

# Human Resources in Science and Technology Indicators: Longitudinal Evidence from Brazil

Gilda Olinto

[gilda@pq.cnpq.br](mailto:gilda@pq.cnpq.br)

Programa de Pós-graduação em Ciência da Informação, IBICT - Instituto Brasileiro de Informação em Ciência e Tecnologia/FACC-UFRJ, Rua Lauro Muller 455, 5º andar, Rio de Janeiro (Brazil)

## Abstract

This paper focuses on detecting time tendencies of specific socio-demographic characteristics of human resources in science and technology (RHST) by analyzing data from the Annual Survey of Brazilian Census Bureau (2002 and 2007). The analyses carried out in this study take into account different aspects of growth of S&T occupations as well as changes in some aspects of the employment situation of HRST and its attractiveness to younger generations. Dimensions of gender and regional inequalities are also considered in the analyses. Despite some positive evidence about RHST development in Brazil, data presented suggest that stagnation and losses also characterizes RHST in the period. Increase in attention to new and diversified RHST indicators to both guarantee international comparisons and reflect specific characteristics and needs of developing countries is stressed here.

## Introduction

Aiming at contributing to the development of Science and Technology (S&T) indicators while paying special attention to the relationship between science and social development, this paper focuses on describing and detecting time tendencies of specific socio-demographic aspects of human resources in science and technology (HRST) by analyzing data from the Annual Survey of Brazilian Bureau of Census. A comparison between data gathered in 2002 and 2007 has been carried out. The five year interval considered, as well as being a commonly adopted interval for analyzing change, also has a special significance: starting in 2002, the Brazilian Census Bureau adopted an occupational classification of occupations that closely reflects present international standards and its data became therefore more suitable for international comparisons (ILO, 2007). Each of the surveys considered here involve interviews with approximately 400,000 individuals (IBGE, 2003, 2008). The analyses undertaken take into account different aspects of growth of S&T occupations as well as changes in some aspects of the employment situation of HRST. The persistence of dimensions of social inequalities, with special emphasis on gender inequalities, is also pointed out in the analyses.

The interest in S&T indicators and the development of initiatives to produce them, especially through the provision of information that can guarantee valid international comparisons, is a global tendency that accompanies international policy efforts towards building and improving knowledge-based societies. These efforts are well represented by the OECD productions on the subject (OECD, 2005, 2007).

The need of S&T indicators for the American region is expressed in the Quebec Plan of Action proposed in the Third Summit of the Americas, in December of 2001. The same emphasis, using a citation of the above-mentioned text, is made in the first paragraph of the document prepared in 2004 by the Organization of American States to promote the development of science and technology in the region: "...the countries should promote, with the support of existing cooperation mechanisms, the development of a regional program on science and technology indicators" (OAS, 2005, p.26).

The importance of S&T indicators could be attributed, among other reasons, to the fact that the growth and characteristics of science and technology are nowadays almost synonymous to economic development. Investment in knowledge, increase in HRST and science production

indicators seem to go hand in hand with social and economic indicators: “Science and technology and innovation have become key factors contributing to economic growth in both developed and developing countries” (OECD, 2005, p8). Human resources indicators, which are the focus of this paper, are a clear example of the close relationship between science and development. In most OECD countries S&T workers represent between a third and a quarter of total employment. Steady growth - faster than that of total employment - is another characteristic of HRST occupations. And the numbers tend to be higher among the more developed countries: in Sweden they represent 37% of total employment whereas in Portugal this figure is still below 20% (OECD, 2005). For Brazil, previous studies indicate that the percentage of HRST in relation to the total labor force was still about 12% around the year 2000 (MCT, 2002, 2006, Olinto, 2005).

Another reason for the increasing interest in S&T indicators is related to the characteristics of modern states which, with the availability of information technology and the concurrent need to deal with an increasing complex environment, are expected to monitor social processes. In fact, an important part of government accountability is to generate information about policy decisions that contribute to social democracy, as is the case of a more egalitarian distribution of resources (OAS, 2005 p72, Smelser, 2003). The importance of S&T indicators would of course place them in a detached position as far as government accountability is concerned. Therefore, regional imbalances of S&T resources, gender differences in S&T participation, the working conditions of S&T personnel and S&T education are relevant information per se, as well as the study of processes that generate these inequalities. The specificities of developing situations and related problems should also point to the relevance of particular information concerning S&T, as is the case of the presence and working conditions of teaching professionals, and the characteristics and perspectives of S&T education and popularization.

There are many types of S&T indicators and one notices a constant tendency of diversification that seems to follow the dynamics of a knowledge society. The input indicators, which could be considered the more traditional ones, deal with S&T financing and S&T human resources; the output indicators measure different aspects of S&T publications and patent production. One also observes in the literature on the subject a new emphasis, not only on different types of indicators, like the international mobility of researchers and international research cooperation, but also of what could be called “à la carte” indicators that would involve the availability of different types of databases that could respond to different user’s needs and requests (Mustar, 2006, Lepori, 2008). The specific problems of developing countries, as mentioned above, would of course suggest specific indicators tailored to the users.

### **Data characteristics, questions and measures**

We focus here on the development of HRST in Brazil, an aspect on the input side of S&T measures. As mentioned in the introduction to this paper, we present longitudinal information about HRST in Brazil. Data utilized in the analyses were obtained from the Annual Survey of the Brazilian Census Bureau (IBGE/ PNAD) in 2002 and 2007. With a large sample size and generating data that is representative of Brazilian population, this database provides information about HRST occupations in addition to several socio-demographic information, specifically those that can answer questions regarding work conditions and perspectives of HRST, as well as the educational infrastructure of science and technology and questions about the perspectives of access to S&T by the population in general.

The analyses presented here try to answer questions about the dimensions of HRST growth in the country, the characteristics and dimensions of change in the work situation of S&T human resources and the dimensions of the inequalities in HRST distribution, especially gender and

regional imbalances. Through these analyses, the diverse possibilities of generating data about S&T human resources with Census Bureau type of data become clear. The provision of information for Brazilian government S&T policies and, at the same time, suggestions for the development of compatible data collection and analyses, particularly keeping in mind the comparisons between OAS countries, is likewise the objective of the analyses undertaken.

The HRST occupations considered in the analyses comprise “professionals” and “technicians”, according to the International Standard Classification of Occupations (ILO, 2007) that was adopted in Brazil since 2002. The specific sub-group of “Managerial Occupations”, traditionally considered as part of HRST, was excluded from the analyses because this subgroup seems to vary substantially in different contexts and compromises the quality of data. This criteria of exclusion was adopted in the OECD report of 2005<sup>1</sup>.

The “**professional**” group, mentioned above, involves five sub-groups. The first group of “S&T professionals” includes Physicists, mathematicians and engineering professionals that are also considered as the more strict definition of S&T professionals; the second group includes life sciences and health professionals; the third and fourth groups comprise college and university teachers and elementary and middle school teachers with college degrees (Olinto, 2005, Ferreira & Viotti, 2003, OECD, 2005); other professionals, typically with college degrees, are included in the fifth group.

The group of “**technicians**” includes elementary school teachers without college degrees; technicians associated with the specific types of professionals indicated above and other types of technicians.

It is important to point out here that the several sub-categories of professionals and technicians were kept in the analyses that follow; this allows one to pay special attention to some specific occupational groups that are particularly relevant in developing countries, as is the case of teachers, whose low availability and low capacity level are often pointed out as major problems.

## **Dimensions of changes in HRST in Brazil**

### *Dimensions of growth*

The first focus of the analyses is on the dimensions of HRST growth. In the first table, the absolute number of people in each occupational group and their rates of increase are presented; the second table displays percentages of each group in 2002 and 2007 relative to the economically active population.

**Table 1. HRST Occupations in Brazil: 2002, 2007. Absolute numbers and % increase.**

<b>HRST Occupations</b>	<b>2002 N of people</b>	<b>2007 N of people</b>	<b>(%) Increase</b>
S&T Professionals	527,576	657,010	24.5%
Life and Health Science Professionals	677,711	808,684	19.3%
College and University Professors	185,905	229,421	23.4%
School Teachers with college degree	1,350,130	1,967,948	45.8%
Other Professionals	1,905,505	2,504,434	31.4%
School teachers without college degree	1,420,290	1,342,136	-5.5%
Technicians associated with S&T Professionals	963,613	1,286,113	33.5%
Technicians associated with Life and Health Science Professionals	678,707	952,080	40.3%
Other technicians	2,572,418	3,249,103	26.3%
<b>Total HRST Occupations</b>	<b>10,281,855</b>	<b>12,996,929</b>	<b>26.4%</b>
<b>Other Occupations</b>	<b>76,635,493</b>	<b>85,848,640</b>	<b>12.0%</b>

Source: IBGE (PNAD, 2002, 2007)

**Table 2. HRST Occupations: percentages relative to total labor force. Brazil, 2002, 2007.**

<b>HRST Occupations</b>	<b>2002 (%)</b>	<b>2007 (%)</b>
S&T Professionals	0.6%	0.7%
Life and Health Sciences Professionals	0.8%	0.8%
College and University Professors	0.2%	0.2%
School Teachers with college degrees	1.6%	2.0%
Other Professionals	2.2%	2.5%
School teachers without college degrees	1.6%	1.4%
Technicians associated with S&T Professionals	1.1%	1.3%
Technicians associated with Life and Health Science Professionals	0.8%	1.0%
Other technicians	3.0%	3.3%
<b>Total HRST Occupations</b>	<b>11.8%</b>	<b>13.1%</b>
<b>Other Occupations</b>	<b>88.2%</b>	<b>86.9%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

Table 1 suggests a substantial growth of HRST occupations in Brazil. One observes a 26.4% increase of these occupations, in total, in the five year period. Especially noteworthy is the rate of increase of the category of school teachers with college degrees and of the technicians associated with life and health sciences. On the other hand, the reduction- in absolute numbers - of school teachers without college degrees does not seem to respond to the present educational demands of the country. Likewise, the results obtained in table 2 indicate that the percent increases observed in the five year period are very modest when viewed as percentages of the total labor force. Altogether they still represent, in 2007, only 13.1% of the working population, well below the rate observed in developed countries, as mentioned above. There are also no major changes in the proportional participation of specific occupational categories in relation to the economically active population, once again, with the exception of school teachers with college degrees.

Another aspect of this growth tendency is presented in table 3, which shows the percentage of people below 35 years of age involved in HRST in 2002 and 2007. This analysis aims at detecting the attractiveness of these occupations to younger generations.

**Table 3. Percentage of people aged 35 years or under in HRST occupations. Brazil, 2002, 2007.**

<b>HRST Occupations</b>	<b>35 years or less</b>	
	<b>2002</b>	<b>2007</b>
S&T Professionals	40.0%	41.0%
Life and Health Sciences Professionals	35.4%	46.1%
College and University Professors	30.1%	29.5%
School Teachers with college degree	38.9%	37.8%
Other Professionals	37.8%	39.9%
School teachers without college degree	55.3%	51.2%
Technicians associated with S&T Professionals	49.8%	51.4%
Technicians associated with Life and Health Science Professionals	37.9%	42.3%
Other technicians	44.6%	41.4%
<b>Total HRST Occupations</b>	<b>43.0%</b>	<b>42.7%</b>
<b>Other Occupations</b>	<b>40.0%</b>	<b>41.0%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

What stands out as a positive result in table 3 is the substantial participation of younger people as both professionals and technicians included in the life and health sciences group. However, the reduction of percentage of college and school teachers with college degrees - as well as school teachers in general - among the members of the younger generation seems to counteract the positive information about these occupational segments suggested in the previous tables and thus require special attention on the part of policy makers. On the whole, the analyses focusing on different dimensions of *HRST* increase in Brazil bring about some, albeit still modest, good news. The data also point out the specific needs of S&T employees involved in education, suggesting strong policy measures on the subject.

*Dimensions of improvements in work situation*

In this section, analyses were undertaken to try to detect changes in the formalization of the S&T work situation, observing formal employment, fulltime jobs, and salary increase. Indicators of formality stand out among human resources indicators due to worldwide worries, frequently mentioned in the literature, regarding flexibility and informality as an intrinsic characteristic of the new economy, with special effects in developing countries (Pochmann, 2003). Tables 4 presents the percentages of HRST as fulltime employees and table 5 shows the percentage HRST with fulltime working hours in 2002 and 2007 for each occupational category.

**Table 4. HRST Formal employees. Brazil 2002, 2007**

HRST Occupations	Formal Employees	
	2002 (%)	2007 (%)
S&T Professionals	68.5%	71.8%
Life and Health Sciences Professionals	33.4%	37.7%
College and University Professors	77.2%	68.0%
School Teachers with college degree	60.6%	55.7%
Other Professionals	32.0%	34.6%
School teachers without college degree	39.8%	38.2%
Technicians associated with S&T Professionals	62.8%	65.5%
Technicians associated with Life and Health Science Professionals	70.6%	73.4%
Other technicians	41.3%	48.0%
<b>Total HRST Occupations</b>	<b>46.5%</b>	<b>49.6%</b>
<b>Other Occupations</b>	<b>34.6%</b>	<b>39.0%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

The two tables above suggest that HRST in Brazil is undergoing a small increase in job formalization and fulltime work overtime. Again, the exception is teaching professionals: the percentage of school teachers - with or without college degrees- as formal employees went down from 2002 to 2007. Also college professors are the only category of HRST that had its relative participation in fulltime jobs reduced in the five years period.

The next table highlights the participation of HRST occupations in the extremes of the salary groups considered. Earnings in the two periods were calculated by the number of minimum wages, to correct for inflationary effects.

**Table 5. HRST in fulltime work (40 hours or more). Brazil 2002, 2007.**

HRST Occupations	40h or more	
	2002 (%)	2007 (%)
S&T Professionals	81.5%	85.4%
Life and Health Sciences Professionals	51.4%	57.2%
College and University Professors	56.1%	54.4%
School Teachers with college degrees	43.6%	44.7%
Other Professionals	62.3%	63.1%
School teachers without college degrees	34.7%	36.9%
Technicians associated with S&T Professionals	82.9%	83.9%
Technicians associated with Life and Health Science Professionals	60.9%	63.4%
Other technicians	73.4%	74.2%
<b>Total HRST Occupations</b>	<b>60.8%</b>	<b>63.1%</b>
<b>Other Occupations</b>	<b>66.3%</b>	<b>66.8%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

**Table 6. HRST occupations earning “two or less” and “ten or more” minimum wages. Brazil, 2002, 2007.**

HRST Occupations	Up to two Minimum wages		Ten or more minimum wages	
	2002	2007	2002	2007
S&T Professionals	0.0%	3.7%	56.8%	39.7%
Life and Health Science Professionals	0.0%	6.8%	57.9%	36.0%
College and University Teachers	4.9%	7.7%	63.5%	38.6%
School Teachers with college degree	18.6%	28.2%	8.9%	2.4%
Other Professionals	26.4%	34.6%	25.5%	16.0%
School teachers without college degree	52.1%	67.6%	1.7%	0.0%
Technicians associated with S&T Professionals	30.1%	40.4%	4.0%	2.7%
Technicians associated with Life and Health Science Professionals	27.6%	40.7%	2.9%	1.2%
Other technicians	32.7%	38.2%	12.7%	7.7%
<b>Total HRST Occupations</b>	<b>27.9%</b>	<b>35.6%</b>	<b>17.1%</b>	<b>10.2%</b>
<b>Other Occupations</b>	<b>64.8%</b>	<b>71.5%</b>	<b>3.7%</b>	<b>2.5%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

Table 6 brings nothing but bad news. One can clearly see an increase of percentages for all the categories in the lower wage group from 2002 to 2007 and also a decrease in the proportion of HRST occupations included in the higher wage group. HRST salaries converge to lower values, and the attractiveness of the more significant professional S&T occupations, as is the case of S&T professionals, seems to become substantially threatened. On the whole, it could be said that the group of tables focusing on improvements in HRST job conditions in Brazil shows a general tendency of small gains in work formalization, with the exception of the teaching categories. Important salary losses also seem to characterize the period under analysis.

#### *Dimensions of gender and regional inequalities*

The last set of analyses focus on two dimensions of inequalities: gender and regional imbalances of HRST distribution. The lack of equilibrium of gender participation in S&T

occupations is being discussed in several contexts and is supported by a lot of evidence (Olinto, 2005, Primo, 2003, OECD, 2007). The data also indicate that inequalities tend to persist: “Generally speaking, women worldwide are underrepresented, underemployed, and underpromoted in every area of science and technology” (OAS, 2005, p.78). Although an increase in women participation in S&T occupations is being observed both in developed and developing countries, evidences of gender involvement, as well as differences in career choices, promotion and salary defy explanations. Gender equality in S&T does not seem to closely accompany economic development, which suggests that socio-cultural factors play a major role in the persistence of gender differences. In OECD countries women represented between 25% and 35% of total researches in 2005, and among these some less developed ones, like Portugal, Poland and Greece are much closer to gender parity, with around 40% of female researches, than more developed ones like Germany and Austria, where only about 20% of researchers are women (OECD, 2007a, 2007b). Data from Latin American countries, like Brazil and Argentina, also suggest that gender equilibrium is already been reached when total numbers of researches is considered (Ministerio de Ciencia, Tecnología e Innovación Productiva, 2008, CNPq, 2009).

Despite forming the majority of HRST individuals in Brazil, women tend to be concentrated in certain “feminine” sub-categories, such as the teaching occupations. Great gender differences with regards to promotion and salaries have also been observed (Olinto, 2005, 2008). These gender differences, which seem to be attributed to socio-cultural values and attitudes, have to be dealt with through the development of studies, as well as the adoption of policy measures, and the constant production of sex-disaggregated indicators of S&T.

In table 7 below the percentage of women in each HRST category in relation to the total number of people involved in each category is presented and table 8 shows gender differences in salaries.

**Table 7. Percentage of women in HRST occupations. Brazil, 2002, 2007.**

<b>HRST Occupations</b>	<b>% Women 2002</b>	<b>% Women 2007</b>
S&T Professionals	20.6%	18.5%
Life and Health Sciences Professionals	59.8%	59.4%
College and University Professors	51.7%	51.3%
School Teachers with college degrees	81.2%	83.4%
Other Professionals	51.5%	52.9%
School teachers without college degrees	84.4%	82.1%
Technicians associated with S&T Professionals	11.0%	11.4%
Technicians associated with Life and Health Science Professionals	74.7%	76.1%
Other technicians	42.9%	36.1%
<b>Total HRST Occupations</b>	<b>55.2%</b>	<b>52.6%</b>
<b>Other Occupations</b>	<b>42.5%</b>	<b>43.3%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

Looking at table 7 it is clear that in 2002, among S&T professionals, only 20% were women, and also that the percentage of women as technicians associated to these professionals was very low (only 11%). On the other hand, high percentages of women are found in teaching activities: they represented more than 80% of school teachers (with or without college degrees). Life science technicians can also be considered a feminine occupation, with around 75% of women. A more equalitarian gender distribution was found among college level professors and life science professionals. It is also noticeable in table 7 that the five year time period considered has not contributed to increases in gender equilibrium. On the contrary, of

all the HRST occupations, only school teachers without college degrees showed a slight movement towards gender equilibrium, in this case with a relative increase in the male participation; all the other categories have either maintained their marked gender profile or have seen an increase in inequality.

**Table 8. Percentage of men and women with ten or more minimum wages  
Brazil, 2002, 2007.**

HRST Occupations	Male		Female	
	2002	2007	2002	2007
S&T Professionals	46.5%	30.3%	26.2%	20.5%
Life and Health Science Professionals	59.7%	46.5%	38.7%	21.9%
College and University Teachers	68.8%	49.9%	53.6%	33.3%
School Teachers with college degree	11.0%	7.3%	6.0%	2.3%
Other Professionals	26.0%	19.7%	10.5%	7.4%
School teachers without college degree	0.0%	0.0%	1.5%	0.0%
Technicians associated with S&T Professionals	3.4%	2.5%	0.0%	0.0%
Technicians associated with Life and Health Science Professionals	0.0%	0.0%	2.9%	1.5%
Other technicians	19.2%	9.0%	4.9%	3.0%
<b>Total HRST Occupations</b>	<b>21.5%</b>	<b>13.7%</b>	<b>9.0%</b>	<b>5.1%</b>
<b>Other Occupations</b>	<b>4.5%</b>	<b>3.2%</b>	<b>1.9%</b>	<b>1.4%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata

Participation in higher salary groups in 2002 and 2007 considering gender is shown in table 8. The first aspect to notice in this table is the decrease of this group for both men and women, suggesting general earning losses. Another point to make is the persistence of gender differences from one period to the next. Considering the whole set of RHST one can see that men are maintaining over time their proportional advantage in relation to women.

In table 9 that follows another aspect of HRST inequality reduction is highlighted: the concentration of these professionals in the two more developed regions of Brazil. The remaining regions, basically the Northern and the Northeastern region, with lower development indicators, comprise around 40% of the country's economically active population.

**Table 9. Concentration of HRST in the more developed regions. Brazil, 2002, 2007.**

HRST Occupations	South and Southeast	
	2002	2007
S&T Professionals	80.9%	85.4%
Life and Health Sciences Professionals	75.9%	73.6%
College and University Professors	72.0%	72.5%
School Teachers with college degrees	65.3%	65.2%
Other Professionals	73.7%	71.1%
School teachers without college degrees	49.4%	48.3%
Technicians associated with S&T Professionals	72.1%	73.3%
Technicians associated with Life and Health Science Professionals	70.7%	66.3%
Other technicians	65.9%	66.7%
<b>Total HRST Occupations</b>	<b>67.3%</b>	<b>67.5%</b>
<b>Other Occupations</b>	<b>59.6%</b>	<b>58.0%</b>

Source: IBGE (PNAD, 2002, 2007) Microdata



From the data above, one sees that the percentage share of HRST occupations was and continues to be regionally unbalanced. Total percentages remain approximately the same in the two periods. One even observes a greater concentration of the sub-categories of S&T professionals and University Professors in the more developed regions in 2007. A remark should be made that among life science professionals and technicians a slightly more egalitarian regional distribution seems to be happening with the increase in their relative presence in less developed regions. However, considering the small differences in percentages observed for most occupations from 2002 to 2007, there is not much to celebrate with regards to regional equilibrium of HRST in the country. On the whole, the analyses focusing on the dimensions of gender and regional HRST distribution in Brazil do not suggest either the presence or the prospect of significant changes in the marked inequalities observed.

### **Concluding Remarks**

Based on information allowing comparisons between developed and developing countries and using Census Bureau data that contribute to the generation of indicators focusing on specific S&T problems of developing countries, several dimensions of HRST growth, changes in work situation and in inequality of HRST distribution in Brazil were considered in the analyses presented here. A comparison was made between the years of 2002 and 2007.

Despite some modest good news with respect to increases in the HRST in the country, the low numbers involved, and the lack of human resources in certain categories, such as teaching professionals, calls for strong policy measures in search of urgent changes. The analyses focusing on improvements in HRST job conditions in Brazil show a general tendency of small gains in work formalization but, once again, point to the more precarious situation of teaching professionals, as well as salary losses across the board. The maintenance of gender and regional differences in the distribution of HRST are evidence that suggest further attention and analyses.

### **Acknowledgment**

I am grateful to CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for its financial support.

### **References**

- Brint, S. (2001). Professionals and the 'Knowledge Economy': Rethinking the Theory of Postindustrial Society. In: *Current Sociology*, 49 (4), 101-132.
- CNPq (Diretório dos Grupos de Pesquisa no Brasil) (2009). Available: [HTTP://dgp.br/censos/series\\_historicas/index\\_basicas.htm](http://dgp.br/censos/series_historicas/index_basicas.htm)
- ECLAT (Economic Commission for Latin America and the Caribbean). (2003). Road maps towards Information Society in the Latin America and the Caribbean. Santiago: ECLAT.
- Ferreira, S.P.; Viotti, R.B. (2003). Medindo recursos humanos em ciência e tecnologia no Brasil: metodologia e resultados. In: VIOTTI, E.B.; MACEDO, M.M. *Indicadores de Ciência, tecnologia e inovação no Brasil*. São Paulo: Unicamp.
- IBGE/PNAD (Instituto Brasileiro de Geografia e Estatística – Pesquisa Nacional por Amostra de Domicílios -2007) (2008) Síntese dos indicadores. Rio de Janeiro: IBGE. Available: <http://www.ibge.gov.br/home/estatistica/populacao/trabalhoerendimento/pnad2007/brasilpnad2007.pdf>
- IBGE/PNAD (Instituto Brasileiro de Geografia e Estatística – Pesquisa Nacional por Amostra de Domicílios - 2001) (2002). Síntese dos indicadores. Rio de Janeiro: IBGE.
- ILO (International Labour Organization) (2007). ISCO (International Standard Classification of Occupations). Available: <http://www.ilo.org/public/english/bureau/stat/isco/docss/resol08.pdf>
- Lepori, B. (2008). New perspectives on science, technology and innovation indicators. *Research Evaluation*, March.

- MCT (Ministério de Ciência e Tecnologia – Brasil) (2002). Indicadores Nacionais de Ciência e Tecnologia. Brasília: MCT.
- MCT (Ministério de Ciência e Tecnologia – Brasil) (2006). Indicadores Nacionais de Ciência e Tecnologia. Brasília: MCT.
- Ministerio de Ciencia y Tecnología e Innovación Productiva - Argentina (2008). Indicadores de Ciencia y Tecnología –2007. Buenos Aires: Ministerio de Ciencia, Tecnología e Innovación Productiva. 182p. Available:  
[http://www.mincyt.gov.ar/indicadores/banco\\_indicadores/publicaciones/libro\\_completo\\_web\\_11dic08](http://www.mincyt.gov.ar/indicadores/banco_indicadores/publicaciones/libro_completo_web_11dic08)
- Mustar, P., Esterle, L. (2006). Key figures on science and technology. Paris: OST (Observatoire des Sciences et des Techniques).
- OAS (Organization of American States). (2005). Science, technology, engineering and innovation for development: a vision for the Americas in the twenty first century. Washington: OAS.
- OECD (Organization for Economic Co-operation and Development). (2005) Science, Technology and Industry Scoreboard. Paris: OECD. Available:  
<http://www.oecd.org/dataoecd/16/33/38332121.pdf>
- OECD (Organization for Economic Co-operation and Development). (2007a). Science, Technology and Industry Scoreboard. Paris: OECD.
- OECD (Organization for Economic Co-operation and Development). (2007b). ICT and gender: Working Party on the Information Economy. Paris: OECD. Available:  
<http://www.oecd.org/dataoecd/16/33/38332121.pdf>
- Olinto, G. (2005). La inserción de las mujeres en la investigación científica y tecnológica en Brasil: indicios de transformación. In: BLAZQUEZ, N (org). *Ciência, tecnologia y género en Iberoamerica*. Mexico: UNAM/CEIICH, 2005, 213-225.
- Olinto, G. (2005). Análise de recursos humanos em ciência e tecnologia no Brasil. In: *XXV Congresso de la Asociación Latinoamericana de Sociología, 2005, Porto Alegre. Proceedings*.
- Olinto, G. (2008) Equilíbrio de gênero em ciencia y tecnologia y el sector público em Brasil. In: Miqueo, C; Barra, M.J.I; Magallón, C. (Org.). *Estudios Iberoamericanos de género en ciencia, tecnologia y salud*. 1 ed. Zaragoza: Prensas Universitárias Zaragoza, v. 1, p. 105-112.
- Pochmann, M. (2003). *As possibilidades do trabalho e a nova economia no Brasil*. In: Ruben, G. ET al. Informática, organizações e sociedade no Brasil. São Paulo, Cortea, p. 93-132.
- Primo, N. (2003). Gender issues in the Information Society. Paris: UNESCO. Available:  
[http://portal.unesco.org/ci/en/file\\_download.php/250561f24133814c18284feedc30bb5egender\\_issues.pdf](http://portal.unesco.org/ci/en/file_download.php/250561f24133814c18284feedc30bb5egender_issues.pdf)
- Smelser, Neil Pressures for continuity in the context of globalization (2003). *Current Sociology*, 51 (2): 101-112.

---

<sup>i</sup> The occupational categories excluded correspond to the following ISCO groups: 121, 122 and 131.