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## **Economic Recognition of Innovation**

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### **Abstract**

Globalization has benefited the economies of member countries of the *Organization for Economic Cooperation and Development* (OECD) by helping their businesses stay profitable through cost-effective outsourcing of mostly garden-variety tasks and some knowledge-based activities. With time, the latter will account for the lion's share of work outsourced and emerging export houses will also tend to cater more to their own domestic markets because of their expanding infrastructure and growing manpower possessing advanced skills. This will result in a leveled playing field coaxing developed countries to adopt widespread innovations to maintain their high perch in the economic pecking order. Such large-scale creativity can be managed better if it could be gauged with an appropriate measure. This work propounds a new

economic measure called the *Gross Domestic Innovation* (GDI) to quantify innovations in OECD countries. It will supplement universal measures such as the *Gross Domestic Product* (GDP), productivity and numbers concerning employment. Apart from the methodology for its estimation, the impact of GDI on the various facets of a vibrant economy is discussed and inter alia, the role of GDI in fighting inflation and alleviating the negative influences of globalization is stressed. Also, a tentative analysis on the economies of U.S., Japan, Germany and China is presented to illustrate the concept.

## I. Introduction

Humankind has been toiling with its creative abilities since time immemorial. Thanks to the creativity of homo-sapiens, major industrial revolutions have occurred, resulting in a modern society with advanced amenities. The ushering in of globalization has made innovation all the more important for member countries of the *Organization for Economic Cooperation and Development* (OECD). This is in view of explosive growth rates experienced by several countries of the “other world”. Three factors account for these fantastic rates. First, countries comprising the East Asian tigers, i.e. Singapore, South Korea, Taiwan and Hong Kong, are at the forefront of the technological race, possessing a knowledge-based workforce that performs high-technology tasks on a par with the developed world [1]. Second, a huge work force has been unleashed by emerging economies, which has led to the outsourcing of many routine tasks from OECD countries. According to Professor Richard Freeman, an economist at Harvard University, the global workforce had effectively doubled in 2000 due to influx of labor from China, India, the former Soviet Union and other emerging economies [2]. China and India, by far, account for

the bulk of this new workforce and China has proved to be the shop-floor to the developed world by providing excellent infrastructure and cheap manufacturing labor. Besides, these newcomers possess a growing army of knowledge-based workers who will play an important role in the future when emerging markets cater to their domestic demands in addition to undertaking larger proportions of knowledge-based tasks from OECD countries. And third, advancements in information and communications technologies have made remote execution of numerous tasks possible. All in all, a new global economy has arrived with a village of workers catering to the service and technological needs of OECD countries. The corporate sector in OECD countries has benefited immensely from outsourcing, albeit globalization has had a negative influence, to some extent, on their domestic work force. Thus in the foreseeable future, developed economies will have to indulge in more innovation to adapt to a new reality where, in addition to the Asian tigers, emerging economies will also become technology savvy. This millennium will witness a significant thrust by developed countries to be ever-innovative, especially, as more and more of knowledge-based tasks are outsourced to their brethren round the world. Against this backdrop, a new economic measure is needed to track innovation for the OECD.

This article contemplates on the development of such a new measure, other than the traditional measures such as GDP, *Gross National Product* (GNP), etc., to characterize the growth in innovation for OECD countries. The concepts presented could be extended to emerging economies when these countries reach the holy grail of being “developed”.

## II. Adieu GDP?

The new economic barometer for creativity will be termed *Gross Domestic Innovation* (GDI). It is defined as the total number of innovations generated by a country in a given period of time. The GDI for a developed economy will quantify innovations in all fields of human endeavor, both scientific and non-scientific. Inasmuch as novel scientific efforts qualify for innovation, so do ingenuity in financial products such as collateralized debt obligations and credit derivatives to reduce risk. Consequently any new fangled idea that antes up the national revenues and employment numbers should be added to the GDI. Moreover, the GDI will also account for innovations occurring outside the geographical boundaries of a developed economy, thus imitating the role of the *Gross National Product* (GNP). The GDI cannot match the sheer numbers of GDP, which for the U.S. runs in trillions of dollars. But its correlation with GDP can reveal important trends, assuming significant receipts of GDP are coming from a developed country's innovative efforts. In fact, adding a new innovation-component to GDP could be beneficial in this regard.

The number for GDI can be obtained from the following sources: patents, publications, copyrights and other sources not yet articulated. Thus, aggregate GDI is given by,

$$GDI = GDIP + GDIPu + GDIC \quad (1)$$

where *Gross Domestic Innovation-Patents* (GDIP) accounts for patents awarded, *Gross Domestic Innovation-Publications* (GDIPu) accounts for non-documented innovations described in scholarly research papers appearing in various prestigious journals and *Gross Domestic*

*Innovation-Copyright* (GDIC) accounts for copyright registrations on certain intellectual products. All three are based on a common time period and enough care should be exercised to avoid double count of any idea between the three sources.

Patents are the best means of documenting unique ideas and the most important font of numbers for GDI. They avoid redundancy associated with counting creative ideas and are earned even by non-scientific entrepreneurs through agencies such as the *United States Patent and Trademark Office* (USPTO). Since both industry and academia apply to the USPTO for registering their creative endeavors, there is no need to mine for these numbers in several disparate sources.

Next, come ideas that are described in refereed publications but not patented nor documented in any other form. Prestigious journals that showcase pioneering research work from industry and academia in both scientific and non-scientific disciplines are an important source for GDIPu. Real world examples of prestigious journals abound with some such as *Nature*, *Science* and the *Harvard Business Review* being widely popular.

Copyrights registered for intellectual property should also be plumbed for numbers on creative products. The GDIC should be limited to copyrights for novel products that smack of ingenuity such as software, industrial design etc. It is imperative that numbers for GDIP, GDIPu and GDIC are carefully scrutinized to avoid any overlaps between them. Trade-secrets could also form a source for GDI, but their inclusion should be mulled over.

The Herculean task of tracking innovation through sources mentioned hitherto is not an end in itself. Thus, any other source tracking innovation should be made avail of to complement or replace the sources posited in this article. The premise underlying the concept of GDI is to leave no innovation behind.

The collective GDI number should be easy to resolve so as to track innovations coming from different sectors of a vibrant economy and individual entities, i.e. companies and other organizations, within each sector. Innovations coming from universities and other learning centers should also be easy to resolve from the aggregate GDI number. Their contribution to industry and the betterment of mankind are of paramount importance.

### **III. Estimating GDI**

The U.S. economy, which is second to none, has consistently attained higher GDP growth clips. Other than good infrastructure, enterprising businesses, excellent financial and administrative institutions, favorable immigration policy and a good rule of law, the U.S. economic power-house is also testimony to a culture that is conducive to learning and innovation. Moreover, U.S. based institutions such as the USPTO do a good job of documenting the creative efforts of persevering individuals and entities the world over. Hence, GDI estimates for the U.S. and its followers in terms of economic mettle, i.e. Japan, Germany and others, should be based on numbers procured from the USPTO, *U.S. Copyright Office* and other germane institutions based in the U.S. Alternatively, GDI can be evaluated from relevant databases of statistics maintained by the OECD. Their patent count is based on *triadic patent families*, which avoids double count, to consider registrations in U.S., Europe and Japan.

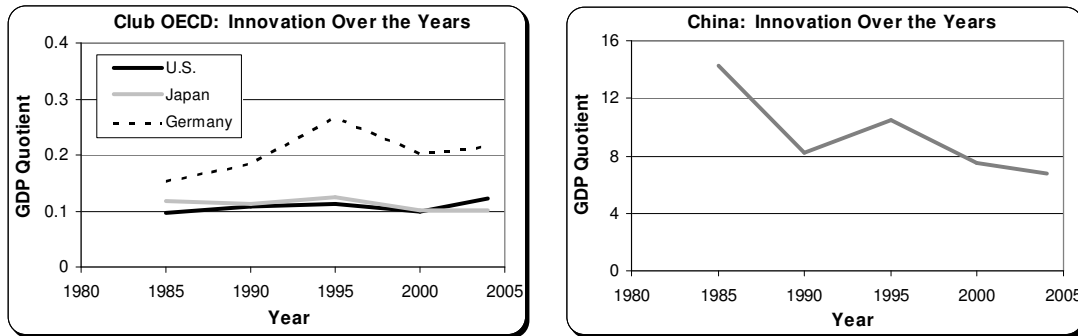
Compared to patents (GDIP), sifting numeric data for relevant publications (GDIPu) and copyrights (GDIC) for intellectual products is an onerous task. Since their assiduous assimilation is a work-in-progress, the tentative analysis on the economies of U.S., Japan, Germany and China is carried out using data on patents (GDIP). Relevant numbers were

gathered from the web-site of the USPTO. The correlation adopted here is GDP per unit GDIP, hereafter referred to as the *GDP quotient*. It is a priori reasonable to assume that trends for the GDP quotient using GDIP or GDI will be similar. However, absolute GDI values, accounting for patents, publications, copyrights, etc., will be needed to ascertain the innovative power of an OECD country and in other applications for the OECD business enterprise. The GDP data, based on *Purchasing-Power-Parity*, was procured from the web-site of the *International Monetary Fund* (IMF) [3].

For the chosen countries, GDIP has been increasing gradually between 1985 and 2004, ditto for the trend in GDP except for China whose GDP shows a steep climb from 1995 onwards. However, with reference to Figure 1, GDP quotient for both U.S. and Japan plateaus in this time frame. Such a flat trend will continue even with an upsurge in innovation because growth rates for GDP and GDIP (and even GDI) will nearly be in concert for these advanced economies. Only in the scenario where GDP growth rate outpaces its counterpart for innovation will this correlation show an increasing trend, as seen in Figure 1 for Germany. Either way, an optimum value of the GDP quotient needs to be ascertained to reconcile innovations with adequate GDP growth. China's decreasing trend for the quotient is because of a significant improvement in its GDP values due to outsourcing-based export activities, whilst innovations have taken a back seat. However, this Chinese trend will reverse in the future, thus justifying the need for large-scale innovations in the OECD economies. In terms of absolute values for the GDP quotient, the ranking in descending order includes China, Germany followed by nearly identical values for both Japan and the U.S. The highest quotient values for China arise from a combination of second highest GDP values and lowest GDIP values. Even though optimum values of GDP quotient, over a certain time frame, bode well for OECD economies, the causal agent might be



overwhelming receipts repatriated by subsidiaries in emerging markets. These subsidiaries implement the innovative ideas developed by their parent companies in the developed world. Hence, optimum GDP quotient concomitant with optimum *employment number quotient*, i.e. number of people employed per unit innovation, over a given time period, will give a true picture of the status quo in terms of employment numbers and revenues. The foregoing analysis illustrates the potential of GDI and its significance when wide-spread innovations foray into OECD economies.



**Figure 1. Variation in the GDP quotient between 1985 and 2004**

**(Unit for GDP quotient: U.S. \$ billions per unit innovation)**

#### IV. Impact of GDI

The happiness and well being of citizenry are central to the field of economics. A burgeoning economy characterized by increasing GDP numbers is frequently correlated to the well being of a republic. Ergo, GDP should be analyzed in relation to GDI. An apt measure, though not limited to, would be the *GDP quotient* to obtain the monetary value created in terms

of products and services generated per unit innovation. Suitable values of this quotient can establish a positive correlation between innovation and total monetary value of goods and services produced in a developed economy. Similar quotients, or other measures of correlation, should be obtained for employment numbers and productivity. In time, a suitable trend and optimum values of these quotients will signify a proper mix of employment, productivity and GDP due to large-scale innovations. Such measures will be critical to protectionist members of the European Union that look upon globalization as a quandary.

Inflation, an ever-present danger, is influenced by a diverse range of factors such as energy, commodities, wages and productivity, to name a few. The advent of globalization has affected the inflation reigning in OECD countries in more than one way. The onslaught of myriad low-cost products, manufactured in China and other emerging economies, on the OECD markets has alleviated inflationary pressures to some extent. This is because of lower wages prevailing in China for excellent productivity. But the foreseeable wage-hikes and graying population in China are causes for concern. Also, the rapacious appetite of a booming Chinese economy for energy and commodities has a negative impact on inflation registered in advanced economies and this performance is being followed suit by India. Hence, globalization is not a complete remedy for tackling inflation in the long term. But large-scale innovations spread across all sectors of a vibrant economy can aid in the effective use of new technologies, manpower and natural and alternative resources to keep consumer prices under control over the long haul. This makes GDI an effective measure in the fight against inflation.

The advent of globalization is somewhat responsible for the current asset-price-bubble in the American economy. Since the dot-com bust, the American populace has been funding their housing boom through investments by Japan and other emerging Asian economies in U.S. debt

securities. The super-power status helps the American economy attract trade surpluses from these countries into its exchequer. However, the specter of the opportunity-cost of these investments becoming unfavorable looms large. In such a scenario, Asian lenders will be forced to park their funds elsewhere. The untoward repercussions of this scenario are avoidable when innovation is emphasized through official measures such as GDI. It is only through widespread innovations that the American economy could engage in soaring exports of its ingenious products and services and reap rich revenues in return. Besides satisfying domestic consumer demand, overwhelming export revenues can also help plug the astronomical deficits incurred by the U.S. government. It is imperative that members of the OECD club strengthen their economic value by embracing significant numbers of disruptive technologies in various sectors over the long term.

Many sectors in developed economies are in thrall with short-term earnings and this has left them in limbo by being unprepared for an uncertain tomorrow. A case in point is the plight of U.S. energy sector where major oil companies have not invested significantly in alternative fuel technologies and exploration. Another example of myopic planning is the plight of U.S. automotive sector where failure to invest sufficiently in alternative fuel technologies has put GM and Ford on the brink of bankruptcy. The GDI numbers should be used to segregate sectors that invest a substantial portion of their retained earnings in research and development. Individual companies within poorly ranked sectors should be encouraged to innovate for unforeseen scenarios. Lately however, there has been significant contribution to U.S. GDP from small business enterprises. Most of these entities thrive through innovation and the GDI numbers should be used to help them gain a firm footing in the economy.

The double whammy of threat perceived from global warming and the world's soaring demand for fossil fuels and commodities has encouraged the OECD economies to go green, i.e. energy conservation through efficient technologies and alternative fuel systems. The greening of OECD economies is bound to be a hotbed of innovations with an active role cut out for GDI.

Recently, companies have resorted to share buyback programs in an attempt to raise their stock price. This measure, which appears attractive in the short-term, is not viable over the long haul. Companies need to keep investing in new innovative technologies to improve the intrinsic value of their enterprise. This alone will increase shareholder value in the long run. Plus, improving intrinsic value can aid in minimizing stock volatility for a company. Consequently, the GDI could be used to track the intrinsic value of publicly traded companies. Their creative growth should be used to rate performance at the management helm and accordingly set a commensurate compensation package.

Last but not least, the advent of GDI will lend credence to innovation in the society at large. This will emphasize better aptitude from the broader population and foster an environment for higher learning to glean more knowledge. Since knowledge will be power in the 21<sup>st</sup> century, the creation of GDI will help improve literacy which will facilitate assimilation of higher education and special skills by people comprising the lower income group in advanced economies. As a result, the need for innovative workers will help wages keep a proper pace with productivity and this will aid in the proper dispensation of business revenues to the broader workforce. Hence, windfalls reaped through innovative efforts will make their way across a wide spectrum of the labor market, thus leading to wage improvements.

## V. Concluding Statement

Globalization is a significant phenomenon for uplifting countries in the bottom rung of the *prosperity-ladder*. Traditionally, a few robust economies of the *Organization for Economic Cooperation and Development* (OECD) have been the *raison d'être* of emerging markets. This dependence will be upended as emerging economies tend to become knowledge-based prosperous societies, thus warranting wide-spread innovations in OECD countries. Innovations also allow for a safe passage of globalization by minimizing any negative ramifications to developed countries of the OECD. In the foreseeable future, innovation and globalization, in tandem, will allay economic maladies of the world. In light of this scenario, this work has propounded a new economic measure for the effective management of innovations. The *Gross Domestic Innovation* (GDI) gauges the total amount of innovation unleashed in various sectors of a vibrant OECD economy over a certain time period. It is a sum aggregate of, but not limited to, the number of patents, number of publications containing non-documented ideas and number of copyrights for intellectual products. Correlation of GDI with traditional economic measures like GDP can reveal the positive impact of innovation on a vibrant economy. Apt correlations, with productivity and employment numbers, will reinforce government efforts to boost employment of the broad workforce despite the exodus of many jobs to offshore entities. The new measure will also be effective in the fight against inflation, greening of developed economies and encouraging businesses to enhance their intrinsic value through innovation. The economic recognition of innovation is inevitable, but is “perennial innovation” evitable?

## References

- [1] 'Emerging Economies Climbing Back,' *The Economist* (2006).
- [2] Freeman, R., 'What Really Ails Europe (and America): The Doubling of the Global Workforce,' *theGlobalist* (2005).
- [3] Web-site for International Monetary Fund (IMF). URL. <http://www.imf.org> (accessed in August 2006).