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Zakaria Hsain  
*Lehigh University*

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# TOWARD PRODUCTIVITY-DRIVEN GROWTH: THE NEED FOR INNOVATION AND ECONOMIC DIVERSIFICATION IN PERU

*Zakaria Hsain*



## Introduction

Few Latin American countries have achieved a more sustained and accelerated economic growth than Peru during the past 15 years. Between 2000 and 2014, the cradle of the Incas experienced extraordinary socio-economic progress characterized by an average GDP increase of 5.3 percent. Behind this tremendous growth are the ambitious structural reforms initiated by the administration of President Alberto Fujimori in the 1990s, which instituted fiscal discipline, restructured sovereign debt, and liberated trade and capital markets (Vostroknutova et al., p. 4). Most importantly, these reforms transformed the Peruvian economy in a way that favored natural resource extraction, especially mining, in which Peru holds a considerable comparative advantage (Auty, 1999). Thanks to increased global demand driven by emerging markets such as China, Peru leveraged its heavy

dependence on commodities to achieve a GDP growth superior to its Latin American peers for more than a decade. However, a recent decline in the prices of metals has caused a slowdown in growth, calling into question the Peruvian commodity-based growth model.

Transitioning from commodity-based growth to productivity-based growth is, consequently, crucial for the Peruvian economy. In other words, improving productivity throughout the economy by diversifying toward higher value-added production, fostering innovation, and promoting investment in research and development is essential for the long-term sustainability of Peru's development. Innovation and economic diversification provide two axes of action, which, through a robust and holistic policy framework, can generate new growth engines and protect the valuable gains made by Peru in the past 15 years.

## Background

### Dependence on Commodities

Peru boasts a wealth of natural resources. It holds significant reserves of minerals (copper, gold, zinc, silver, phosphates, etc.), hydrocarbons, and fertile—although limited—arable lands, which notably produce quinoa, asparagus, and coffee. In 2014, natural resource exploitation accounted for about three-quarters of exports, with the lion's share taken by mining, at 55.21 percent of all exports (Figure 1A). More recent data from the Ministry of Energy and Mines show that mineral products represented 65.37 percent of Peruvian exports in the period between January and May 2016 (“Boletín Estadístico del Subsector Minero”).

The dependence on mining is as much dictated by geography as it is by the 1990s reforms. The Peruvian government, motivated by deficiencies in the centralized state mining administration and the numerous problems limiting sector growth, sold many mines and unexploited deposits to private investors. As a result, foreign investment increased substantially and new mines were opened, such as the Yanacocha gold mine, now one of the world's largest (Moore et al.). The growth of mining revenues led to even greater concentration of exports. The share of traditional exports such as metals grew substantially between 1995 and 2011 (Figure 1B), despite a slight diversification in non-traditional exports like fish and agricultural products. This heavy reliance on natural resource exploitation has been a boon for Peru but also exposed the Achilles heel of the Peruvian economy, creating unforeseen issues and challenges.

### Vulnerability to External Market Forces

The reliance on natural resource exports has made the economy vulnerable to the volatility of commodity prices. The decline in Chinese demand contributed to a drop in the prices of metals, thus negatively affecting revenues of Peruvian mining. Metal exports experienced a noticeable decline in value after 2011, which was further exacerbated after 2013

(see Figure 1B). Between 2013 and 2015, copper exports, for instance, decreased from \$9.821 billion to \$8.175 billion (17 percent), and gold declined in a starker fashion, from \$8.536 billion to \$6.537 billion (23 percent). Overall, mining exports declined by 21 percent, from \$23.789 billion to \$18.836 billion, during the same period (“Boletín Estadístico Del Subsector Minero”). This recent decline is, in fact, not surprising: a look at historical data on prices of various commodities (energy, metals, raw materials, etc.) shows wild fluctuations. Prices rose by as much as 50 percent immediately following the 1973 Arab oil embargo and fell by as much as 30 percent in the early 1980s. By comparison, the prices of manufactured goods did not vary by more than 10 percent between 1962 and 2008 (Sinnott et al.). Hence, these price fluctuations make dependence on natural resource exports less attractive in the long term because they create economic uncertainty and discourage investment.

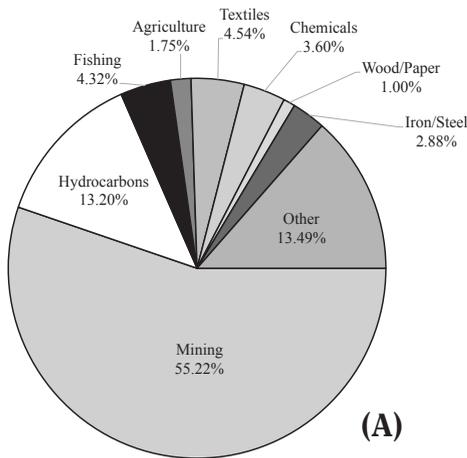
### The Resource Curse and the Dutch Disease

Even if commodity prices were to remain stable, Peru would still struggle to maintain high growth. An International Monetary Fund study projected a two-percent decline in Peruvian GDP growth between 2014 and 2019 (Gruss, p. 16). This tendency, referred to as the resource curse, has been observed in many commodity-exporting countries that show lower long-term GDP growth than diversified economies (Auty, 1993; Davis; Ploeg). Furthermore, natural resource dependence is correlated with slower-than-expected growth, even after accounting for many variables, including initial GDP, trade policy, investment rates, and trade volatility (Sachs and Warner). Yet, the resource curse theory is controversial. A thorough review of the literature on this topic by Sinnott and colleagues finds no consensus on the existence of a generalized resource curse, concluding that resource abundance does not necessarily compromise growth, at least in a direct fashion.

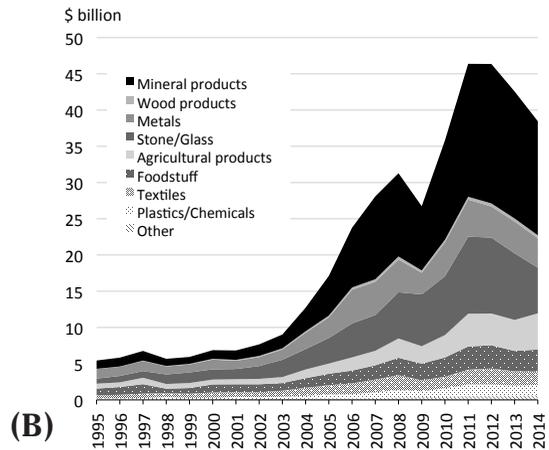
However, commodity dependence can slow growth through indirect mechanisms such as the Dutch disease. This term was coined in the 1970s to explain the decline of manufacturing in the Netherlands following

**Figure 1**

**(A) Distribution of Peruvian Exports by Sector in 2014**  
**(B) Evolution of Exports by Type of Product Between 1995 and 2014**



Source: Peru's Mining and Metals Investment Guide...



Source: "The Atlas of Economic Complexity."

large oil discoveries in the North Sea. It refers to a strengthening of the primary sector at the expense of manufacturing and high value-added activities in commodity-dependent economies. As natural resources are exported, the real exchange rate appreciates due to an inflow of foreign currency, which raises the price of non-tradable goods relative to the price of tradable goods and increases the returns of commodities relative to other tradable goods (Bahar and Santos). These transformations make investment in manufactured and high-technology goods less attractive, thus further reinforcing the domination of commodities. This is illustrated by the very low share of high-technology products in Peruvian exports (4.74 percent) compared to 17.18 percent in the OECD and 11.53 percent in Latin America and the Caribbean ("High-Technology Exports..."). On the other hand, data from ProInversión (Peruvian Agency for the Promotion of Private Investment) show that almost a quarter of foreign direct investment (FDI) went to the mining sector in 2014 ("Business and Investment Guide...").

Hence, the dependence on commodity exports leads to resource misallocation, since instead of investing in more productive sectors or other forms of capital, Peru sees the bulk

of investment flow into the already strong commodity sector due to incentives created by the Dutch disease effect.

### Productivity-driven Growth

Generally, if resource extraction revenues are not reinvested in human or other productive capital, the economy's real stock of wealth depreciates over time (Sinnott et al.). This depreciation can cause a loss of total factor productivity (TFP)<sup>1</sup> and capital, thus negatively affecting economic growth. TFP growth contributed to as much as 20 percent of Peruvian GDP growth between 1990 and 2013 (Vostroknutova et al., p. 28). Yet, TFP in Peru remains substantially lower than the OECD average (*Multi-dimensional Review...*), which is usually indicative of low investment in human capital, innovation, and technology diffusion (Busso et al., p. 904).

Although gains in human capital, labor, capital stocks, and other related factors of production may yield significant economic returns, growth in TFP can bring the highest contribution to growth. A study that examined

<sup>1</sup>TFP measures how efficiently and intensively inputs are utilized in production.

data from 145 countries between 1980 and 2000 concluded that the growth of TFP accounted for a greater part of GDP growth than growth in physical and human capital (Baier et al.). Hence, to sustain high growth Peru must boost TFP by switching from commodity-driven growth to productivity-driven growth. This transformation can be achieved via diversification as well as by investment in the sort of innovation that generates new comparative advantages and improves the efficient use of resources.

## **Economic Diversification**

Enhancing TFP growth in a context of commodity dependence can prove difficult, if not impossible. Hence, diversifying the Peruvian economy can lead to faster productivity growth than by specializing in the extraction and export of raw materials. In fact, ample empirical evidence has been put forth in favor of diversification, owing to its numerous positive effects on the overall economy (Agosin; Hesse; Illescas and Jaramillo; Ramcharan). One of the simplest arguments in favor of diversification is its portfolio effect, meaning that the more diverse and varied the export basket, the less volatile are export earnings. Diversification is also directly linked to accelerated GDP growth, as an examination of data from 159 countries covering 17 years revealed that export diversification can be correlated with a rise in GDP per capita for countries, like Peru, with a GDP per capita less than \$23,000 (Cadot et al.).

The Peruvian government in fact recognized the importance of economic diversification and proposed the National Plan for Productive Diversification. While the plan's name suggests that it is exclusively concerned with diversification, it includes a broad set of measures that encompass, for example, trade, fiscal policy, biodiversity, education, and innovation (*Plan Nacional de Diversificación...*). Therefore, the execution of the plan will surely require coordination among almost all the components of the national government as well as consistent collaboration with local governments and the private sector.

## **Policy Measures for Economic Diversification**

While diversification may face numerous challenges, the main measures proposed by the plan, summarized later, can lead to positive economic outcomes if implemented with sufficient financial backing and within a robust institutional framework.

### ***Identifying and promoting non-traditional sectors with good growth potential***

The Ministry of Economy and Finance and the Ministry of Production are responsible for developing sectoral plans for the development of potentially lucrative sectors. One such sector is tourism, which is surprisingly small despite Peru's rich historical and cultural heritage and its immense natural endowments. In fact, Peru received only 4.4 million visitors in 2015 ("Medición Económica del Turismo"). This number remains low, judging by 2014 international arrivals in comparable middle-income countries, such as Brazil (6.4 million) and Morocco (10.3 million) (*OECD Tourism Trends...*). Strengthening infrastructure and capitalizing on Peru's many UNESCO World Heritage Sites can help attract more international visitors as well as boost domestic tourism, which has grown steadily in the past decade. Promising niche sectors, such as meetings, incentives, conferencing and exhibitions tourism, should be used as a precursor to grow the overall sector and increase Peru's international exposure (see article by Schaaf in this volume).

Manufacturing can also benefit from additional investment to bolster its standing as a key growth engine. The sector accounted for 13.4 percent of GDP in 2015; yet most manufacturing is in low- and medium-technology sectors (textiles, construction materials, processed food, and mineral products) ("Anuario Estadístico Industrial..."), which in turn leads to low added value and low returns on investment. Tax incentives and measures to increase FDI, as proposed in the plan, can enhance the size and productivity of the sector.

### ***Encouraging foreign direct investment***

Attracting foreign firms and investors is an efficient method to grow the local technology base, to develop weak—but potentially important—sectors, and to cultivate a highly skilled local workforce. Currently, most foreign investment goes into resource extraction, thus engendering negative economic outcomes. For instance, Chinese investments in Peru are concentrated in the hydrocarbons and mining sectors, while interest remains modest in forestry and agriculture (Chen and Pérez Ludeña, p. 19).

Mining FDI tends to be capital-intensive compared to investment in manufacturing and high value-added production, which requires far less capital but generates more employment. It is important for Peru to facilitate and encourage investment in non-traditional sectors as well, particularly those requiring specialized knowledge or technology. However, action in this regard remains underwhelming. As of 2014, FDI in high- and medium-technology sectors accounted for less than 40 percent of investments in Peru, which is low compared to Latin American peers (“Foreign Direct Investment...”). In addition, the most recent projects overseen by ProInversión are still centered around energy, mining, and infrastructure. Non-traditional sectors remain largely ignored by the agency.

### ***Investing in critical infrastructure***

High-quality infrastructure can catalyze diversification and economic growth. It can facilitate the movement of people and goods, bring down business operating costs, draw foreign investors, and improve overall economic productivity. Unfortunately, Peru suffers from a considerable infrastructure gap. The Peruvian government has taken great strides toward closing this gap via public-private partnerships (PPPs), which allow Peru to benefit from the technical know-how and financial resources of the private sector, with little or no pressure on the fiscal resources of the state. PPPs also enable a more efficient distribution of risks and liabilities, since each partner usually takes charge of the risks it can

manage more effectively (*Economic Survey of Latin America...*). For these reasons, Peru has relied heavily on PPPs for its infrastructure needs with good results. The main projects undertaken under this scheme include the second metro line in Lima; the expansion or modernization of ports in Lima, Piura, and Loreto; and the construction of the Chinchero International Airport in Cuzco (“Multiannual Macroeconomic Framework...”). Yet, more effort and resources are needed because the infrastructure gap in Peru is immense. The professional services firm EY estimated that Peru needs to invest eight percent of its GDP annually through 2025 to overcome this deficit (Arizmendi et al.).

### ***Reforming regulations and simplifying administrative procedures***

The time required to start a business in Peru was 26 days in June 2015. At that time, starting a business took on average 11 days in Colombia, 7 days in Uruguay, and 6 days in Chile (“World Development Indicators”). Making starting a business easy and convenient, via a targeted reform of administrative procedures and regulations, is likely to encourage thousands of creative Peruvians to launch start-ups and small businesses. In addition to streamlining time-consuming procedures, ensuring the efficient and equitable diffusion of information will help attract foreign investors outside the circle of large mining and construction firms, thus enabling the growth of a diverse array of sectors.

### ***Boosting entrepreneurship and enterprise creation***

The environment for entrepreneurship is still fragile and immature in Peru. The country boasts one of the highest rates of early-stage entrepreneurial activity worldwide but also has one of the highest percentages of business termination. This contradiction can be attributed to excessive regulation of firm entry and exit, a lack of appropriate training in entrepreneurship and management skills, and the near-absence of private equity funds and venture capital markets (*OECD Reviews of*

*Innovation Policy...*). Furthermore, restrictive labor regulations (e.g., prohibitive employee dismissal rules) and high labor costs inhibit the growth of small businesses and impede the transition of informal firms into the formal sector. This leads to low productivity across the economy since the productivity differential between the formal and informal sectors in Peru is almost six to one (Vostroknutova et al., p. 55).

Thanks to the National Plan for Productive Diversification, the Peruvian government founded the Micro, Small and Medium Enterprises Fund, in 2014, with a 10-year budget of about \$200 million to fund various programs aimed at supporting entrepreneurs and small and medium-sized enterprises (SMEs). However, further progress can be made by introducing training programs and conditional tax exemptions to induce the growth of firms in high- and medium-technology sectors. Reducing administrative red tape is also crucial because small businesses and start-ups are generally the most vulnerable to bureaucratic inefficiency.

### **Learning from Malaysia**

Among those countries that have attempted large-scale economic diversification, Malaysia stands out as a prominent success story. Diversification in Malaysia resulted in a meteoric rise in GDP per capita from \$354 in 1970 to \$11,305<sup>2</sup> in 2014 (“Malaysia”), which greatly improved socio-economic conditions and propelled the country to near high-income status. This successful transformation is ripe with lessons from which Peruvian policymakers and business leaders can learn.

On the eve of independence from Great Britain, Malaysia was a largely agrarian economy relying heavily on exports of rubber and tin. In the 1960s, diversification efforts mainly concerned the agricultural sector with heavy investment in palm oil production (Yusof and Bhattasali). The first phase of industrialization relied on import substitution to induce the growth of industries focused on the processing of agriculture, mining, and forestry products. Starting in

the 1970s, export-oriented manufacturing gained increasing attention. The electronics and electrical products industry grew rapidly, driven mainly by FDI attracted through fiscal incentives as well as public investments in infrastructure and workforce training (Yusof). Non-resource-based manufacturing (e.g., electronics, machinery, textiles, and transport equipment) became an important part of the Malaysian economy, accounting for as much as 86 percent of total manufactured exports in 2000 (“Performance and Challenges of Industrial Development”). Forty years of diversification policies led to a decline in the share of mining and agriculture and a rapid expansion of manufacturing (Figure 2).

The service sector experienced a similar expansion, mainly in retail, tourism, and finance. For instance, Malaysia positioned itself as the world leader in the niche sector of Islamic finance, issuing 80 percent of the sukuk (Islamic bonds) available worldwide in 2012 (“Banking on the Ummah”). The emphasis on complying with Islamic law in financial transactions has helped attract capital, especially from the oil-rich Gulf countries.

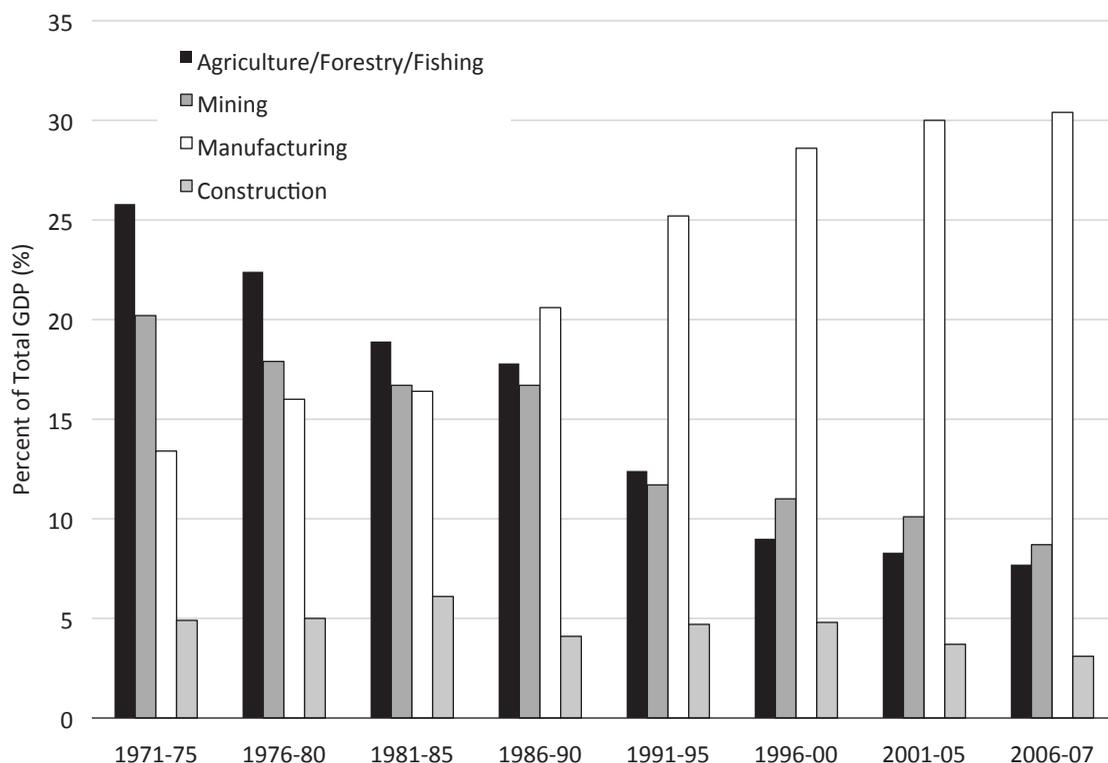
A look at the legislation, policies, and programs that guided Malaysian diversification highlights the boldness and leapfrogging that characterized many economic policies. One example is the push for palm oil production when little was known about the expected returns on investment. Risks were mitigated through pilot projects and the involvement of the private sector in policymaking (Yusof and Bhattasali). Peru could, likewise, work to attract more investment in non-traditional sectors, such as the production and processing of agricultural products (quinoa, lucuma, maca, and cacao), which can act as a precursor for more diversification.

Most importantly, the Malaysian example reveals that the key to sustaining high rates of economic growth for any middle-income country resides in continuous structural transformation from resource-based exports to high productivity sectors, such as manufacturing and technology-intensive services (Flaen et al.). An economy in the process of diversification must continuously evolve with the intent of boosting productivity

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<sup>2</sup>Expressed in 2016 U.S. dollars.

**Figure 2**  
**Average Share of Different Economic Sectors in Malaysian GDP**  
**Between 1971 and 2007**



Source: Yusof, p. 4.

and enhancing the sophistication of the goods and services produced.

## Innovation

Innovation is one of the most effective ways to boost productivity. It is defined in *The Oxford Handbook of Innovation* as the attempt to carry a novel idea, product, or process into the realm of practice (Fagerberg). Innovation has the power to create new productive sectors, to enhance firm competitiveness, and, through Schumpeterian creative destruction, to continuously eliminate, generate, and maintain comparative advantages. But for all its promises, innovation in Peru requires significant investment and attention to overcome the numerous challenges in education and training as well as the long-standing deficits in infrastructure and funding.

## Survey of the History, Strengths, and Weaknesses of Innovation in Peru

Latin America, with the exceptions of Brazil, Mexico, and Chile, has been late in acknowledging the importance of innovation. No different from its regional context, Peru suffered from economic and political instability from the late 1960s until the early 1990s, which hampered its efforts to build a strong science and technology (S&T) base. The National Council of Science and Technology (CONCYTEC)<sup>3</sup> was created in 1981 as a public entity tasked with supporting and setting policies for research and innovation, but it

<sup>3</sup>CONCYTEC was created by renaming and restructuring its predecessor, the National Council of Research, which was originally founded in 1968.

remained largely ineffective for the following two decades. In 2002, backed with a re-energized political will, CONCYTEC launched the National Emergency Plan for the Support of Science, Technology and Innovation (*Plan Nacional Estratégico de Ciencia...*). This plan spurred some development of S&T infrastructure as well as improved existing policies for funding and supporting research. CONCYTEC saw its budget grow rapidly in recent years: from a mere \$6.3 million in 2012 to \$110 million in 2014 (Orjeda). In 2013 new policies were put in place to foster research and development (R&D) within the private sector, which included a 30 percent tax deduction and a fund to finance credit guarantees through the financial system (“Latin American...”).

Several technological innovation centers were also created under the supervision of the Ministry of Production to transfer technology and provide training programs for SMEs in specific sectors and geographic areas. Furthermore, several praise-worthy programs were initiated with assistance from the Inter-American Development Bank and the World Bank. The most notable is the Fund for Innovation, Science and Technology, which helped fund 393 projects between 2007 and 2013 in sectors as diverse as agriculture, aquaculture, biotechnology, and textiles (“60 Proyectos Financiados por FINCYT”).

Although Peru’s efforts in the last 15 years are laudable, the system of innovation in the country is still marred with weaknesses. Public research institutions, such as INGEMMET,<sup>4</sup> IMARPE,<sup>5</sup> and IPEN,<sup>6</sup> are rarely audited to assess their quality and output. An evaluation of a sample of these institutions revealed that many were weak in technology transfer or lagged far behind the technology frontier in their R&D activities (Kuramoto and Torero). Of 144 countries, Peru ranked 117th for the quality of its scientific research institutions in 2014, and its public spending on S&T remains far below par by Latin American standards (*Multi-dimensional Review...*). As for technological innovation centers, they have been successful in improving the productivity

and competitiveness of SMEs through demand-driven technology diffusion. Their impact, however, has remained limited, since they have had neither the means nor the intent to engage in R&D, and the SMEs in question were not usually linked with large firms and international markets (Kuramoto and Torero).

The main problems of Peruvian research and innovation were succinctly outlined in a *Nature* article by the president of CONCYTEC, Gisela Orjeda, who was herself a successful scientist. According to Orjeda (p. 210): “Peru needs highly qualified scientists and scientific managers. We must learn how best to organize calls for proposals, allocate funds, build [programs] and reach companies. Then we must work out how to build prosperity with our new-found knowledge.”

While the government has understood the critical importance of innovation to economic growth, most firms, in particular SMEs, have no interest in risking capital on innovation. A national survey of firms with annual revenues higher than \$30,000 found that only two of every 100 firms invested in S&T activities. In fact, apart from large enterprises and the few SMEs which benefit from government innovation funds and various technological services, most Peruvian firms still operate with obsolete technologies, poor technical standards, and/or ineffective management practices (*OECD Reviews of Innovation Policy...*).

## **Policy Measures to Foster Innovation**

The current Peruvian policy in fostering innovation is summarized in the National Strategic Plan of Science, Technology and Innovation for Competitiveness and Development published by CONCYTEC (*Plan Nacional Estratégico...*), which outlines the national policy on technological innovation until 2021. Although the Peruvian innovation landscape appears to be gradually improving, it is too early to comment on the impact of this plan. Rather, a few general policy measures are listed below. They are likely, if implemented with adequate resources and within the right institutional framework, to yield positive outcomes.

<sup>4</sup>Institute of Geology, Minerals, and Metallurgy.

<sup>5</sup>Maritime Institute of Peru.

<sup>6</sup>Peruvian Institute of Nuclear Energy.

### ***Improve the quality of education***

Widely accepted as the yardstick of education quality, the OECD Programme for International Student Assessment (PISA) is a test administered in over 30 countries (including Peru) to assess the performance of 15-year-old students in science, mathematics, and reading. Although Peruvian students have improved substantially in science since 2006, their overall scores were well below the OECD average. The reading results were particularly disappointing, as fewer than one in two students demonstrated the minimum requisite reading skills to participate effectively in society (*PISA 2015 Results...*). On the bright side, the primary school completion rate stands at 96 percent (“World Development Indicators”), and most Peruvians can access post-secondary education thanks to a network of approximately 140 universities (50 are public) plus hundreds of technological institutes and pedagogical institutes.

Therefore, the main weakness of Peruvian education is related to quality, not access or infrastructure. Devoting more resources to education is a first step; the government has planned to increase spending to six percent of GDP at 0.25 percent annual increments starting in 2014 (*Plan Nacional de Diversificación...*). Teaching quality could be improved by increasing teacher compensation at the primary and secondary levels as well as ensuring that teachers receive high-quality initial training and participate in continuing education programs. In addition, families, especially those from rural areas, should be educated and incentivized to enhance their commitment to their children’s academic success.

In tertiary education, facilitating the creation of links between enterprises and universities can lead to courses and training programs that are relevant in the job market. The 2010 World Bank enterprise survey showed that 28.4 percent of Peruvian firms cite inadequate workforce training as a major constraint (“Enterprise Surveys...”). This shortage of skilled workers has also been proven to have a negative impact on SMEs, especially those in high-technology sectors (Pangerl). Dedicating substantial long-term resources

to education and mending the gap between institutions of higher learning and private firms are two key aspects of the solution. A creative approach to close the university-firm gap could be the introduction of an apprenticeship system, which allows youth to combine school and on-the-job-training. This system has proved successful in Germany (Sloane) and Switzerland (Muehleemann), and is increasingly seen as a model to follow in the United States (Schwartz). The Peruvian government should emulate these models, while keeping in mind the realities of the local culture, economy, and education system.

### ***Expand access to the Internet***

It is estimated that only 40 percent of Peruvians have access to the Internet (“World Development Indicators”). One cannot stress enough the importance of the Internet in facilitating communication and enabling access to knowledge and technology. Access to the Internet also fosters the convenient provision of government services in remote areas, reduces red tape in enterprise creation procedures, helps create denser links between the different actors of the innovation system (private firms, universities, research institutions, etc.), and can increase the productivity for thousands of small businesses throughout the country.

### ***Create a ministry in charge of innovation and scientific research***

While CONCYTEC, the government body in charge of setting policy in innovation and S&T, has tremendously improved the innovation landscape in Peru, more needs to be done. A ministry in charge of innovation and scientific research would facilitate the procurement of funds and the execution of policies at the national and state levels. Furthermore, elevating innovation to the ministerial level is in line with the need for investment in S&T to become a national priority in Peru. An OECD report, in fact, proposed a similar idea by arguing that such a ministry would ensure policy coordination and coherence, and would also establish strong links between the different players in the national innovation system (*OECD Reviews of Innovation Policy...*).

## ***Develop industrial clusters and parks***

Industrial clusters are agglomerations of innovation-oriented firms that complement each other, compete against each other, or share common resources with the intent of achieving increasing returns to scale (Hill and Brennan, p. 66). Clusters are particularly beneficial since firms can agglomerate around universities and research centers, which catalyzes R&D collaboration and facilitates access to technology and human resources. Two prominent examples in the United States are Silicon Valley in Northern California and Route 128 in the Boston area, both consisting of high-technology companies established around two technically minded universities, Stanford and MIT (Saxenian). The clustering of firms is known to improve firm performance due to increased collaboration, decreased supply chain costs, and easy access to qualified employees (Boja). Most importantly, both formal inter-firm networks and informal professional networks established within clusters are regarded as the most significant contributors to enhanced knowledge creation and transfer (Powell and Grodal).

While industrial clusters are virtually unheard of in Peru, the country currently possesses several industrial parks, which are zones equipped specifically to host manufacturing facilities and industrial firms that are not necessarily in similar sectors. While some of these parks are operational, like the one in Arequipa, most are under construction and estimated to open by 2020 (Rodríguez-Pose, p. 25). Parks are advantageous for governments because they help lower the cost of providing quality infrastructure and services to firms. Expanding these parks outside the relatively prosperous coastal regions, possibly with the help of foreign investors, should be the next step forward. Furthermore, grants and appropriate intellectual property protections should be provided, first, to encourage the agglomeration of firms within the same sector or supply chain, and, second, to incentivize innovation and inter-firm collaboration in the existing industrial parks.

## **Conclusion**

Since 2000, Peru has experienced outstanding economic growth, mainly due to its heavy reliance on commodities. But with the decline of commodity prices in recent years, the Peruvian economy has slowed down, exposing weaknesses within its structure. As an alternative to commodity dependence, boosting economic diversification and fostering innovation can enhance productivity and generate new engines of economic growth.

Economic diversification should, first, focus on Peru's strengths in agriculture and fishing, and then extend to high value-added manufacturing and technology services. Furthermore, the diversification effort should aim to continuously increase the sophistication of Peruvian products and services and learn from the "success story" of Malaysia throughout this process. Special attention should be given to closing the infrastructure gap, since it would decrease costs for businesses and facilitate the movement of resources, capital, and people.

As for innovation, while it has been on the agenda of the government since the 1980s, it was never given the requisite attention and funding. Recently, however, numerous programs and significant resources have been put in place, under the leadership of CONCYTEC, to improve the environment of innovation, science, and technology. More needs to be done in the next decade, particularly in education, as the lack of qualified experts and professionals is considered the main constraint hindering the growth of high-technology sectors and scientific research. Increasing public expenditure on education to six percent of GDP is a critical first step; but a more holistic approach that takes into consideration the students, the teachers, the families, and the educational institutions can substantially improve educational outcomes.

Finally, it is important to note that accumulated fiscal deficits since 2014, due to the slowdown in mining exports and a decrease in tax revenue, may hamper the implementation of many of the ambitious policies mentioned in this article. Broadening the tax base and exploiting an international environment of low interest rates by increasing the public debt may lead to positive outcomes

in the long term. In fact, public debt, at around 20 percent of GDP, remains low compared to that in most developed countries (“Recent Trends and Macroeconomic Forecasts...”). Peru should, however, remain cautious of the negative effects of a ballooning debt on growth prospects.

## **Acknowledgments**

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