# Special Feature C

# Economic Growth Through Innovation And Entrepreneurship

by Wong Poh Kam and Ho Yuen Ping[1]

## Introduction

In the five decades since political independence in 1965, Singapore has achieved one of the highest economic growth among newly industrialised economies (NIEs). This rapid growth was initially driven by a strategy that leveraged on foreign direct investment (FDI). As Singapore's factor costs, especially of land and labour, rose in tandem with rapid economic growth, the government made a concerted effort in the 1990s to shift its policy focus, transforming Singapore from an investment-driven economy into a knowledge-based economy. This policy shift emphasises the building of intellectual capital and a vibrant entrepreneurial culture to create value and jobs. What are the theoretical underpinnings for such policies? Is there empirical support for the purported efficacy of such policies to influence macroeconomic growth? In this article, we outline salient findings from our past and ongoing research to answer these questions.

## Contribution Of Entrepreneurship And Innovation To Economic Growth

Wong *et al.* (2005) traced the conceptual link between entrepreneurship, innovation and economic development to the economist Joseph Schumpeter who established the "entrepreneur as innovator". By feeding a creative destruction process, entrepreneurs create opportunities for more innovations to be spun-off and for more entrepreneurs to enter and expand the economy. Subsequent to Schumpeter's pioneering work, there has been a divergence in the research literature, with distinct strands of work separately examining either innovation or entrepreneurship as determinants of growth. While empirical work examining the effect of innovation on economic growth has increasingly utilised international panel data on R&D spending (see for example, Guellec and van Pottelsberghe de la Potterie, 2001), most empirical studies on the contribution of entrepreneurship have been single country-based, due to the lack of internationally comparable measures of entrepreneurial propensity. In Wong *et al.* (2005), we were among the first to examine the combined contributions of the two growth determinants in a cross-country setting, utilising new constructs for measuring entrepreneurial propensity that were beginning to emerge from an international comparative study called Global Entrepreneurship Monitor (GEM) (Reynolds *et al.*, 1999). In addition, rather than using R&D expenditures, we utilised patenting data to better capture the innovative outputs of economies.

Using cross-country data on 37 economies, we estimate a regression equation derived from a Cobb-Douglas production function. The rate of growth of GDP per employed person is the dependent variable, and Technological Innovation and Entrepreneurship are the two key predictors.

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Technological Innovation is measured by the number of USPTO patents granted to inventors from the economy, normalised against GDP. Entrepreneurship is measured by the Total Entrepreneurial Activity (TEA) rate captured by the GEM project. TEA is a propensity measure that quantifies the proportion of the adult population in an economy that is actively engaged in attempting to start up a new business or in running an early-stage business.

Four alternative measures of TEA are utilised, addressing different forms of entrepreneurship. Apart from the Overall TEA measure, we also examined Opportunity TEA, Necessity TEA and High-growth Potential TEA. Opportunity and Necessity TEA rates differentiate between two different motivations for individuals choosing to become entrepreneurs. Opportunity TEA captures those who form new businesses because they perceive opportunities in the market that can be pursued for economic gain; for example, introducing an innovative product, or targeting a market segment that is currently not served by other enterprises. Necessity TEA on the other hand addresses those who are driven to become entrepreneurs as a last resort, when other options for economic activity and employment are absent or unsatisfactory. High-growth Potential TEA identifies the subset of entrepreneurs that expressed high-growth aspirations, derived by operationalising their business expectations along four characteristics: (1) potential for employment growth; (2) market impact; (3) global customer base; and (4) use of new technology.

Our findings support the hypothesis that technological innovation is positively associated with economic growth. Our analysis also concludes that at the national level, technology innovation and new business creation can be regarded as two separate growth determinants. This is in contrast to conventional neoclassical models of growth that have tended to implicitly consider innovation as a proxy for entrepreneurship, as defined by firm formation.

Our findings suggest that the correlation between the two is not substantial, consistent with the empirical observation that technological innovation can be commercialised by both existing firms as well as new firms, and only a small proportion of entrepreneurial start-ups are engaged in commercialising technological innovation even in advanced economies.

Of the four different measures of entrepreneurial activities captured by GEM's TEA rates—High-growth Potential TEA, Necessity TEA, Opportunity TEA and Overall TEA—only High-growth Potential TEA is found to have a significant impact on cross-country variations in economic growth. While our cross-sectional analysis precludes a stronger causal conclusion, our finding is consistent with extant findings from single-country studies in the literature that it is fast-growing "gazelles" firms, not new firms in general, which accounted for most of the new job creation by small- and medium-sized enterprises in advanced countries.

Our main finding that High-growth Potential TEA is the sole form of entrepreneurship that has any explanatory effect on differing rates of economic growth across nations suggests that entrepreneurship promotion policy needs to be targeted. A high propensity of entrepreneurial participation does not in itself guarantee enhanced economic performance as there are entrepreneurial activities that do not contribute to growth. These would be exemplified by the Necessity-type entrepreneurs that create a "refugee" or "shopkeeper" effect where entrepreneurship provides employment to the business owner, but generates few jobs.

Supporting the above suggestion that entrepreneurship promotion policy needs to be targeted, we showed in a subsequent study (Ho and Wong, 2007) that the underlying factors that influence different types of TEA could vary. For example, the availability of informal investment ("angel investment") has a significant positive effect on Opportunity TEA and High-growth

Potential TEA, but not Necessity TEA, while regulatory costs (as measured by the World Bank's Cost of Doing Business) have a significant negative effect on Opportunity TEA, but not on High-growth Potential TEA or Necessity TEA.

These findings suggest that, to promote High-growth Potential TEA, merely reducing the domestic cost of doing business is not sufficient—other policy interventions may be needed (e.g., development of venture capital industry and international market access assistance).

# Widening Income Inequality: The Potential Downside Of Entrepreneurship

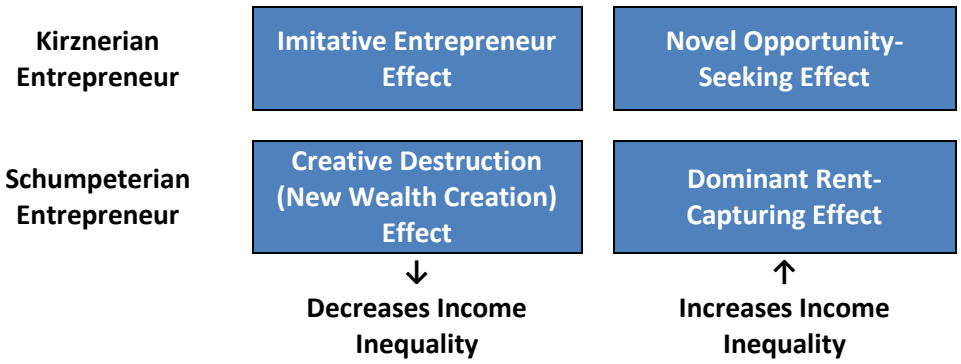
There is a conventional assumption that entrepreneurship is associated with higher income inequality, which has found some theoretical support in the economics literature (Cagetti and De Nardi, 2006). Scholars in the field of entrepreneurship on the other hand posit that entrepreneurial activity contributes to more equal wealth distribution through the mechanisms of new firm creation, innovation and competition. The disparity in conceptual views is in part due to different definitions of entrepreneurship. The sparse empirical literature suggests that entrepreneurship widens the income gap in advanced economies but has the opposite effect in developing economies. One shortcoming of the extant empirical literature is the broad measurement of entrepreneurship to encompass all forms of business ownership or self-employment.

In Wong and Ho (2014), we examined the effect of entrepreneurial propensity on the level of income inequality in a cross-section of 32 economies. Drawing on the UNU/WIDER World Income Inequality Database (WIID), income inequality is measured by the Gini coefficient. Our contribution is to focus on entrepreneurial activity which results in the creation of new enterprises. We measure entrepreneurship as the rate of new firm entry, which is computed as the share of newly registered businesses within a calendar year in the total stock of registered businesses as at the end of the year. In a discourse on wealth distribution, new firm entry assumes great significance because of the job-creating dynamics of firm birth.

We developed a framework based on two perspectives on the role of entrepreneurs in wealth generation. In the Schumpeterian view, entrepreneurs are innovators who engender creative destruction in the economy. They generate new wealth by creating new market demands with innovative products or services that did not exist before, or capture value from existing firms through innovating superior products or processes that take market share away from the incumbent firms (the destructive part of creative destruction). In contrast, the economist Israel Kirzner portrays entrepreneurs as "arbitragers" who bring markets into equilibrium by exploiting opportunities created by exogenously initiated changes. Kirzner's entrepreneur is alert to opportunities present in undiscovered, undervalued resources. While Kirzner's view of entrepreneurs thus emphasises the entrepreneur's novel opportunity exploitation role, it also suggests an alternative imitative role, whereby the entrepreneur merely seeks to copy what has been earlier discovered by other entrepreneurs in the hope of capturing a share of the market being created.

Integrating the insights of both the Schumpeterian and Kirznerian perspectives, we can posit that the dynamics of new firm formation in any economy consists of a mix of stylised Schumpeterian and Kirznerian entries, with the former endogenously creating opportunities and the latter recognising and exploiting opportunities that arise exogenously. While both are likely to generate new loci of income concentration, the Schumpeterian wealth creation effect as well as the income redistribution effect of the imitative Kirznerian entries are likely to lead to a lowering of income inequality over time. (Figure 1) The net effect of entrepreneurial new firm formation on overall income inequality therefore depends on the relative sizes of these opposing effects, and whether it is positive or negative can only be determined empirically.

**Figure 1**
**Opposing Income Distribution Effects of Schumpeterian and Kirznerian New Firm Entry**




We conducted multivariate regression analysis with data on 32 economies, ranging from mid-income developing to high-income advanced. Our first key finding is that increasing rates of new firm entry are associated with widening income inequality. Income accumulation appears to accrue disproportionately to new economic agents, and this accumulation effect is stronger than the redistributive effects of increased resource utilisation and demand generated by the newly created firms.

The second key finding from our results is that higher levels of new firm entry widen the income gap more in developing economies, as compared to high-income advanced economies. This finding is consistent with the view that opportunity-driven entrepreneurs create a temporary monopoly and the profits generated accrue temporarily to the innovator-entrepreneur. In advanced economies, there are mechanisms for knowledge and skills upgrading to equip the labour force with the capabilities to capitalise on the new opportunities created by new firm entry. At the same time, the innovation systems in advanced economies also facilitate knowledge transfer to a greater extent, allowing other entrepreneurs to initially imitate, and thereafter improve upon, the innovative ideas of the original new entrant. This creates a virtuous cycle of new firm entry that partially counters the wealth concentration arising from the initial temporary monopoly. On the other hand, systems and structures for supporting knowledge transfer and skills upgrading are less well-established in mid-income developing economies. New entrants are able to engage in monopolistic rent-seeking for longer periods and the scarcity of skills is more pronounced, leading to greater inequality compared to the advanced economies.

Hence, contrary to the unbridled optimism about the role of entrepreneurship in economic development among many government officials, a major implication from this study is that public policymakers need to recognise that the pure pursuit of entrepreneurship may not be optimal, as it may lead to potential adverse effects on social equity. A related policy implication is that, if and when a government does decide to embark on a public policy push to promote entrepreneurship, it should also incorporate policies to mitigate the potential adverse consequences of increasing income inequality arising from that promotion policy.

# Impact Of Innovation In Singapore: Contribution Of R&D To Productivity Growth

Total R&D expenditure in Singapore has been increasing steadily over the years, with a more pronounced increase in spending on R&D observed over the last two decades. This has led to questions on the impact of these R&D investments, in particular the socio-economic returns. In Ho *et al*. (2009) and Wong and Ho (2016), we conducted time series analysis on the impact of R&D investments on Total Factor Productivity (TFP) in Singapore. Utilising the two-step productivity approach, we first derive TFP from the underlying Cobb-Douglas production function. This

formulation yields TFP as the increase in output (GDP) that is not explained by changes in capital and labour, otherwise referred to as the Solow residual. In the second step, we estimated the regression equation:

$$TFP = \beta + \gamma \log S$$

where *S* is R&D capital stock. This estimates the long-run relationship between TFP and R&D capital stock, which is computed from the stream of annual R&D expenditure, applying the perpetual inventory method. Testing the residuals from the estimated long-run equation establishes whether there is a stable cointegrating relationship between TFP and R&D capital. If a cointegrating relationship exists, we can estimate the short-run relationship as follows:

$$TFP_t = \beta + \lambda_1 TFP_{t-1} + \ldots + \lambda_x TFP_{t-x} + \gamma \log S_t + \ldots + \gamma_y \log S_{t-y}$$

where γ (the coefficient on $\log S_t$) refers to the short-term elasticity of TFP with respect to knowledge stock.

In the earlier paper (Ho *et al*., 2009), we used data for the period 1978 to 2001. An updated analysis was recently conducted, extending the period covered to 2012 (Wong and Ho, 2016). In both papers, we established that there is a stable, long-run relationship between R&D and TFP in Singapore, providing concrete support for the returns on R&D investment. Table 1 summarises the parameter estimates from the two papers and provides a comparison with those found by other researchers for other economies. Short-term productivity of R&D in Singapore is comparable to that of the advanced economies in the OECD. However, in terms of R&D productivity in the long term, Singapore is comparable to the non-G7 members of the OECD but lags behind the G7 nations. This gap may be related to the issue of "leakage" of value capture. This challenge, which is common to most small advanced economies, arises from the relatively small domestic economy which faces fierce global competition to capture the chain of downstream values created by R&D. In the case of Singapore, value capture leakage is likely to be exacerbated by the high share of R&D being done by subsidiaries of foreign MNCs.

**Table 1**
**Comparison of R&D Elasticity Estimates from Selected Studies**

| | Singapore (Wong and Ho, 2016) | Singapore (Ho *et al.*, 2009) | Greece (Voutsinas and Tsamadias, 2014) | 16 OECD Countries (Guellec and van Pottelsberghe de la Potterie, 2001) | 22 OECD countries + Israel (Coe and Helpman, 1995) |
|---|---|---|---|---|---|
| **Dependent Variable** | **TFP (based on GDP)** | **TFP (based on GDP)** | **TFP (based on GDP)** | **Private Sector TFP** | **Private Sector TFP** |
| **Period of Estimation** | **1978–2012** | **1978–2001** | **1987–2007** | **1980–1998** | **1971–1990** |
| Short-term Elasticity with respect to R&D | 0.025 | 0.013 | Non-significant | 0.024 (Private R&D)<br>0.028 (Public R&D) | N.A. |
| Long-run Elasticity with respect to R&D | 0.091 | 0.081 | 0.038 (Total R&D)<br>0.075 (Public R&D) | 0.13 (Private R&D)<br>0.17 (Public R&D) | 0.078 (Non-G7)<br>0.234 (G7) |

We additionally tested the hypothesis that increases in public sector R&D stimulate R&D activities in the private sector. The opposite direction of causality is not expected; innovation in the private sector is usually protected for reasons of corporate competition. To test these hypotheses, we conducted Granger Causality tests between the public and private R&D capital stocks. The findings confirm that private sector R&D has no causal effect on public sector R&D. However, an increase in public R&D spending in the previous year does have a significant and positive impact on private sector R&D in the current year. We concluded that public sector R&D contributes to increased private sector R&D, with a one-year lag between cause and effect.

The empirical findings in this paper suggest several policy implications for increasing the economic impact of R&D investment in Singapore. Firstly, policies should continue to be developed to facilitate a greater degree of technology transfer from the public to the private sector, in order to maximise the positive externalities of publicly-funded research. Secondly, our findings suggest the need for initiatives to improve the absorptive capacity of local Singapore firms. Finally, the possibility of leakage of value capture implies the need for policies to promote greater retention of the downstream value creation activities arising from R&D investments within Singapore. In particular, value-capturing activities pertaining to the commercialisation of Intellectual Property (IP) as the most tangible outcome of R&D should be emphasised.

# Entrepreneurial Start-ups In Singapore: Trends And Impact

The lack of sufficiently long time series data on start-up rates in Singapore prevents us from conducting a similar economic impact analysis for entrepreneurship. Here, we present some preliminary descriptive statistics from an ongoing study to illustrate the role of young firms in Singapore's economy.

New firm formation in Singapore has increased rapidly, especially in the last five years. (Table 2) Further, the firm birth rate in high-tech sectors has surged strongly. As at end-2014, almost half the active firms in high-tech sectors were young firms registered within that calendar year. This is significant, as firm birth rate is one indicator of business dynamism. Research using US data (for example, Decker *et al.*, 2014) showed that high dynamism contributes to productivity growth and job creation by reallocating resources to more productive activities. This will be a key point of interest in our ongoing study using Singapore data.

**Table 2**
**Formation of New Enterprises in Singapore**

| | Number of New Enterprises | | Firm Birth Rate (New Enterprises as % of Total Enterprises) | |
|---|---|---|---|---|
| | High-tech | Non-High-tech | High-tech | Non-High-tech |
| 2004 | 3,469 | 31,387 | 34.5 | 30.6 |
| 2009 | 4,959 | 48,267 | 37.6 | 37.6 |
| 2014 | 8,567 | 68,812 | 47.4 | 40.2 |

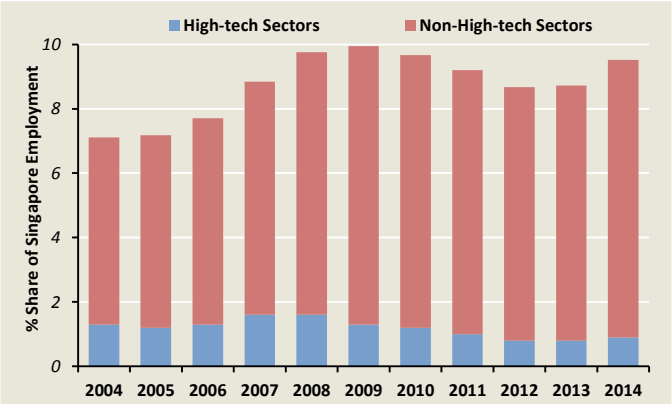
Source: ACRA and DOS

We are particularly interested in the segment of new enterprises which are start-ups. In this context, we adopt the definition of "start-up" used by SPRING Singapore, namely that a start-up is a business entity that: (a) is less than 5 years old; (b) has at least 50% of its equity individually owned; (c) has at least one employee. Chart 1 shows that start-ups now contribute close to 10% of jobs in Singapore, up from less than 8% in the mid-2000s. As at end-2014, start-ups provided employment to 345,000 people. While the number of jobs in high-tech start-ups is comparatively small (0.9% of total

employment), a closer examination shows that start-up employment growth is faster in high-tech services than other sectors. (Chart 2) A survey of Singapore's tech start-ups is currently undertaken in our ongoing study to examine the determinants of their growth dynamics.

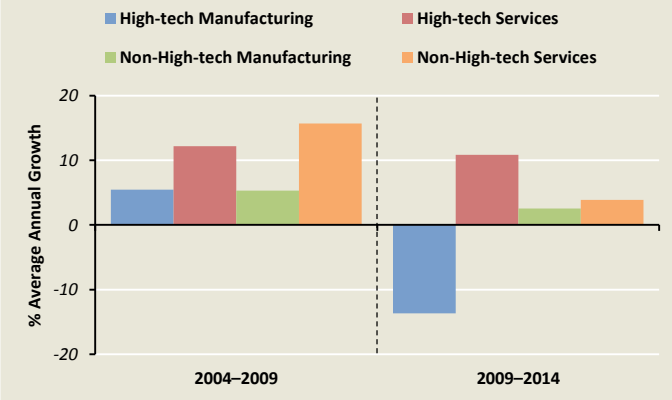
We are also developing a comprehensive information portal on Singapore's tech start-up ecosystem (www.TechSG.io) to study the dynamic links between the tech start-ups and other key actors in the ecosystem (investors, incubators, industry associations and supporting government agencies).

**Chart 1**
**Trends in Start-up Employment**




Source: DOS and EDB

**Chart 2**
**Growth in Start-up Employment by Sector**




Source: DOS and EDB

# Concluding Remarks

Our research confirmed that there are persuasive theoretical and empirical foundations for policies that promote entrepreneurship and innovation in pursuit of economic growth. However, entrepreneurship promotion policy must be nuanced, recognising that not all entrepreneurial activities generate growth, and should be accompanied by appropriate measures to mitigate the potential for increased inequality of wealth.

Similarly, R&D investments have enhanced productivity levels in Singapore but R&D promotion alone is insufficient. Further steps should also be taken to facilitate the transfer of public R&D to industry in general, and to improve the capability of local economic agents to capture the value of R&D outputs in particular.

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