

Brazilian scientific funding agency budgets have not matched the country's economic growth

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Abstract

The growth of the Brazilian economy in recent years has created an atmosphere of optimism in various segments of Brazilian society, with several important international repercussions. In this paper, we analyze in detail how this economic growth is reflected in investments in science and technology made by major academic funding agencies. As a result, we observed a discrepancy in the growth of funding input and the growth of the Brazilian gross domestic product. This fact associated with an increased academic output entails negative consequences for the system. This may be a symptom of an academic community not fully understood by society and vice versa. Finally, we believe that a long-lasting important change in investment policy in science is necessary in order to ensure financial security for the academic system as a whole.

Key words: Scientific investment; Brazil; Inputs and outputs; Gross domestic product; Scholarship

The outstanding performance of the Brazilian economy has been the subject of a great deal of world attention recently and, in addition to its vast pre-salt oil reserves and significant improvements in social indicators, its recent academic development is yet another sign of its emergence. Over a span of two decades, between 1990 and 2009, the numbers of Brazilian scientific papers published and doctoral graduates increased significantly (from less than 5,000 to more than 35,000, and from 1,400 to 12,000, respectively) (1), leading to a new wave of optimism in academic circles (2). However, the growth of Brazilian academia is not a result of the country's recent economic performance (3). Current Brazilian scientific production is a direct consequence of the academic structure that has been gradually constructed over the last 40 years (4), and this system needs to be further strengthened in the current moment of economic growth, if its future success is to be assured.

In this context, it is important to ascertain whether Brazilian society at large is making the necessary effort. Despite the fact that scientific effort involves society as a whole, one way of evaluating whether a country is investing enough in science and education is to analyze the relative values invested, compared to the overall economic output of the country. This is precisely what we did when we considered academic investment in Brazil as a percentage of the country's gross domestic product (GDP) (1,5-8) (Figure 1).

The academic system in Brazil needs to be strengthened if the current economic growth is to be transformed into improved social and industrial production (9). Thus, it is important to analyze the consequences of investments made in this area, and, in this study, we conclude that it is also important to examine input (investment) and output (scientific production). Considering that the bulk of financial support for academic research in Brazil comes from the federal government, an understanding of the budgets for the Improvement of Personnel in Higher Education (CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) and the National Council for Scientific and Technological Development (CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico) federal funding agencies can indicate how support for graduate scholarships and scientific support is being provided. Furthermore, considering the importance of a number of state funding agencies, we have also included the State of São Paulo Research Support Foundation (FAPESP - Fundação de Amparo à Pesquisa do Estado de São Paulo), since it is the largest state funding agency in Brazil. The State of Minas Gerais Research Support Foundation (FAPEMIG - Fundação de Amparo à Pesquisa do Estado de Minas Gerais), which has had its budget significantly expanded in recent years (from BRL 26,000,000 in 2003, to BRL 280,000,000 in 2010) (10), can be considered an outlier, and although it

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may have important local impacts, it is not significant enough to make any difference to the overall scenario in the country.

As we have previously shown (3), one of the main problems is the disconnection between input and output in the scientific field in Brazil, which is contrary to what one would expect under the present economic circumstances (11) (Figure 1). Despite the current growth in GDP, investments by the three major scientific research funding agencies, CAPES, CNPq and FAPESP, have not kept pace. In 1996, direct investments from these agencies amounted to 0.17% of the GDP, whereas in 2009 it was down to only 0.11% (5-7). This decrease seems to indicate a lack of long-term commitment with regards to the development of Brazilian scientific production, the indelible mark of a country that does not understand that investment in science and technology is an essential factor in its growth. Indeed, the aforementioned drop in investments between 1996 and 2009 amounted to USD 7 billion, sufficient to finance fulltime fellowships for 150,000 PhD students. Many other consequences can also be observed; between 1995 and 2009, the investment per doctoral graduate decreased by 68%, while the investment per paper published decreased by 72% (Figure 1). In fact, since 2003 there has been an apparent change in policy, but two important points must be considered: the fact that more recent data are not available and the recent news of budget cuts; together, these factors raise doubts as to how effective this policy change is. In 2011, when the apparently positive economic conditions in Brazil could have resulted in increased investment, USD 1 billion was slashed from the science and technology budget. In

2012, a further reduction of almost USD 1 billion from the proposed education, science and technology budget is expected to further compromise CAPES and CNPq. Thus, we believe that the current well-conceived academic structure is likely to be at its limit, which means further investment is urgently needed.

When analyzing the decoupling of input and output, one may wonder how Brazil managed “to do better with less” over the period in question. Undoubtedly, this indicates some increase in the efficiency of the system. “However, one question lingers: how is it possible to improve a system that has traditionally suffered from a chronic lack of resources, when relatively fewer investments are currently being made, compared to the past?” (3). One consequence of this apparent enhancement in efficiency is the significant loss of purchasing power of graduate scholarships over the same period as the reduction in financial investments (observed between 1995 and 2003) (Figure 2).

Despite the fact that input and output are traditionally understood as correlated effects (11), Brazil currently presents a much different scenario than the period between 1995 and 2003. Scientific growth has apparently resulted mainly from growing competition and an increased pressure to publish, such that it has come without any improvement in input (structure, financial support, etc.), and this probably compromises the quality of the science being produced, the quality of life of people involved in scientific production and the future of scientific production in this country (12-14).

Whether a cause or a consequence, the fact that scientific output has grown without a corresponding

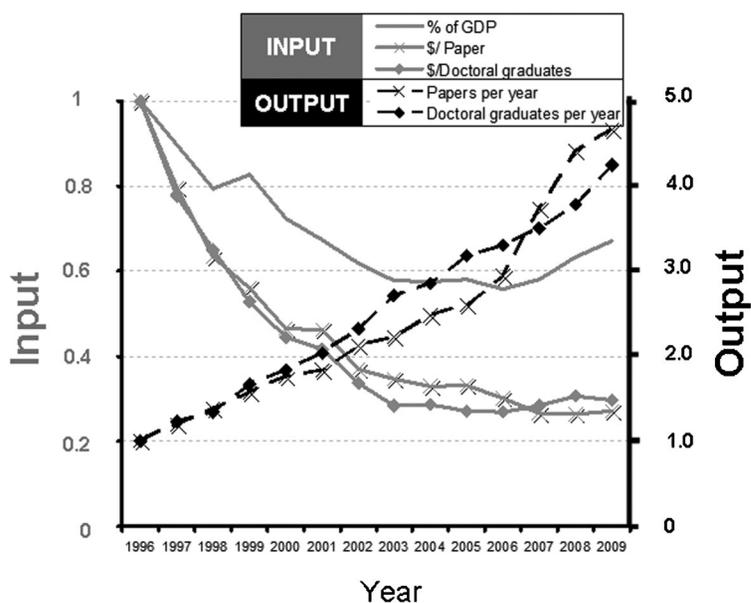


Figure 1. Input variation [financial resources per doctoral graduate, per paper published and gross domestic product (GDP) percentage of investments by federal scientific grant foundations] and the output variation (number of papers published and doctoral graduates per year) from 1996 to 2009. The reference is the 1996 value. In order to compare budgets, we chose those available to all the funding agencies (CAPES, CNPq and FAPESP) in 1996.

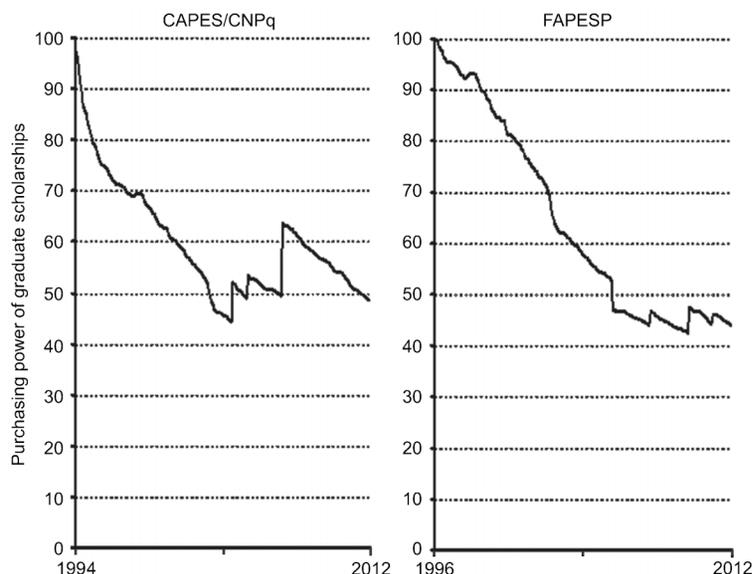


Figure 2. Purchasing power of CNPq and CAPES (left panel), and FAPESP (right panel) graduate scholarships between 1994 (CNPq and CAPES) or 1996 FAPESP and 2012, calculated using a National Consumer Price Index (IPCA) by the Economic Research Institute Foundation (FIPE), considering the scholarship values for December 1994 (CNPq and CAPES), or November 1996 (FAPESP) as 100% (updated from Ref. 13). Despite considerable inflation in the 1994-2006 period, scholarships were frozen over this period. Thus, the loss of purchasing power pertains to the period without any monetary correction, from 1994 to 2004 for CNPq and CAPES, and from 1996 to 2006 for FAPESP. The criterion adopted for choosing the values of scholarships from CNPq and CAPES since 1994, and FAPESP since 1996, was the moment of correction in the period in question.

increase in input is probably a symptom of a society that is not prepared to regard science as a means of adding value to its economy, industrial production and social improvement, as well as an academia that is far removed from society.

Therefore, Brazil's relatively insignificant participation in the global economy, with regards to the technology and manufacturing segments (15,16), would seem to be explained by the disconnection between the country and its investments in science. For Brazil to truly take its place as a global player, scientific development has to be seen as a strategic investment with profound long-term social and economic consequences.

The deterioration of CAPES and CNPq in recent years (at least between 1995 and 2003) is currently undermining scientific research and we believe that the only way to revert this situation is to reestablish support for the funding agencies that provide resources for graduate scholarships, fellowships and everyday academic life.

It is possible to propose several hypotheses in order to understand the inverse correlation between input and output. But we believe that the ability of academia to survive and continue to produce, even in such an unfavorable environment, will have the negative consequences detailed here, and probably several others (Figure 2). The lack of any strategic organization within academia in Brazil is likely to be one important reason for the relative reduction in input. Science is a long-term investment that will never be regarded as politically expedient by politicians as long as society at large does not sufficiently grasp its importance. Accordingly, there must be better scientific representation among politicians and a greater understanding of its importance by Brazilian society before any permanent changes in the current scenario can be implemented. Therefore, we believe that Brazilian academia urgently needs a forward-looking financing project, including the development of a structure with a clear and consistent investment plan.

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