A key challenge for Singapore and other developed economies is to sustain economic growth. Growth can be based on working harder (more labour, more investment, more resources) or working smarter (raising productivity). Innovation contributes to working smarter -- getting more from the same resources.

This module introduces recent research in productivity, innovation, and entrepreneurship, focusing on implications for economic policy and business strategy. The module will be highly interactive and apply multiple disciplines including economics, psychology, and management. Students will present research papers, analyze data, write reports, and engage in discussion.

The only prerequisite is basic knowledge of microeconomics, statistics, and algebra.

The following syllabus is subject to revision and will be updated online. Please refer to the IVLE for the current version.

Assessment
- Class participation: 20%
- Presentation and discussion of research papers: 20%
- Data analysis: 25%
- Examination: 30%

The assignments are due as follows:
- Slides for presentation and discussion of research paper: due at the start of class on the day of the topic;
- Slides for discussion questions: due at the start of class in following week;
- Slides and report of data analysis: due at the start of class in following the topic.

Note: Penalty of 25% for submission after the deadline.
## Syllabus

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Productivity</td>
<td>Econometrics tutorial</td>
</tr>
<tr>
<td></td>
<td>● TFP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Estimation</td>
<td></td>
</tr>
</tbody>
</table>
Empirical exercise:  
For any airline, estimate TFP growth over the last 10 years.  
General question:  
Identify and explain other important factors that might affect productivity which Syverson (2011) did not review. |
| ● Management | |
| #3 Jan 27 | Innovation | General questions  
1. Bloom et al. show that $250,000 of consulting raises profit by $350,000. Why didn’t the manufacturers engage consultants before Bloom et al’s experiment?  
2. Refer to the Lee and Freebody study. Suppose that you estimate a company-level regression to explain the management score of Singapore businesses. What explanatory variables would you include? What are the signs of the coefficients that you expect?  
3. Refer to “A Sectoral Examination of Singapore’s Productivity Growth”, 2014, and focus on one domestically-oriented sector. To what the extent can |
| ● Economic growth |
| ● Types |
| ● Sources |

1 Notes: # Instructor presentation; ^ Student presentation; + For reference only.
better management raise productivity?

Readings

Specific question: Read one of the above items.
   a) Summarize the authors’ recommended strategies to increase innovation.
   b) Compare the recommended strategies to possible alternatives.
   c) Thought experiment: How would you test the authors’ recommendations?

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
</table>
| Feb 3 | Types  
Measure  
Stimulants |  |

General questions
1. Amabile defines creativity as the production of ideas or outcomes that are novel and appropriate to some goal. How does this model apply to totally new, blue-sky inventions (eg, electricity, nuclear physics, Internet) as contrasted with problem-driven innovations (eg, electric vis-a-vis petrol-engine car)?
2. Amabile’s Consensual Assessment Technique uses experts to rate creativity. Compare it to the divergent thinking test as a measure of creativity.
3. If individual creativity is purely neurological, what are the implications for management and policy?

Specific questions
1. Experiments in behavioural economics typically pay incentives to encourage the subjects to work hard. How would such payments affect the laboratory experiment carried out by Grant and Berry (2011)?
2. Both the Leung et al. (2012) and Oppezzo and Schwartz (2014) studies find that physical activity stimulates creativity. Compare their explanations for this effect.
3. Why does walking stimulate divergent thinking, but not convergent thinking?
4. When economists conduct randomized controlled trials, they typically check for selection (control and treatment groups are similar in observable characteristics) and spillovers from the treatment to control groups. In the walking experiments, what would you check?
5. Refer to the studies by Grant and Berry (2011), Leung et al. (2012), Oppezzo and Schwartz (2014). How would variation of creativity by age or gender affect their findings and managerial implications?

Date | Subject | Assignment
--- | --- | ---
#5 Feb 10 | Architecture  
- Exterior  
- Interior  

General questions
1. “Most scientific breakthroughs have occurred in boring buildings. Can a new generation of architects change that?” (*Financial Times*). Please discuss.
2. Allen and Henn describe a factory (Skoda) and university
Specific questions
1. Referring to the Dul et al. (2011) study, compare the effects of improving the social organizational and physical work environments by one standard deviation on performance. Which is more cost-effective?
2. Dul et al. (2011: 727) report that the interaction between creative personality and physical work environment was “relatively high (coefficient: 0.09, but not significant)”. Assess whether this interaction is large or small.
3. Evaluate the empirical design of the Toker and Gray (2008) study. What do we learn from the study about the effect of office design on scientific productivity?
4. Referring to Toker and Gray (2008) Table 5, how would you estimate and report the effect of accessibility on interaction?
5. Referring to Waber et al. (2014), can frequent unintended meetings be bad for productivity and innovation?
6. In a survey of workers in coworking spaces, 75% reported an increase in productivity after joining their space (Waber et al. 2014). Discuss this finding and its managerial implications.

Specific questions
1. “[A]pplication of HRM practices does matter for
the likelihood of innovation", (Laursen and Foss 2003: 258). Do you agree?
3. Referring to the Laursen and Foss (2003) study, how would you test for complementarities among new HRM practices in their effect on productivity?
4. In the Gibbs et al. (2014) experiment, suppose that control groups knew about the rewards given to treatment groups. How might that affect the behaviour of control and treatment groups?
5. Gibbs et al. (2014) controlled for age, gender, and tenure. How might these individual characteristics have affected the response to incentives?
6. Should Ederer and Manso (2013) have tested for interaction between the treatments and gender?
7. Discuss the external validity of the Ederer and Manso (2013) findings.

Date | Subject | Assignment
--- | --- | ---
#7 Mar 3 | Human resource management  
- Selection  
- Training  
Site visit: Equinix  
Host: Mr Clement Goh, Managing Director - South Asia | # Virginia Stuart, "Prime Time", UNH Magazine, Fall 2013.  
Specific questions  
1. Referring to the Lindquist et al. (2015) study, discuss whether entrepreneurs are born or nurtured.
2. What do the Stuart essay and Lindquist et al. (2015) study tell us about the role of selection in increasing innovation in an organization?
3. Refer to the Chu et al. (2016) study. What does the School of Hard Knocks teach and how?
Empirical exercise  
Using the China survey data-set, investigate any relation between entrepreneurship and (i) self-efficacy, (ii) resilience, (iii) persistence and tenacity, and (iv) craftiness and opportunism. Compare OLS with IV estimates.

Date | Subject | Assignment
### Diversity
- Gender, age, ethnicity
- Experience
- Education


**General questions**
1. Does diversity increase productivity, and if so, how?
2. Does diversity increase innovation, and if so, how?
3. Compare job rotation and diversity as ways to increase innovation.

**Specific questions**
1. Reagans et al. (2004) discuss their identification strategy on page 109. Discuss why their analysis does not identify the causal effects of diversity or network structure.
2. Gruber et al. (2013) study recombination by individual inventors. For a business that employs half engineers and half scientists, what is the expected degree of recombination?
3. Hoogendoorn et al. (2013) find that gender diversity contributes to performance. What if gender is correlated with ethnicity?

### Assignment

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>#9</td>
<td>Mar 17</td>
<td>Learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Knowledge decay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Benchmarking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Spillovers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>^ Amitabh Chandra, “Economics Meets the Geography of Medicine”, Harvard University, September 2012.</td>
</tr>
</tbody>
</table>

Guest lecture: Gong Jie, “Work Interruption and Productivity”. 
Specific questions
1. Referring to Chandra (2012), discuss whether organizations should invest in learning from best practices of others?
2. How does research into learning in the aircraft manufacturing and steel industries apply to other industries?
3. Referring to the Hendel and Spiegel (2014) study, suppose that the business acquired another steel plant. To what extent could it apply the learning of its original plant to the new plant?

Empirical exercise:
1. Refer to the New York report, Appendices 1-3. To estimate the effects of hospitals and surgeons, what variables would you add to the regressions? Ideally, what data would you like?
2. Refer to the data for New York heart surgeons. (a) For surgeons with 8 or more data points, chart the risk-adjusted mortality rate against experience for (i) coronary artery bypass graft (CABG) and (ii) valve surgeries. (b) Use OLS to estimate the learning rates in CABG and valve surgeries with dummy variables for each surgeon.

General questions:
1. Consider the sources of learning that increase organizational productivity. Which of these are subject to decay and to what extent?
2. “The more of its competitors’ spillovers there are..., the more incentive the firm has to invest in its own R&D” (Cohen and Levinthal 1990). Discuss whether own and spillover R&D are complements or substitutes.
3. How do the estimates of Cohen and Levinthal (1990) bear on the models in Figures 1 and 2?

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
</table>
| #10 Mar 24 | Adoption of innovations  
- Innovation cycle  
- Absorptive capacity  
Specific questions:
1. With network effects, current adoption depends on past adoptions by others. Discuss the challenges in estimating network effects.
2. Repair of the mitral heart valve requires more surgical skill than replacing the valve. Bolling et al. (2010) analysed patient and surgeon characteristics that are associated with repair. How could you use multiple regression to improve on their analysis? What other factors would you include?
3. In the Atkins et al. (2014) study, the businesses that did not respond to the initial survey tended to be larger than those that did respond. Discuss the possible reasons and implications.
4. To better understand the diffusion of the new soccer ball making technology, why should we study the management of the diemakers?

Empirical exercise:
1. Estimate models of (i) residential broadband penetration and (ii) mobile phone ownership in China.

General question
1. Anderson and Tushman (1990: 614-615) argue that “In regimes of low appropriability, a single dominant design will emerge following each technological discontinuity … majority of potential adopters will await the emergence of an industry standard before purchasing a new product or installing a new process technology”. Discuss in the context of smartphones -- comparing the iOS, Android, and other systems.

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>#11</td>
<td>Geography</td>
<td># Gerald Carlino and William R. Kerr, “Agglomeration and Innovation”, in <em>Handbook of Regional and Urban Economics</em>, forthcoming. (Exclude Sect 4.3.1)</td>
</tr>
<tr>
<td></td>
<td>Knowledge spillovers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional</td>
<td></td>
</tr>
</tbody>
</table>
Specific questions:
1. Moen (2005) finds that workers in more R&D-intensive industries earn relatively less in the earlier years and more in later years. How does this theory apply to (a) doctors and (b) satellite engineers? How does it apply to a small labour market like Singapore?
2. Alcacer and Chung (2007) interpret local stocks of patents as source of knowledge spillovers. But what if stocks of patents proxy for the stock of engineers and scientists? How would this affect the interpretation of their empirical results?

General questions:
1. How would improvements in information and communication technologies change the effect of geographical proximity on innovation?
2. Suppose that the total factor productivity of businesses increases with the stock of knowledge in the vicinity. Does this mean that businesses benefit from a positive externality?
3. In a cross-sectional U.S. study, Skinner and Staiger (2007) find that the adoption of beta blockers to treat heart attacks in the early 2000s correlated geographically with the adoption of hybrid corn in 1930s-40s. What does this finding suggest about the adoption of innovation?

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
</table>
| #12 Apr 7 | Appropriability  
  - Patents  
  - Trade secrecy  
Specific questions:
1. Referring to the Png (2017) study. Suppose that there are no spillovers of R&D between businesses? How would that affect the interpretation of the empirical results?
2. The UTSA was associated with more R&D among larger and more R&D intensive companies (Png 2017). Is that good or bad for society?
3. Marx et al. (2009) show that mobility is lower in a state that enforces non-competition agreements. From society’s viewpoint, is this good or bad?

Empirical exercise:
1. Estimate patents as function of revenue and R&D among Singapore publicly-listed companies. (a) How would you estimate the effect of reforms to the patent law in 2004? (b) How would you address R&D being endogenous?

General questions:
1. Does stronger protection of intellectual property increase innovation?
2. How do knowledge spillovers depend on the laws of intellectual property rights, trade secrets, and employment?
3. “Although subsequent court decisions have upheld some of EMI’s patent claims, once the product was in the market it could be reverse engineered and its essential features copied” (Teece 1986: 298). Please discuss.

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>How does Felin and Zenger’s (2014) model apply to totally new, blue-sky inventions as contrasted with problem-driven innovations?</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>What do the findings of the Hui and Png (2015) study imply for the “digital divide”?</td>
<td></td>
</tr>
</tbody>
</table>

General questions

1. Why should any organization *not* engage in open innovation?
2. How does the trend towards self-service affect the measurement of total factor productivity?
3. From a societal standpoint, is it reasonable to charge a higher price to consumers who prefer human service?