilled, and exacerbates inequality”.

The implications of skill-biased technological progress will be similar to Case 4 above. It is still an ongoing debate that how far the technology can displace human labor. Brynjolfsson and McAfee (2012) and Brynjolfsson and McAfee (2014) suggest that the threat of technology to employment is quite serious and irreversible. Autor (2014) takes the opposing view and observes that the journalists and expert commentators overstate the extent of machine substitution for human labor and ignore the strong complementarities.

6 SHORTCOMINGS OF THE MODEL

I have intentionally kept the model presented in this note very simple to get the main ideas across. Like any economic model, the present model is based on a number of simplifying assumptions. For example, I have assumed normal distributions for both demand for and supply of skills. This may not be true but the model can easily be modified to accommodate other type of skill distributions.

I have also assumed arbitrary numbers for the means and standard deviations of the skill distributions. For example, I have fixed the standard deviation of all the skill distributions in this paper to be equal to 10. Similarly, I have fixed the mean of the distribution of demand for skills at 50 and varied the mean of the distribution of supply of skills between 45 and 55. None of these numbers comes from the data. The reason for making all these assumptions is that the data on the subject does not exist. In fact, MOOCs are a very recent phenomenon and it will be some time before universities are able to offer full degree programmes based on MOOCs. The objective of this note is to think about the possible future effects of MOOCs on the market for university graduates using a simple model and some assumed numbers. I do not claim to have achieved anything beyond this objective.

Another shortcoming of the model is to assume that skill has only one dimension and it can be accurately measured on a linear scale. I make this assumption to simplify the analysis. Moving to a multi-dimensional definition of skill in the absence of any data would have forced me to make even more arbitrary assumptions. Having said that, the model can be extended to accommodate multi-dimensional definitions of skill.

The model does not allow for an explicit downward adjustment of wage when there is excess supply of workers at a particular skill level. However, it does allow a worker to do a job that requires a lower skill level than his/hers. In this way, the model implicitly allows for lower wages as a result of excess supply of workers. This is also a likely consequence of the rapid growth of MOOCs such that, instead of causing unemployment, they may lead to lower wages for university graduates[16].

[16] I asked Coursera CEO Richard Levin about the effect of MOOCs on returns to education and his immediate reponse was that the rapid growth of MOOCs would likely reduce the returns to education.

7 CONCLUSION

MOOCs are a very recent phenomenon and it will be some time before their full impact on the market for university graduates becomes clear. In the absence of any data on the issue, I use a simple model of the market for university graduates to reflect on various possible scenarios. If MOOCs increase the supply of university graduates, the graduate unemployment will increase. If they also lead to a shortage of skills, the problem of unemployment will be worse. If they cause an abundance of skills, the result will be an increase in underemployment among university graduates.

The most desirable scenario among the ones that I consider in this note is the one in which new graduates and existing workers use MOOCs to learn new skills or update their existing skills according to the needs of the market. This will minimize the mismatch between actual and required skills. However, even in this scenario, graduate unemployment will increase if there are too many graduates and not enough jobs.

Graduate unemployment and underemployment are already considered serious problems in some countries. This is due to the rapid expansion in the number of degrees awarded over the last few decades[17]. The rapid growth of MOOCs is likely to further increase the overall education levels and may worsen the problems of graduate unemployment and underemployment.

[17] For example, in the US, the enrollment rates of 18- to 24-year-olds in degree-granting institutions increased from 26.6% to 41.0% between 1982 and 2012 [Source: U.S. Department of Education, National Center for Education Statistics. (2013). Digest of Education Statistics, 2012 (NCES 2014-015), Table 302.60 available at http://nces.ed.gov/programs/digest/d13/tables/dt13_302.60.asp. Retrieved September 25, 2014.]

REFERENCES

Acemoglu, D. (2002). Technical Change, Inequality and the Labor Market. *Journal of Economic Literature, 40*(1), 7-72.

Autor, D. (2014). Polanyi's Paradox and the shape of Employment Growth. *NBER Working Paper No. 20485*.

Blazquez, M. & Jansen, M. (2008). Search, Mismatch and Unemployment. *European Economic Review*, 52(3), 498-526.

Brynjolfsson, E. & McAfee, A. (2012). *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*. Digital Frontier Press, Cambridge, MA.

Brynjolfsson, E. & McAfee, A. (2014). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. Norton, New York, NY.

Cappelli, P. (2014). Skill Gaps, Skill Shortages and Skill Mismatches. Evidence for the US. *NBER Working Paper No. 20382*.

Coursera (2014). *Coursera Website*. https://www.coursera.org/about/community. Retrieved March 27, 2014.

Farrel, D. & Grant, A. J. (2005). China's Looming Talent Shortages. *The McKinsey Quarterly*. McKinsey & Company (4), 70-79.

Fowler, G. A. (2013). *An Early Report Card on Massive Open Online Courses*. Available at http://tinyurl.com/Fowler13WSJ. Retrieved September 25, 2014.

Means, B., Toyama, Y., Murphy, R., Bakia, M. & Jones, K. (2009). *Evaluation of Evidence- Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studie*s. Center for Technology in Learning, US Department of Education, Office of Planning, Evaluation and Policy Development, Washington D.C.

OECD. (2012). *Education at a Glance 2012: Highlights*. OECD Publishing. Available at http://dx.doi.org/10.1787/eag_highlights-2012-en. Retrieved September 25, 2014.

Pauw, K., Oosthuizen, M. & Van Der Westhuizen, C. (2008). Graduate Unemployment in the Face of Skills Shortages: A Labour Market Paradox. S*outh African Journal of Economics, 76*(1), 45-57.

Phelps, E. S. (2014). *Teaching Economic Dynamism*. Available at http://tinyurl.com/ProjectSyndicatePhelps2014. Retrieved September 23, 2014.

Rogerson, R. & Shimer, R. (2011). Search in Macroeconomic Models of Labor Market, in O. Ashenfelter & D. Card (eds)., *Handbook of Labor Economics, Vol. 4a*. Elsevier, Amesterdam: North-Holland.

Romer, D. (2012). *Advanced Macroeconomics*. 4 edn. McGraw-Hill Irwin, New York, NY.

Singapore Department of Statistics (2013). *Statistics Singapore Newsletter.* Available at http://tinyurl.com/sds13ssn. Retrieved September 25, 2014.

Waldrop, M. (2013), Massive Open Online Courses, aka MOOCs, Transform Higher Education and Science. *Scientific American*. Available at http://tinyurl.com/ Waldrop13. Retrieved September 25, 2014.