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The Effect of Entrepreneurial Activity on 2011-2015 National Economic Growth: An Econometric Analysis of Global Entrepreneurship Monitor Data

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Abstract

Although it is generally agreed that entrepreneurship acts as a key determinant for economic growth, there has been a historical lack of empirical-based work on this topic. The creation of the Global Entrepreneurship Monitor (GEM), an organization that internationally collects data on entrepreneurship, provided researchers a standardized way to compare entrepreneurial activity across countries. Past literature that utilized this data offered promising insights on the effect of entrepreneurship on economic growth. However, most, if not all, of these papers were conducted only a few years after the advent of the GEM in 1999, limiting the amount of data that could be studied. Now that around two decades have passed, enough countries have participated in the GEM for multiple years to allow for an extensive time-series based analysis. With the latest GEM data, this paper investigates whether Total Entrepreneurial Activity (TEA) and its variants-opportunity, necessity, and high potential TEA-affect Gross Domestic Product (GDP) growth for a sample of 54 countries. Alternative growth-influencing variables are controlled for with the inclusion of the Growth Competitiveness Index (GCI). Out of the four types of TEA, only high potential TEA is found to have a statistically significant effect on economic growth. This finding is consistent with past literature that conducted empirical work on the GEM data and suggests that firms with high potential for growth impact the economy through job creation, increased innovation, and firm dynamics.

Keywords: GEM (Global Entrepreneurship Monitor); GCI (Growth Competitiveness Index); Entrepreneurial activity; Economic growth; High-growth firms

Abbreviations: GEM: Global Entrepreneurship Monitor; TEA: Total Entrepreneurial Activity; APS: Adult Population Survey; GCI: Growth Competitiveness Index; GCR: Global Competitiveness Reports; GNIC: Gross national income per capita; OLS: Ordinary least squares; PPP: Purchasing Power Parity; RESET: Ramsey Regression Equation Specification Error Test; BLUE: Best Linear Unbiased Estimator

Introduction

Economic growth and its influencing factors receive interest in policymaking and economic research when considering issues as high unemployment, stagflation, and slow growth [1]. Past literature determines such factors to be investment, trade, capital development, climate, policy, technology, etc. [2]. But even with extensive research, entrepreneurship fails to be listed as a critical determinant of growth despite its proposed benefits of stimulating innovation and competition [1,3,4].

The effect of entrepreneurship on economic growth seems clear, but this relationship has mainly been theorized in past literature with relatively few studies providing data-backed evidence for its existence. Empirical research on this topic usually look at the impact of entrepreneurial activity on elements that potentially influence economic gains, such as net job creation or firm productivity, and merely infer from the findings that entrepreneurial activity may affect economic growth. The lack of literature directly linking entrepreneurship to economic growth is partly due to the difficulty in defining and measuring entrepreneurship for an empirical model [4]. In general, the meaning of entrepreneurship has been interpreted in three different ways [5].

Concept 1: Engaging in new venture creation or being a nascent entrepreneur.

Concept 2: Owning a small firm.

Concept 3: Being self-employed or owning a business.

In the past, data on entrepreneurship had to be extrapolated from other unreliable measures such as self-employment or business size and age. These metrics were collected and interpreted differently by country, making it challenging to cross-nationally compare the rate and effect of entrepreneurship [3,6]. However, in 1999, the creation of the GEM research program offered a standardized measure of entrepreneurship across countries in the form of TEA which measures the number of young business owners and nascent entrepreneurs for a given country. As a result, GEM applies consistent definitions and reliable data collection across countries to allow for international comparisons [6].

This paper empirically analyses the effect of entrepreneurial activity on national economic growth using data from the GEM. Statistical analysis is conducted to see if TEA rates during the 2006-2010 period influenced GDP growth during the 2011-2015 period for a sample of 54 countries. Therefore, this paper will follow Concept 1 for its definition of entrepreneurship. The study will also look to see if the effect of entrepreneurship on growth varies by the type of entrepreneurial activity, the country's stage of economic development, or the country's

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income level. Such an analysis can contribute to past literature that has utilized data from the GEM and help inform policies designed to encourage entrepreneurial activity.

The rest of this paper is structured as follows. Section 2 discusses the various benefits of entrepreneurship as well as the theoretical and empirical literature describing the relationship between entrepreneurial activity and economic growth; Section 3 explains the data, empirical framework, and hypotheses to be tested; Section 4 introduces the results of the analysis; Section 5 presents the discussion of the findings, and Section 6 delivers concluding remarks.

Literature Review

Entrepreneurship and growth

Entrepreneurship can affect economic growth in a variety of ways. Analysis of panel data of firms across industries in the United Kingdom finds that the introduction of advanced technology by new firms forces incumbent firms near the technology frontier to innovate or face market exit, supporting the idea that entrepreneurship increases productivity growth [7]. It has also been theorized by that entrant firms introduce variations of existing products into the market which results in the creation of a de facto product or dominant design. From that point, firms shift their focus from product innovation to process innovation, heavily investing in capital methods of production to increase efficiency and maintain competitiveness [8]. Although this outcome results in reduced innovation, the increased productivity from process innovation still contributes to economic growth.

Entrepreneurship in the form of young firms and start-ups have been a vital source of net job creation despite having high market exit rates that contribute to job destruction [9,10]. Haltiwanger et al. analyze data from the Census Bureau's Business database and find no relationship between firm size and net job growth, contrary to previous literature. The authors determine that firm births are responsible for a large amount of gross and net job creation while small, mature firms hurt net job creation [9]. Additionally, Stangler finds that the fastest growing young firms, termed as "gazelles," create around 10% of new jobs in a given year despite comprising less than 1% of all companies. Thus, entrepreneurship can boost economic growth by helping to reduce a country's unemployment rate [10].

In terms of wealth, entrepreneurs experience more wealth, mobility, and saving-income ratios than workers [11]. These findings suggest that entrepreneurship can increase per capita income and reduce wealth inequality. Such wealth redistribution can boost overall consumer spending, which in turn can stimulate economic growth. Moreover, wealth generation can promote intergenerational mobility by reducing frictions in an economy, and incentivizing people to work hard, increasing overall productivity [12].

Theoretical literature

Numerous theoretical arguments have been made in an attempt to connect entrepreneurship to economic growth. Schumpeter gives the first glimpse into the role of the entrepreneur as a critical determinant for economic growth. From examining European industrial structure in the 19th century, Schumpeter discusses how the entry of innovating entrepreneurs challenges incumbent firms by introducing new ideas, products, or processes. As a result, current technologies and products are made obsolete in the process of creative destruction that is labelled as the Schumpeter Mark I regime [13,14].

Schumpeter adjusts his view after observing the American industry in the 20th century and argues that a more centralized industry structure is better for economic growth. He describes how large firms generate most of the innovation from the creation of R&D laboratories. Increased innovation allows these firms to improve their production and distribution, which in turn increase their financial resources to fund more R&D activities in a positive feedback loop. As a result, new entrepreneurs and small firms face greater barriers to entry. This process of creative accumulation by centralized firms is referred to as the Schumpeter Mark II regime [13,15].

Small firms and entrepreneurs will flourish in a Schumpeter Mark I regime while a core of industries will form in a Schumpeter Mark II regime. Whether which system is more prevalent varies by period and industry. However, developed countries have been experiencing a shift from a 'managed' economy towards an 'entrepreneurial' economy in the last three decades, similar to a transition from a Mark II to a Mark I regime. As a result, economies are becoming less dependent on large-scale production that utilizes capital and unskilled labour and more reliant on innovation and the presence of entrepreneurs to facilitate knowledge spill over by exploiting R&D from private corporations and universities that have not yet been commercialized [16,17]. These findings suggest the importance of having an entrepreneurial-friendly environment for sustainable economic growth.

The assertions of the Schumpeter Mark I regime are supported by extensive literature reviews of the diverse pieces of research on the relationship between entrepreneurship and economic growth. Wennekers and Thurik create a working blueprint that links entrepreneurial activity to economic growth [1]. The framework shows the various effects and conditions that need to occur for entrepreneurial activity to have the largest effect on economic gains at different levels of analysis (individual, firm and aggregate level). Entrepreneurship stimulates advancement by generating innovation, enhancing and creating competition, and increasing new jobs. Holding everything constant, having more entrepreneurs should increase national economic growth [18].

When trying to improve economic gain with entrepreneurship, it is also possible that quality matters just as much as quantity. Lloyd-Ellis and Bernhardt theorize that the number of 'efficient,' or high ability, entrepreneurs will determine the type of economic development a nation undergoes. They utilize an equilibrium model and propose that having an abundant or scarce number of efficient entrepreneurs results in different development processes. Past findings suggest that the role of entrepreneurship on growth can vary by a country's stage of economic development and by the type of entrepreneurial activity [1,19].

Empirical literature

Literature empirically studying the effect of entrepreneurship in the form of new venture creation on national economic growth is limited. A reason for this is the difficulty in measuring entrepreneurial activity at the national level. Many empirical works that do not utilize data from the GEM vary in their definition of entrepreneurship and data sources.

Audretsch et al. use a modified Cobb-Douglass function to estimate the effect of entrepreneurship on output in 440 German counties. In this study, entrepreneurship is measured by start-up rates obtained from a German credit-rating agency. They conclude that entrepreneurs promote economic growth by facilitating knowledge spill over through the commercialization of new knowledge not fully exploited by incumbent firms [20]. A potential issue with this study lies with the data source. The use of a secondary source such as a credit-rating agency makes the findings of this paper unsuitable for international comparisons. Only around half of all aspiring entrepreneurs succeed in starting new ventures that appear on business records [5]. Thus, the calculated new firm creation rate is not representative of all those who initially tried to start a business as the authors are analysing a positively selected group of entrepreneurs. The presence of this survival bias will understate the true level of entrepreneurial activity in a region and potentially overstate the impact of an increase in entrepreneurship on economic growth.

Other studies empirically analyse the effect of entrepreneurship on a country-level. Carree et al. create an error correction model to find the equilibrium rate of entrepreneurship, in the form of business ownership, as a function of an economy's stage of development from analysing data of 23 Organisation for Economic Co-operation and Development (OCED) countries. The authors conclude that a country will experience reduced GDP growth if it deviates from its respective equilibrium rate of entrepreneurship [21]. Audretsch et al. apply a similar methodology to analyse the impact entrepreneurship, in the form of small business prevalence, on economic growth in 18 developed European countries. The authors conclude that deviating from the optimal rate of entrepreneurship resulted in a growth penalty of foregone economic growth [22]. The studies find that the relationship between growth and entrepreneurial activity depends on a country's actual and equilibrium entrepreneurship rates.

Despite these results, both papers have issues with their definition of entrepreneurship and data collection methods. Carree et al. admit that entrepreneurship does not equate to business ownership, which makes it impossible to obtain entrepreneurship rates that are statistically comparable across countries [21]. Business ownership, although a convenient and standardized proxy measure of entrepreneurial activity to make cross-national comparisons, is a broad definition that includes those that are self-employed and does not capture the true meaning of entrepreneurship. Many entrepreneurs have a job while starting their own business and may not be considered independent or a business owner. Finally, it is questionable whether some individuals, such as farmers, crafts workers, or independent professionals, that are considered business owners, should be also be seen as entrepreneurs. With Audretsch et al. making small firms synonymous with entrepreneurship raises several concerns [22]. The definition of a small firm is subjective and often determined by the laws of a specific economy [5]. For example, having higher corporate taxes for businesses with a certain number of employees might prevent numerous firms from hiring above this specified amount. What is considered small in one country may mean something different in another, and it is essential to note that not all entrepreneurs run small firms, and not all small firms are run by entrepreneurs. A common issue with both studies is the analysis of only developed countries. The measures of business ownership or small firms might not include start-ups because such firms are too young to be listed on any business records. Also, these metrics might correlate well with the number of new firms only in developed nations as new venture creation is more sporadic in developing countries [4].

The problems demonstrated in this literature review may be resolved by using the TEA metric from the GEM datasets. Stel et al. and Wong et al. both study cross-sectional data of 36 and 37 countries, respectively that participated in GEM 2002 to test the influence of TEA on GDP growth in the medium term. Stel et al. looks at the effect of overall TEA in countries with different stages of economic development and income levels while using the Growth Competitive Index (GCI), log (GNIC), and lagged economic growth as control variables. The authors determine that TEA negatively impacts GDP growth for relatively poor countries and positively impacts that of relatively wealthy countries. The interaction term of TEA and per capita income has a significant effect on growth. In terms of economic development, TEA has a significant impact on growth for only highly developed countries. These findings suggest that the effect of overall TEA changes varies by stages of development and income levels [3].

Wong et al. analyse the effects of different types of TEA on GDP growth using a modified Cobb-Douglas production function. It is determined that out of the four categories analyzed: opportunity, necessity, high growth potential, and overall, only high growth potential TEA has a significant impact on growth. This finding is consistent with conclusions of past literature that contend that fast-growing new firms, rather than new firms, are responsible for most of the net job creation in advanced countries [4,10].

Due to data constraints, both papers were forced to adopt a cross-sectional approach rather than the ideal time-series based analysis. Stel et al. tries to regress the average GDP growth from 1999-2003 onto the average TEA from 1994-1998, and Wong et al. try to regress average growth from 1998-2002 onto average TEA from 1993-1997. However, TEA data before 1999 wasn't available, so both papers are forced to use the 2002 GEM dataset as it was the most comprehensive file that covered more countries than from previous years [3,4]. The overlap between the periods of growth and entrepreneurial activity make it difficult to determine the actual direction of causality. Now that around two decades have passed since the advent of GEM, there is enough yearly data to establish distinct current and lagged periods for a time-series based analysis.

Methodology

Variables and data

This analysis utilizes four different variables: Total Entrepreneurial Activity (TEA), Growth Competitiveness Index (GCI), Gross National Income per Capita (GNIC), and Gross Domestic Product (GDP) growth to study the effects of entrepreneurship on 2011-2015 economic growth for 54 countries. The list of countries is presented in Table 1. The data for the independent variables and dependent variable are respectively calculated by averaging the variable's values from 2006-2010 (lagged period) and 2011-2015 (current period). Summary descriptive statistics for these variables can be viewed in Table 2.

TEA, the explanatory variable of interest, is computed by averaging annual TEA rates from the lagged period. Data on TEA comes from the GEM 2006-2010 datasets. The GEM data are supported by macroeconomic indicators from separate national and international data sources that are standardized to a per capita basis. The consistency in TEA rates allows for cross-sectional comparisons across the countries. The GEM has produced a yearly report since 1999, and the number of participating countries has risen since. GEM country reports are created by teams assigned to each country and cover a variety of nations that include those with economies considered as developing, transition, or highly developed. Before the creation of GEM, entrepreneurship research experienced several insufficiencies. There was a lack of internationally comparable data for entrepreneurial activity, and available data were outdated and did not capture the

Countries	Economic Development	Income Level	TEA	Opportunity TEA	Necessity TEA	High potential TEA
Angola	D	P	27.328	15.252	9.696	0.061
Argentina	T	M	14.016	8.493	5.129	0.178
Australia	HD	R	9.881	8.354	1.362	0.149
Belgium	HD	R	3.183	2.625	0.260	0.157
Bolivia	D	P	34.210	26.284	7.542	0.233
Bosnia and Herzegovina	T	M	7.064	3.892	3.056	0.113
Brazil	T	M	13.844	8.500	5.233	0.040
Chile	T	M	13.430	9.702	3.487	0.268
China	T	P	16.459	9.227	6.882	0.305
Colombia	T	M	22.581	13.378	8.815	0.496
Croatia	T	R	6.910	4.109	2.546	0.260
Denmark	HD	R	4.511	3.889	0.257	0.143
Dominican Republic	T	M	18.212	12.344	5.714	0.280
Ecuador	T	P	18.084	12.722	5.295	0.095
Egypt	D	P	10.063	6.781	3.075	0.137
Finland	HD	R	6.026	4.650	0.918	0.061
France	HD	R	4.679	3.432	1.021	0.097
Germany	HD	R	4.062	2.626	1.219	0.078
Greece	HD	R	7.554	5.326	1.812	0.028
Guatemala	D	P	17.751	10.708	3.626	0.000
Hungary	T	R	7.152	5.256	1.687	0.124
Iceland	HD	R	11.165	9.402	0.836	0.689
India	D	P	10.146	6.747	2.333	0.035
Ireland	HD	R	7.481	5.718	1.166	0.321
Israel	HD	R	5.747	3.977	1.338	0.371
Italy	HD	R	3.836	2.989	0.606	0.032
Jamaica	D	M	17.291	10.289	6.465	0.080
Japan	HD	R	3.845	2.703	1.062	0.058
Latvia	T	M	7.550	5.480	1.800	0.375
Malaysia	T	M	6.820	5.890	0.749	0.014
Mexico	T	M	9.598	7.268	1.640	0.012
Netherlands	HD	R	6.043	4.860	0.542	0.115
Norway	HD	R	8.111	6.944	0.649	0.199
Peru	T	P	27.958	19.993	7.687	0.376
Portugal	HD	R	6.592	5.265	0.916	0.107
Romania	T	M	4.328	2.625	1.227	0.115
Russia	T	M	3.768	2.592	1.012	0.077
Saudi Arabia	D	R	7.031	6.179	0.743	0.360
Serbia	T	M	7.017	3.738	2.832	0.117
Slovenia	HD	R	5.164	4.465	0.594	0.203
South Africa	T	M	6.959	4.672	2.064	0.223
South Korea	HD	R	7.852	4.468	3.227	0.206
Spain	HD	R	6.266	4.958	1.037	0.032
Sweden	HD	R	4.160	3.565	0.431	0.182
Switzerland	HD	R	6.341	5.275	0.701	0.207
Thailand	T	P	21.036	14.054	6.275	0.021
Tunisia	T	P	7.776	5.473	1.670	0.029
Turkey	T	M	6.551	3.684	2.319	0.454
Uganda	D	P	32.479	17.073	15.332	0.000
United Arab Emirates	HD	R	8.475	7.195	0.928	1.448
United Kingdom	HD	R	5.972	4.749	0.650	0.190
United States	HD	R	9.189	7.107	1.625	0.300
Uruguay	T	M	12.102	8.152	3.383	0.301
Venezuela	D	M	19.410	12.906	6.241	0.097

Source: 2006-2010 GEM Datasets.

Table 1: List of 54 countries that participated in the 2006-2010 GEM datasets with corresponding TEA rates.

Countries	Frequency	Overall TEA	Opportunity TEA	Necessity TEA	High Potential TEA
Economic Development					
Developing	9	19.523	12.469	6.117	0.111
Transition	22	11.782	7.784	3.659	0.194
Highly Developed	23	6.354	4.980	1.007	0.234
Income level					
Poor	11	20.299	13.119	6.310	0.117
Middle	17	11.208	7.271	3.598	0.191
Rich	26	6.432	5.003	1.082	0.235
All countries	54	10.760	7.370	2.939	0.197
Source: TEA rates from the 2006-2010 Gem Datasets, countries categorized by stage of economic development using 2010 Global Competitiveness Report, countries categorized by income level using 2010 World Bank Analytical Classification Ranges.					

Table 2: Average TEA levels (2006-2010) by stage of economic development and income level.

true meaning of entrepreneurship. Additionally, there was little information regarding the business founders themselves or the stages of the start-up process. Without GEM, it was not possible to conduct an international time-series study of entrepreneurial activity and its framework conditions since cross-national comparisons could not be made [23].

The goal of GEM is to provide complete global data on entrepreneurship. GEM administers an Adult Population Survey (APS) in each country to a representative national sample of at least 2000 participants to create standardized data on a population's "entrepreneurial preferences, capacities, and activities" [23]. Every country in GEM has a group of 'experts' that are interviewed to obtain an appraisal of the country's nine entrepreneurial framework conditions, such as cultural values or government policies, as well as its entrepreneurial opportunities and capabilities. Another group of 'experts' is tasked with completing a questionnaire that covers the same topics conducted in the interviews to create a normalized measure of the perceptions of a country's entrepreneurial conditions [23]. These various assessments determine a country's TEA, which is the leading explanatory variable of interest.

Not all countries covered in GEM 2006-2010 were studied in this paper due to some of them missing data on TEA for specific years. In total, 54 countries were analyzed, with 24 of them investigated by the GEM for the entire period while the rest were covered for two or more years. The analysis was expanded to countries with incomplete data to get a larger sample size with more variety in terms of stage of economic development and income level.

TEA measures the percentage of the 18-64 population who are either a nascent entrepreneur or owner-manager of a new business less than 42 months old. Part of this overall TEA value is comprised of different types of TEA accounted for by the GEM. The following types of TEA are also used in this study:

- Opportunity TEA: Measures the percentage of the 18-64 population who pursue entrepreneurship out of the desire for independence, to increase their income, or to maintain their income.
- Necessity TEA: Measures the percentage of the 18-64 population who pursue entrepreneurship out of necessity because other economic options were unsatisfactory.
- High Potential TEA: Measures the percentage of the 18-64 population who pursue entrepreneurship and start firms that have high growth potential. This measure is not directly calculated by the GEM and must be derived from the APSs, where the number of high potential firms is divided by the total sample. For this study, the following criteria from Wong et al. are used to define a high potential firm (all requirements must be met) [4]:

i. The venture plans to employ at least 20 employees in five years.

ii. The venture indicates at least some market creation impact.

iii. At least 25% of the venture's customers normally live abroad.

iv. The technologies employed by the venture had not been widely available more than a year ago.

GCI, a control variable, is computed by averaging annual GCI values from the lagged period. Data on GCI comes from the World Economic Forum's 2006-2010 Global Competitiveness Reports (GCR). The purpose of the GCR is to appraise the ability of countries to have sustained economic growth and provide high levels of prosperity to its citizens. The report accomplishes this task by looking to see if individual national economies have the necessary structures, institutions, and policies needed for growth in the medium term. The GCR identifies twelve pillars of competitiveness associated with economic growth: institutions, appropriate infrastructure, stable macroeconomic framework, good health and primary education, higher education and training, efficient good markets, efficient labour markets, developed financial markets, ability to harness existing technology, market size (domestic and international), production of new/different goods using the most advanced production processes, and innovation. These growth factors are captured by the GCI, which is a measure that incorporates micro and macroeconomic aspects of competitiveness. Countries analyzed by the GCR are given a GCI score from 1-7, with 7 being the best and 1 being the worst. When calculating this score, each of the twelve pillars is given different relative weights depending on the country's stage of economic development. The more relevant a certain pillar is for an economy given its current stage, the higher its weight. Therefore, the best way for a country to improve it's GCI might not be the optimal process for a different country. In summary, the GCI is included in this study as it encapsulates several important control variables that can affect economic growth [3,24].

GNIC, a control variable, is based on Purchasing Power Parity (PPP) and is computed by averaging annual GNIC values from the lagged period. GNIC is converted to international dollars using PPP rates, and an international dollar has the same purchasing power as a U.S. dollar. Data on PPP GNIC comes from the World Development Indicators database of the World Bank for the years 2006-2010.

GDP Growth, the measure of economic growth in this study, is used as both the dependent and control variable. The dependent variable is computed by averaging annual GDP growth rates from the current period, while the control variable averages rates from the lagged period.

Data on growth rates come from the IMF World Economic Outlook database for the years 2006-2015.

Empirical framework

The methodology used in this paper is influenced by that of Stel et al. and Wong et al. [3,4]. The model specifications follow closely to that of Stel et al. who created five different equations to test the effect of overall TEA on economic growth and to see if this effect varies by stages of economic development or income levels.

The 2010 GCR was used to classify each country by the level of economic development. The GCR ranked countries from a scale of 1-3 with 1 indicating a country's economy to be factor-driven, 2 to be efficiency-driven, and 3 to be innovation-driven. For this paper, countries with a GCR development score of 1 were considered as having "developing" economies, 2 as "transition" economies, and 3 as "highly developed" economies. An economy in a factor-driven stage gets its competitiveness from primarily unskilled labour and natural resources, resulting in low productivity and wages. As development increases and wages rise, the economy enters the efficiency-driven stage of development where more efficient production processes are created, product quality increases, and competitiveness becomes driven by higher education and training, efficient markets, and the ability to use existing technologies. Finally, with enough development and innovation, the economy enters the innovation-driven stage where competition stems from the production of new and different goods, and the utilization of the most sophisticated production processes results in higher wages and standard of living [24].

For income, countries are categorized as being poor, middle, or rich in per capita wealth. The World Development Indicators classifies countries by income level using GNIC in U.S. dollars calculated using the Atlas methodology. In this study, average GNIC in U.S. dollars (Atlas method) for 2006-2010 was used to classify each country by income level based on the following 2010 World Bank Analytical Classification ranges: Poor (≤ \$3,975), Middle (\$3,975 ≤ \$12,275), and Rich (>\$12,275).

Like Wong et al., overall TEA will be substituted with opportunity TEA, necessity TEA, and high potential TEA to see if the effect on economic growth varies by the type of TEA. As mentioned previously, this analysis defines high potential firms using the criteria given by Wong et al. [4]. Ordinary Least Squares (OLS) regression will be applied to all model specifications.

$$\Delta GDP_{it} = a + b\log\left(\text{GNIC}_{i,t-1}\right) + cGCI_{i,t-1} + d\Delta GDP_{i,t-1} + \varepsilon_{it} \quad (1)$$

$$\Delta GDP_{it} = a + bTEA_{i,t-1} + c\log\left(\text{GNIC}_{i,t-1}\right) + dGCI_{i,t-1} + e\Delta GDP_{i,t-1} + \varepsilon_{it} \quad (2)$$

$$\Delta GDP_{it} = a + bTEA_{i,t-1} + c\left(TEA_{i,t-1} * \text{GNIC}_{i,t-1}\right) + d\log\left(\text{GNIC}_{i,t-1}\right) + eGCI_{i,t-1} + f\Delta GDP_{i,t-1} + \varepsilon_{it} \quad (3)$$

$$\Delta GDP_{it} = a + bTEA_{i,t-1}^{Rich} + cTEA_{i,t-1}^{Middle} + dTEA_{i,t-1}^{Poor} + e\log\left(\text{GNIC}_{i,t-1}\right) + fGCI_{i,t-1} + g\Delta GDP_{i,t-1} + \varepsilon_{it} \quad (4)$$

$$\Delta GDP_{it} = a + bTEA_{i,t-1}^{Highly\ Developed} + cTEA_{i,t-1}^{Transition} + dTEA_{i,t-1}^{Developing} + e\log\left(\text{GNIC}_{i,t-1}\right) + fGCI_{i,t-1} + g\Delta GDP_{i,t-1} + \varepsilon_{it} \quad (5)$$

All five specifications include the control variables GCI, log (GNIC), and lagged GDP growth due to their universal effects on the dependent variable. GCI captures several control variables that can affect GDP growth, which is a practical measure since the study's small sample size limits the number of independent variables that can be included in the models. The logarithm of GNIC is included in all models to represent the initial income level of countries and the "catch-up effect" which refers to the high growth rates achieved by poor, underdeveloped nations from absorbing superior technologies and capital from richer, highly developed countries [3]. Finally lagged GDP growth is present in all models to limit the potential effect of reversed causality.

The subscript notations t and t-1 indicate the variable data is averaged from the current period of 2011-2015 and the lagged period of 2006-2010 respectively. Model 1 only includes the control variables. Model 2 includes a linear TEA term. Model 3 includes a linear TEA term and an interaction term of TEA and GNIC. Model 4 includes linear TEA terms for rich, middle, and poor countries. Model 5 includes linear TEA terms for highly developed, transition, and developing countries.

Using data for the explanatory and independent variables that are from a period that precedes the period of the dependent variable can strengthen the causal relationship of TEA on economic growth by removing the presence of endogeneity as economic growth in a later period cannot affect TEA in a previous period. As mentioned previously, both Stel et al. and Wong et al. try to conduct their analyses in this way but are unable to because of data constraints, resulting in the periods of GDP growth and TEA to overlap [3,4].

Hypothesized relationships

Stel et al. find no statistical significance with the linear TEA term in Model 2 but found significance with the TEA*GNIC interaction term and TEA of rich, poor, and highly developed countries [3]. Wong et al. on the other hand, find that only high potential TEA had a significant effect on economic growth [4].

A possible explanation for why overall TEA has a significant positive impact in rich or highly developed nations could be due to the presence of economic conditions such as a stable government or good infrastructure promotes entrepreneurship. In such environments, it's easier to create and grow new ventures that contribute to economic growth. Also, economies that have high wages and efficient labour markets can increase the average ability pool of entrepreneurs as those with low entrepreneurial ability choose waged labour while those with high capacity start ventures [5,12]. Thus, rich or highly developed countries probably have more opportunity and high potential TEA relative to necessity TEA.

In poor or developing nations, the effect of overall TEA on growth is significantly negative due to worse economic conditions that hinder start-up creation and growth. Factors such as low wages and inefficient job markets cause those with lower entrepreneurial abilities to create start-ups because they have no other option, reducing the average quality of entrepreneurs [5]. Therefore, poor or developing countries have more necessity TEA relative to opportunity and high potential TEA.

In summary, countries that are rich or highly developed have more productive firms that contribute to the economy than those that are poor or developing. Although this rationale is incomplete, the following hypotheses are proposed:

- ➢ Hypothesis 1: Overall TEA has a positive or negative significant effect on economic growth depending on a country's stage of economic development or income level.

➢ Hypothesis 2: Opportunity TEA has a positive significant effect on economic growth for all countries.

➢ Hypothesis 3: Necessity TEA has an insignificant effect on economic growth for all countries.

➢ Hypothesis 4: High potential TEA has a positive significant effect on economic growth for all countries.

Results

The effect of entrepreneurship on economic growth was estimated by applying OLS regression to the model specifications containing one of the four types of TEA as the main explanatory variable. Tests were also conducted to assess the validity of the empirical framework used in this study. A Ramsey Regression Equation Specification Error Test (RESET) found no misspecification in any of the models, and a Breusch-Pagan test confirmed that all regressions lacked heteroskedasticity. All criteria required for the OLS estimator to be the Best Linear Unbiased Estimator (BLUE) of the coefficients have been met.

Tables 3-6 presented the estimation results from the regressions run on Models 1-5 for overall, opportunity, necessity, and high potential TEA, respectively. The results from Model 1 in all tables were identical as the model only includes the control variables of log (GNIC), GCI, and lagged GDP growth. The interaction term of TEA and GNIC had no effect on growth for all types of TEA. Statistical and economic significance was found for GCI and lagged GDP growth at the 10% level or lower in all regressions. Coefficient values for each variable remained consistent throughout the models, suggesting that a one-unit increase in GCI and a one percentage point increase in lagged GDP growth will increase GDP growth by roughly 1-1.5 and 0.5 percentage points respectively. All models had negative coefficients for log (GNIC) that were economically significant; however, only models containing high potential TEA demonstrated statistical significance for this control variable at the 5% level or lower. Models 2-5 for high potential TEA suggested that a 1% increase in GNIC would decrease GDP growth by roughly 0.03-0.035 percentage points (Tables 3-6).

When looking at results from Tables 3 and 5, no statistical or economic significance was found for any of the explanatory variables in the models containing overall and necessity TEA. For both types of TEA, the adjusted R-squared values for Models 2-5 did not significantly differ when compared to that of Model 1.

From Table 4, the effect of opportunity TEA on GDP growth was significantly positive at the 10% level in Model 2 as a linear term and in Model 5 as a linear term for transition or developing countries. However, economic significance was not that high. Model 2 suggested that a one percentage point increase in opportunity TEA would increase GDP growth by 0.11 percentage points; Model 5 indicated that a one-point increase in opportunity TEA would increase GDP growth of transition and developing countries by 0.15 and 0.13 points respectively. Additionally, Models 1-5 all had similar values for the adjusted R-squared.

Next, Table 6 showed the positive statistical and economic significance for the effect of high potential TEA. Model 2 found the effect of the linear term to be significant at the 1% level, suggesting that a one-point increase in high potential TEA increased GDP growth by 4.5 points. Model 3 found that one-point increase in high potential

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2.215	-1.273	9.707	-2.911	-5.859
	(4.674)	(5.431)	(9.475)	(6.983)	(7.054)
TEA		0.062	-0.017		
		(0.050)	(0.075)		
TEA*GNIC			0.000		
			(0.000)		
TEA Rich Income				0.021	
				(0.130)	
TEA Middle Income				0.070	
				(0.067)	
TEA Poor Income				0.068	
				(0.055)	
TEA Highly Developed					-0.047
					(0.119)
TEA Transition					0.093
					(0.059)
TEA Developing					0.078
					(0.057)
log(GNIC)	-1.460	-0.910	-3.582	-0.551	-0.018
	(1.363)	(1.426)	(2.366)	(1.816)	(1.689)
GCI	1.101*	1.232**	1.265**	1.278*	1.437**
	(0.593)	(0.599)	(0.593)	(0.638)	(0.629)
lagged GDP growth	0.514***	0.476***	0.445***	0.469***	0.464***
	(0.123)	(0.126)	(0.127)	(0.132)	(0.132)
R-squared	0.411	0.429	0.452	0.432	0.450
Adjusted R-squared	0.376	0.3827	0.3948	0.3589	0.3796

[a]Dependent variable=average annual GDP growth over 2011-2015 period. Standard-errors are in parentheses. TEA is total entrepreneurial activity rate (Global Entrepreneurship Monitor). GNIC is per capita income. GCI is growth competitiveness index (Global Competitiveness Report). Lagged GDP growth is average annual growth over 2006-2010 period. *p<0.1; **p<0.05; ***p<0.01

Table 3: OLS Regression Results of Models 1-5 for Overall TEA (54 observations)[a].

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2.215	-1.320	7.257	-1.909	-5.528
	-4.674	(5.025)	(8.315)	(6.655)	(6.521)
Opportunity TEA		0.114*	0.027		
		(0.067)	(0.095)		
Opportunity TEA*GNIC			0.000		
			(0.000)		
Opportunity TEA Rich Income				0.104	
				(0.164)	
Opportunity TEA Middle Income				0.140	
				(0.097)	
Opportunity TEA Poor Income				0.116	
				(0.072)	
Opportunity TEA Highly Developed					-0.018
					(0.146)
Opportunity TEA Transition					0.154*
					(0.079)
Opportunity TEA Developing					0.133*
					(0.077)
log (GNIC)	-1.460	-0.961	-3.016	-0.907	-0.126
	(1.363)	(1.368)	(2.094)	(1.767)	(1.607)
GCI	1.101*	1.252**	1.256**	1.323**	1.428**
	(0.593)	(0.588)	(0.584)	(0.625)	(0.614)
lagged GDP growth	0.514***	0.475***	0.444***	0.477***	0.468***
	(0.123)	(0.123)	(0.124)	(0.127)	(0.124)
R-squared	0.411	0.445	0.463	0.447	0.464
Adjusted R-squared	0.376	0.3995	0.4075	0.3761	0.3951

[a]Dependent variable=average annual GDP growth over 2011-2015 period. Standard-errors are in parentheses. TEA is total entrepreneurial activity rate (Global Entrepreneurship Monitor). GNIC is per capita income. GCI is growth competitiveness index (Global Competitiveness Report). Lagged GDP growth is average annual growth over 2006-2010 period. *p<0.1; **p<0.05; ***p<0.01

Table 4: OLS Regression Results of Models 1-5 for Opportunity TEA (54 observations)[a].

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2.215	2.729	3.221	0.543	-0.275
	(4.674)	(5.877)	(7.293)	(6.329)	(6.636)
Necessity TEA		-0.022	-0.037		
		(0.147)	(0.197)		
Necessity TEA*GNIC			0.000		
			(0.000)		
Necessity TEA Rich Income				-0.444	
				(0.448)	
Necessity TEA Middle Income				-0.025	
				(0.178)	
Necessity TEA Poor Income				0.022	
				(0.160)	
Necessity TEA Highly Developed					-0.545
					(0.508)
Necessity TEA Transition					0.063
					(0.171)
Necessity TEA Developing					-0.002
					(0.159)
log (GNIC)	-1.460	-1.554	-1.694	-0.983	-1.016
	(1.363)	(1.517)	(1.948)	(1.654)	(1.633)
GCI	1.101*	1.085*	1.102*	1.088*	1.268**
	(0.593)	(0.607)	(0.631)	(0.640)	(0.627)
lagged GDP growth	0.514***	0.519***	0.517***	0.490***	0.509***
	(0.123)	(0.129)	(0.132)	(0.136)	(0.131)
R-squared	0.411	0.412	0.412	0.424	0.434
Adjusted R-squared	0.376	0.3635	0.3505	0.3503	0.3618

[a]Dependent variable=average annual GDP growth over 2011-2015 period. Standard-errors are in parentheses. TEA is total entrepreneurial activity rate (Global Entrepreneurship Monitor). GNIC is per capita income. GCI is growth competitiveness index (Global Competitiveness Report). Lagged GDP growth is average annual growth over 2006-2010 period. *p<0.1; **p<0.05; ***p<0.01

Table 5: OLS Regression Results of Models 1-5 for Necessity TEA (54 observations)[a].

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	2.215	8.691**	7.899	6.452	5.488
	(4.674)	(4.305)	(4.851)	(4.525)	(4.418)
High Potential TEA		4.511***	5.413**		
		(1.056)	(2.679)		
High Potential TEA*GNIC			-0.000		
			(0.000)		
High Potential TEA Rich Income				6.280***	
				(1.893)	
High Potential TEA Middle Income				7.293***	
				(1.972)	
High Potential TEA Poor Income				7.076**	
				(3.484)	
High Potential TEA Highly Developed					6.145***
					(1.842)
High Potential TEA Transition					7.540***
					(1.810)
High Potential TEA Developing					15.253***
					(5.240)
log (GNIC)	-1.460	-3.591***	-3.448**	-2.993**	-3.011**
	(1.363)	(1.277)	(1.346)	(1.284)	(1.231)
GCI	1.101*	1.565***	1.604***	1.416***	1.620***
	(0.593)	(0.522)	(0.538)	(0.521)	(0.519)
lagged GDP growth	0.514***	0.396***	0.395***	0.408***	0.402***
	(0.123)	(0.110)	(0.111)	(0.114)	(0.105)
R-squared	0.411	0.571	0.572	0.592	0.615
Adjusted R-squared	0.376	0.5361	0.5278	0.5401	0.5655

[a]Dependent variable=average annual GDP growth over 2011-2015 period. Standard-errors are in parentheses. TEA is total entrepreneurial activity rate (Global Entrepreneurship Monitor). GNIC is per capita income. GCI is growth competitiveness index (Global Competitiveness Report). Lagged GDP growth is average annual growth over 2006-2010 period. *p<0.1; **p<0.05 ; ***p<0.01

Table 6: OLS Regression Results of Models 1-5 for High Potential TEA (54 observations)[a].

TEA increased growth by 5.4 points with the effect being significant at the 10% level. Model 4 found the impact of high potential TEA to be statistically significant at the 1% or 5% level for all income categories, suggesting a one-point increase in high potential TEA increased growth by 6.3-7.3 points for rich, middle, and poor countries. Model 5 demonstrated a similar trend with the effect of high potential TEA being significant at the 1% level for all stages of economic development. The results suggested that a one-point increase in this type of TEA caused growth to increase by roughly 6.1, 7.5, and 15.2 points for highly developed, transition, and developing countries respectively. In terms of magnitude, high potential TEA had a bigger impact on growth than the other types of TEA, with the largest effect occurring in developing nations. When compared to Model 1, the inclusion of high potential TEA as a linear term in Models 2 and 3 and as linear terms by groups of countries in Models 4 and 5 caused a considerable increase of around 0.15 points in each regression's adjusted R-squared.

To ensure that the method of sample selection did not bias the results, four countries were randomly removed from the pool before re-running regressions so that every estimation utilized a completely different dataset. Estimated coefficient values remained consistent throughout all model specifications. Universal statistical significance was found once again for log (GNIC), and GCI and significance levels did not change for overall, necessity, and high potential TEA. No significance was found for opportunity TEA in Models 2 and 5, contrary to initial findings. However, this is neither surprising, nor a cause of concern as the predicted effects of this type of TEA were weakly significant to begin with. Original and modified regressions yielded nearly identical outcomes, indicating the robustness of this study's results.

Discussion

As previously mentioned, a common theme among all model specifications for every type of TEA was the statistical and economic significance of the log (GNIC) and GCI variables. The negative effect of initial income [log (GNIC)] confirmed the aforementioned "catch-up' effect where countries with poor or underdeveloped economies achieve high growth rates by successfully absorbing superior technology and capital from countries with rich or highly developed economies. As countries "catch-up" to the current level of technology, the amount of new technology from more developed nations that can be adopted lowers, reducing the potential for economic growth. Thus, it makes sense that as a country's level of wealth rises, GDP growth decreases. The GCI captures variables that can affect economic growth, with each variable weighted relative to a country's stage of economic development. An increasing GCI indicates a nation increasing its competitiveness and growth potential. Thus, it is expected that an increase in the score results in higher growth.

The regression results confirmed or rejected the previously stated hypotheses. The first hypothesis-overall TEA will influence GDP growth depending on a country's economic development or income level-was not supported. Overall TEA was found to be a statistically insignificant determinant for all model specifications (Table 3). The second hypothesis-opportunity TEA will positively affect growth-was weakly supported. Statistical significance for the effect of opportunity TEA was found in Models 2 and 5; however, results from the robustness test found no significance for the effect of this variable in any of the specifications (Table 4). This inconsistency in significance suggests that the causal effect of opportunity TEA on growth is not robust.

Therefore, it cannot be definitively concluded that this type of TEA meaningfully impacts GDP growth. The third hypothesis-necessity TEA does not impact economic growth-was supported. Regression results found the effect of necessity TEA to be statistically insignificant in all model specifications (Table 5). Support was found for the fourth hypothesis-high potential TEA will positively affect economic growth. Of the four types of entrepreneurial activity, only high potential TEA was found to have statistically and economically significant coefficients. All variations of the high potential TEA variable except the interaction term in Models 2-5 had a significant effect on GDP growth (Table 6). Coefficient values of high potential TEA are 4-15X greater than those of the other types of TEA whose values never went beyond a tenth of a decimal point. Regression results support the idea that high potential TEA has a causal effect on growth.

Significance of high potential TEA is aligned with the findings of Wong et al. [4]. A difference from this study was the non-robust results that suggested the possible significance of opportunity TEAs. Also, the regression results fail to support the findings of Stel et al. as no significance was found for the effect of overall TEA [3]. The findings suggest that the effect of entrepreneurship on GDP growth depends on the type of entrepreneurial activity. The insignificance of overall TEA suggests that only specific entrepreneurial activities or behaviours impact GDP growth. It may also provide evidence for the assertions made by Carree et al. and Audretsch et al. who find that deviating from the equilibrium rate of entrepreneurship influences economic growth rather than just the prevalence of entrepreneurial activity [21,22]. This could imply that many countries struggle to achieve the optimal amount of overall TEA needed to stimulate growth.

Another reason why the effect of overall TEA is insignificant could be due to the misallocation of resources that occurs when starting new ventures. New firms usually require large amounts of investment to enter a market, and economic frictions such as corruption, licenses, or taxes can exacerbate these entry costs. These financial barriers prevent new firms from achieving their optimal growth or size, reducing the positive impact of entrepreneurial activity on economic growth. Poor or developing countries tend to have high firm entry costs that negatively affect productivity [12]. For these countries, it is possible that the inefficiencies caused by entry costs offset the benefits of overall TEA.

For rich or highly developed countries with negligible entry costs, a different explanation is required to account for the insignificance of overall TEA. A possibility could be that not all entrepreneurial activity induces economic growth. An example of this can be seen with mom-and-pop shops or shopkeeper stores that start small and remain small for the remainder of their lifetimes. These types of firms experience little growth, productivity, or innovation, which reduces the potential for economic growth [12,25].

The existence of small and unproductive firms can also explain why the effect of necessity TEA is insignificant. Individuals who become entrepreneurs due to the absence of other employment options tend to have less human capital and entrepreneurial ability. As a result, they are less likely to sustain a new venture that will contribute to economic growth [4,26,27].

The significance of opportunity TEA was ambiguous due to the lack of robustness. Opportunity TEA is usually associated with GDP growth because it implies that entrepreneurs can achieve economic profit usually by adopting/creating technology or knowledge. Assuming there is no significance with this variable, a reason could be due to the presence of poor or developing nations in the sample where economic profit is gained by exploiting market imperfections rather than untapped sources of knowledge and information [4]. In other words, a venture that is created out of the desire for independence or higher income uses market inefficiencies rather than technology or innovation to generate profit, reducing potential gains to productivity that could have contributed to economic growth. However, if opportunity TEA is significant, the rationale could be that entrepreneurship leads to wealth creation that increases intergenerational mobility. Having a higher incidence of individuals moving to higher wealth brackets than the ones they were born into stimulates economic growth by reducing frictions, allowing workers to earn wages reflective of their skills, and incentivizing individuals to work hard to increase their productivity [11,12,28,29].

The most important finding of this study was the significance of high potential TEA, the only type of entrepreneurial activity that definitively impacted the dependent variable and offered an explanation as to why GDP growth rates differ across nations. The significance of high potential TEA could be explained by the existence of fast-growing "gazelle" firms mentioned previously. Gazelles stimulate economic growth by reducing unemployment through significant increases in net job creation. Since one of the qualities of high potential start-ups is to plan to employ at least 20 employees in five years, it's reasonable to link the economic benefits of these firms with those of gazelles. Providing more employment opportunities translates into increased utilization and creation of human capital, and fewer individuals burdening the economy through transfer payments. New jobs increase the chances of knowledge spill overs, resulting in greater productivity through the adoption of improved technology [10,30]. Additional criteria of high potential firms involve using technologies that have not been widely available more than a year ago and having some market creation impact; therefore, the significance of high potential TEA could be explained through innovation and firm dynamics.

Regarding innovation, high potential firms can introduce advanced technologies of their own or adopt new knowledge that hasn't been adequately capitalized upon by incumbent firms [30]. The entry of these firms increases competition, forcing incumbent firms to innovate or face bankruptcy [7]. This increase in innovation by entrants and incumbents boosts overall productivity and economic growth. Additionally, high potential start-ups in developing nations can boost innovation by adopting advanced technology and knowledge from more developed countries that would be considered novel in their nation. This catch-up effect suggests that these start-ups can introduce greater innovation and contribute more to economic growth in a developing country than in a transition or highly developed nation. This logic could explain why the effect of high potential TEA on growth in developing countries nearly doubles that of highly developed and transition nations. The catch-up effect should also cause this type of entrepreneurial activity to have the greatest impact on growth in poor nations, so it is surprising to see that this trend isn't apparent when comparing the coefficient values by country income levels (Table 6). Although they may seem similar, perhaps poor and developing nations are not synonymous with each other in terms of growth potential, suggesting the existence of unaccounted factors that cause the economies of developing countries to be more influenced by high potential TEA than those of poor countries.

In terms of firm dynamics, the reallocation of limited resources from less productive to more productive firms can occur when high potential firms enter and displace inefficient incumbent firms. As mentioned previously, not all entrepreneurial activity is conducive for economic growth due to the presence of wasteful ventures that experience little growth due to the preference or lack of entrepreneurial ability by the firm's owners. Therefore, the exit of these less productive ventures can increase productivity growth, stimulating the economy [25].

Conclusion

The findings of this study offer evidence that high potential TEA can significantly increase national economic growth in the medium term and can be used to explain some of the differences in GDP growth rates observed across countries. The small prevalence of high potential entrepreneurship relative to other types of entrepreneurial activity suggests that only a tiny fraction of entrepreneurs engage in true technological innovation and productivity growth. The insignificance of overall and necessity TEA reconfirms the findings of Wong et al. however; more empirical work is required to determine the true effect of opportunity TEA.

The greater availability of TEA data over multiple years has allowed this analysis to take a time-series based approach, which is the ideal method Stel et al. and Wong et al. couldn't conduct due to data constraints. Although this paper improves and expands upon the findings and methodology of past literature, there are still data flaws that need to be addressed.

First, data limitations could not be completely avoided as TEA rates for several countries weren't available for every year of the lagged period. Nations with incomplete data had to be included to increase the sample size and the variety of countries. Despite this adjustment, poor and developing countries were still underrepresented among the sample. Also, it is possible that countries with less than five years of data had TEA averages that were not representative of the actual average, affecting the regression results.

Second, it was difficult to determine the stage of economic development or income level that best represented a country for the entire lagged period, which is why 2010 categories were used. Although it is unlikely that a country will experience dramatic economic or per capita income changes within five years, it would be ideal to somehow control for these changes in the models.

The goals of this paper were to contribute to the lack of empirical research on the effects of entrepreneurship on economic growth and to address the suggestions of past literature that called for a time-series based analysis once enough data was available. Other areas of research could be to apply this paper's methodology on larger sample sizes and GDP growth periods of different lengths to see if the effect of entrepreneurship varies in the short, medium, and long term. With the goal of economic prosperity in mind, the results of this study should motivate policymakers to promote high potential entrepreneurship through regulations that facilitate knowledge transfers, provide sufficient intellectual property protection, and promote an efficient market for loanable funds .

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