Measuring Technological Opportunity: The Brazilian Case[#]

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Abstract: This paper aims to contribute to the discussion on the measurement of technological opportunity (TO). Using micro level data form IBGE's PINTEC, the paper elaborates a probit model that associates innovative effort with the probability to innovate. TO is defined as the level of effort that maximizes the probability to innovate. Two measures of innovative effort are used the total cost of innovation (TCI) and R&D. Most sectors showed decreasing static returns to innovative effort. This means that there is a level of innovative effort where the probability to innovate achieves its maximum level. The ranking established by these measures is positively correlated to measures that express innovativeness, intensity of sectoral innovative effort and spillovers from other sources of information. However, these correlations showed to be stronger when TCI measure of TO was used. R&D measure of TO did not perform well in these correlations. Both measures performed quite well in the correlation with Herfindahl Hirschman market concentration index

Keywords: technological opportunity; Brazilian industry; technological innovation

JEL: O31; O33; L11

Resumo: O artigo procura contribuir para a discussão acerca das formas de mensuração de oportunidade tecnológica (TO). A partir de microdados da PINTEC do IBGE, elabora-se um modelo probit que associa esforço inovador à probabilidade de inovar. TO é definida como o nível de esforço que maximiza a probabilidade de inovar. Duas medidas de esforço são utilizadas: o custo total da inovação (TCI) e P&D. A maior parte dos setores apresentou retornos estáticos decrescentes do esforço inovador. Isto significa que há um nível de esforço em que a probabilidade de inovar atinge seu nível máximo. As medidas de TO baseada em TECI está positivamente correlacionada com medidas de inovatividade, de esforço inovador e de transbordamentos de outras fontes de informação. Contudo, essas correlações não se apresentaram tão forte quando a medida de TO baseada em P&D foi usada. As duas medidas tiveram ótimo desempenho na correlação com indicador de concentração de mercado.

Palavras-chave: oportunidade tecnológica; indústria brasileira; inovação tecnológica

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1 INTRODUCTION

Since the studies on the relationship between market structure and innovativeness, indicators associated with technological opportunity (TO) have appeared as important explanatory variables. Though there is an explicit and clear definition of TO, associated with the easiness to innovate, the measurement of TO has followed a two-fold trajectory. On the one hand, there are those that measure it as a parameter that relates effort inputs to outputs (results), based on a hypothetical production function of knowledge. On the other hand, a second stream of the literature has developed a measurement of TO through the determinants of innovativeness. This has been mainly an approach at the *sectoral* level. TO has been linked to the sources of the innovative process: relevance of science and technology, other external extra-industrial sources and natural technology trajectories. Therefore, the closer a sectoral pattern of innovation is to science sources, the greater the spillovers, the easier it should be to obtain results and therefore, the greater the TO level will be. This latter analysis implicitly assumes that TO will show low variation inside sectors and therefore that sectoral level analysis is sufficient to adequately assess TO.

The importance of externalities from science and other sources of knowledge may vary with the distance a country's productive structure keeps from scientific and technological frontiers. Learning routines are evaluated as being quite different in catching-up countries when compared with leader nations. Therefore, other sources of TO either than science may and should play a more relevant role in catching-up former countries. Furthermore, once the proximity to science is not as important as other issues to determine TO, sectoral levels and rankings of TO should vary with the proximity to scientific frontier and catching-up countries sectoral rankings of TO may be quite different from scientific frontier countries. Thus, it should be inadequate the simple transposition of TO parameters from science-frontier to catch-up countries.

This paper aims to shed some light into these issues. Therefore, it undertakes three tasks:

(i) the assessment of TO according to the input-output approach;

(ii) the comparison of the results obtained with key variables associated with innovativeness and sources of innovation; and

(iii) association of TO levels with market structure

Apart this introduction, the paper has other four sections. In the second section, the paper develops the analytical framework that illuminates the empirical analysis. The third section describes succinctly the database. The fourth section presents the main results from the analysis and the fifth section describes the main conclusions from the paper.

2 ANALYTICAL FRAMEWORK

2.1 DEFINITION

Since Schumpeter's *Capitalism, Socialism and Democracy*, economists and students of technology have studied the relation between innovativeness and market structure or between R&D and market structure. This interest has increased due to the fact that some R&D intensive industries have been dominated by some key global players (Sutton 2000). Empirical evidence is however still mixed. Though there seems to be a positive correlation between concentration and R&D intensiveness, some studies still find this relationship to be neutral or even in some exceptional cases to show a negative sign (see Cohen and Levin 1989). However, as argued by Sutton (2000:4) "if such correlation exist, the direction of causation should be seen as running from concentration to R&D intensity, or vice versa"? In general, there has been a perception that both variables are endogenous. Efforts have been developed towards finding an exogenous variable that could explain these relations. Technological opportunity has showed to be the most important of these efforts (Cohen and Levin 1989).

Technological opportunity has been defined in different ways usually associated with the easiness to obtain an innovation from an investment in technological activities. Klevorick et al. (1995) define it as the probability to obtain an innovation or to keep the pace of technical change as a result of the undertaking of technological activities. The greater the TO the higher should be the probability to obtain results from the dedication of R&D. Cohen and Levinthal (1989) associate TO with the costs of absorption of the results of R&D in different technological fields. Coombs (1988:304-305) divides TO in two different types: intensive and extensive TO associated respectively with the occurrence of incremental and radical innovations. Extensive TO admits a variety of applications in different products and processes, while intensive opportunity is associated with the occurrence of incremental innovations in the same products and processes, that is, to specific technology trajectories. In all cases, TO is associated with specific technological fields and to its application in specific sectors, that is, since its application TO is determined at the sectoral level and therefore is sector specific.

2.2 MEASUREMENT

There have been many attempts to measure TO and a great number of methodological approaches have been applied. They have differed according to the availability of information, the complexity of the techniques and the approach to TO. Pioneer attempts to assess TO were linked to structure and performance models. They mostly used sectoral dummies to represent distinct science and technology influences over sectoral technological activities. Scherer (1965) used dummies obtained from average patenting rates. Paricio (1993) assigned non-estimated parameters to sectors according to their R&D intensity, while Levin (1978) used a parameter that altered the innovation possibilities curve according to sectoral rate and direction of technical change.

However, as the concept grew in importance and was spread over structure and performance models, efforts were directed towards the direct measurement of TO. These efforts may be classified into two different approaches. First, there are studies that attempt to measure TO from the input-output perspective. These studies are more interested in the ranking of sectors. Second, there are studies that address the sources of knowledge and their potential spillovers as the main determinants of technological opportunities. These studies are more involved in the horizontal classification of sectors and in providing subsidies for policies to address these sectors.

2.2.1 Input-Output Approaches

Several studies that link structural variables to the performance of R&D use elasticity between input and output variables as measures of TO. Pakes and Schankerman (1984) explilicitly estimates technological opportunities parameters by obtaining the random variation of a model that explains the intensity of R&D from different equations referring to sectoral demand. Geroski (1990 and 1994) estimate a fix sectoral component from the residuals of a model that attempts to explain sectoral innovation rate through structural variables.

Other studies address attention directly to the measurement of TO. Dasgupta and Stiglitz (1980) and Levin and Reiss (1984) measure TO as the cost elasticity with respect to R&D expenditures. Nelson (1988) uses the elasticity of the sectoral total factor productivity with respect to R&D expenditures. Kamien and Schwartz (1982) and Thompson (1996) consider the elasticity of the R&D production function with respect to the results of R&D processes.

Input-output measures to TO, particularly those that estimate elasticities, hold implicitly or explicitly a hypothesis of diminishing returns of R&D projects. They seem to assume that as R&D expenditures increase, their marginal benefits decrease and may even be extinguished. This hypothesis however may not be true. More specifically, using Coombs (1988), if innovations are incremental, there should be diminishing returns to R&D expenditures in the exploration of technology trajectories. However, whenever radical innovations are present, new technological paradigms (Dosi 1988) are present, new opportunities to innovate may appear and rend the hypothesis useless, though the appearance of new paradigms does not alter immediately the rhythm of production of innovations (Thompson 1996).

If these elements are considered, the assessment of TO through the examination of the sources of knowledge may show some shortcomings. Scherer (1965) stresses that TO does not solely depend on demand forces, but it also relies on forces that come from the supply side, associated with the advancements in scientific and technological knowledge. The relevance of the sectoral closeness to scientific knowledge has also been emphasized in later studies, such as Rosenberg (1974), Nelson (1982) and Dosi (1988). Dosi (1988) specifically highlights the role played by technological paradigms arguing that TO should be greater the more recent the technological paradigms.

An additional shortcoming of these approaches is how to measure outputs of the innovative process. Innovations present different values and uneven effects over the productive sector, their appropriation by economic actors differ across sectors. Alternative measures such increase in productivity may be influenced by other factors than innovation, such economies of scale, organizational innovations, etc. The use of patent data has important shortcomings due to differences in the value of patents (Griliches 1990). Therefore, the identification of the output of R&D and non-R&D innovative efforts and its value is not easily done.

2.2.2 Sources of Knowledge Approach

Jaffe (1986) measures the effects of TO through the examination of patenting propensity, assessing the excess of benefits obtained by companies that have their efforts located in specifically dynamic technical fields. Using patent data, the author identifies technology families and fields of knowledge where companies hold most of their patents. TO is then represented by dummies assigned to each sector according to their proximity to these dynamic technologies.

There are however other sources of knowledge either than science. Moreover, a non-depreciable part of scientific knowledge is produced through research and learning processes inside companies. Furthermore, interaction across firms' boundaries also provides an important source of knowledge. Therefore, inter-industrial relations and the proximity of firms of its clients and suppliers may be a source of TO as well, once it provides important knowledge spillovers that increase firms' probability to innovate.

The perception that closeness to different sources of knowledge affects TO opened a new line of investigation that attempts to account for the complexity of technological and market environments and their interactions. Therefore, on the one hand, this line of work approaches TO with reference to the scientific and technological fields that prevailed in each sector, their speed of change, the closeness of the linkages between firms, technology and science (Jaffe 1989) and their pervasiveness (Marsilli 2002).

This line of work achieves its main objectives in the analysis of TO through the application of surveys to sectoral specialists that identify as sources of innovation the proximity to science, the rate of use of inter-industrial knowledge and the level of industrial maturity through the interaction with technology trajectories (Levin et al. 1984, 1985 and Klevorick et al. 1995). The seminal work of Klevorick et al. (1995) systematizes a methodology of analysis at the sectoral level. Their effort aims to answer two different questions. First, to what extent and how do sectors differ in their level of TO? Second, how does TO influence levels of expenditure in innovative efforts?

Klevorick et al. (1995) determine that electronic components, aircraft and drugs are the manufacturing three-digit sectors with greater level of opportunity while non-metalic minerals, metallic products and mechanical industrials present the lowest levels of opportunity. However, they also claim that one cannot rank with absolutely certainty sectors' TO based in their use of certain sources of knowledge. For instance, though non-metallic minerals present a low level of opportunity sector, advances in science seem particular important for technical change in the sector. On the other hand, electronic components have high level of opportunity and rely on their input suppliers to display innovations.

They also find that R&D intensity is not a perfect match with TO, though it shows a positive correlation, mainly when sources of knowledge are associated with science developments in universities and public laboratories. In some cases however R&D intensity may have a negative correlation with TO such as those industries where clients and equipment suppliers are the main sources of external knowledge. Therefore, other modes of efforts and expenditures that account for acquisition of embodied knowledge and the interaction across firms' boundaries should be viewed as relevant.

2.3 TO AND COUNTRY HETEROGENEITY

Though the literature has stressed the importance of demand and technological features in the determination of TO, little effort has been put into the examination of other variables related to the firm's environment. More specifically, TO has always been treated at the sectoral level and little attention has been driven to variables outside the sectoral level. However, some works have already shown that patterns of innovation and the classification of sectors into innovation taxonomies may vary across countries due to productive specialization (Archibugi et al. 1991). Nonetheless, developing countries have a further reason to display different opportunity levels and modes across sectors: they are not in the technology frontier. Therefore, spillovers from science and inter-industrial sources should not play the same role as they do in technology frontier countries. Furthermore, the literature has stressed the importance of non-R&D efforts to determine technological opportunities. However, the way to deal with these contributions and the way they capture spillovers from inter-industrial sources of knowledge is far from consolidated.

2.4 APPROACHING TO THROUGH DIMINISHING RETURNS

Input-output measures of opportunity have been developed in previous studies but since the effort of Klevorick et al. (1995) they have been put aside. Nonetheless, input-output relations are in the heart of the definition of TO and should be seen as an important source of information about TO. As stressed above, one important shortcoming of this approach is the assumption of diminishing marginal returns of the input variable. The main argument against this hypothesis is that the pool of opportunities may be replenished and as put by Klevorick et al (1995:188): "It is precisely the sources of new technological opportunity, the additions to the pool, and their relative importance in different industries that we seek to measure".

The point is that a high technological effort level (R&D and non-R&D based) cannot be sustained unless innovative opportunities are renewed. The rate of creation of innovative opportunities is precisely what TO should capture. The emphasis of Klevorick et al. (1995) is on the sources of these renewed opportunities: science and technology, extra-industry sources of knowledge and technology trajectories. However, it is implicitly argued that the greater the sectoral TO the higher the level of technological effort is admissible. Therefore, sectors with higher technological opportunities are those that hold higher technological efforts.

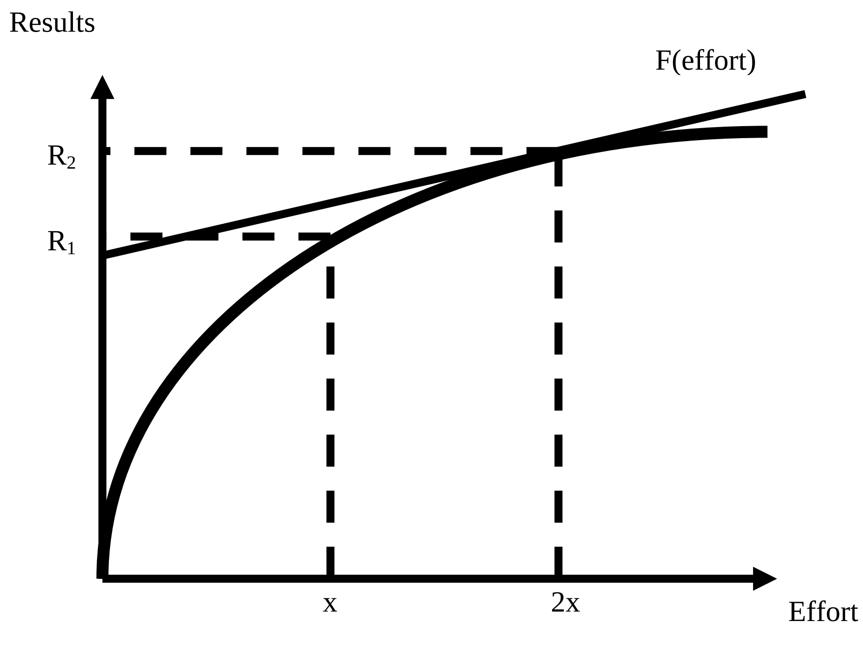

Figure 1 Static Production Function with Decreasing Returns

Figure 1 presents a production function of innovative effort. Suppose that there exists a pool of knowledge that firms may use. In order to transform this pool of knowledge into an innovation the firm has to carry out some effort. In date 1, the firm chooses a level of effort, say *x* in Figure 1 it would obtain a return of R_1. If the firm chose *2x*, the additional level of return would be $\Delta R = (R_2 - R_1) < R_1$. Let's make an additional simplifying assumption: any effort realized in period 1 does not add any new technological opportunity, that is, in terms of Klevorick et al. (1995), the sector has zero TO. Then if the firm chose *x* at period 1, obtained a return of R_1, in the next period, the same effort level of effort, *x,* will take the firm to a new position *2x.* This additional level of effort will generate an additional return $\Delta R = (R_2 - R_1)$. If the firm decides to adopt a high effort strategy such as *2x*, in the first period, the only result will be to extinguish still more rapidly the returns of innovative efforts. Suppose that the ratio of the unit cost of effort to the unit price of the return is represented by the tangent to the production function at *2x*, then firm can adopt a low level effort strategy in the two periods or a high level strategy in only one effort. However after that the level of effort will decline to zero. Therefore, in a sector where no new opportunities are created the level of effort will tend to zero, due to the exhaustion of the opportunities.

It is easily argued however that the picture does not work this way. New opportunities are constantly created. In fact, the innovative effort itself is a source of new opportunities. The consequence of the appearance of new opportunities is the displacement of the production function, reducing the effects of the marginal diminishing returns over the pool of knowledge. This is represented in Figure 2 where the production function shifts upwards in the second period, achieving a higher level of results. Therefore, an additional expenditure in the second period will provide an additional $\Delta R = (R_2 - R_1) = R_1$. This shift is what is usually named by the literature as TO (see Klevorick et al. 1995). What is the exact format of the dynamic production function does not matter for present purposes: for what matters here it may have constant (as in Figure 2), diminishing or increasing returns. The point is that the rate of birth of new opportunities is what defines the level of opportunity by shifting the production function of innovation. The optimum level of innovative effort should therefore be a proxy of the level of TO in a specific sector.

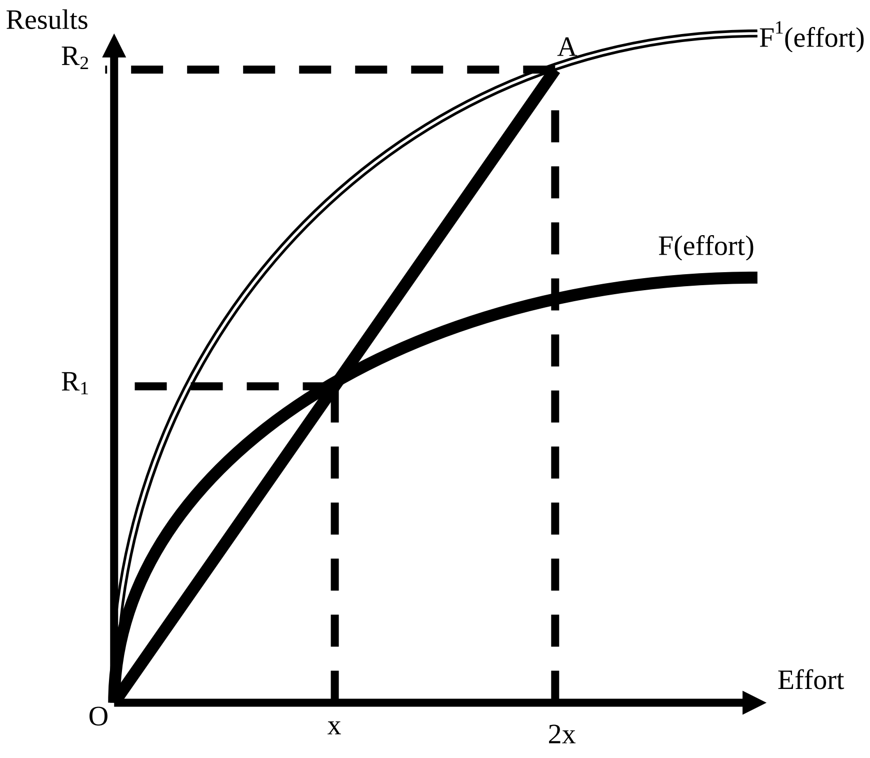

Figure 2 Dynamic Production Function with Static Decreasing Returns

A question that follows directly from this exposition is: why can't the level of effort be used directly as the level of TO? There are good reasons not to do approach the matter in this way. First, the level of effort varies according from firm to firm, according to their size, nationality, technological competencies and other firm characteristics. Second, even sectoral average of innovative effort to sales ratio also has problems associated with firm variety and does not express the level of opportunity itself. However, the most important reason may be obtained from Sutton (2000). Sutton's work aims at explaining how the pace of technology influences market configuration. Sutton's argument is based on the ability of a firm (entrant or incumbent) that outspends incumbents on innovative effort to achieve profit to cover its outlays. Suppose that a firm outspends its rivals in *k* times, it has to obtain at least an *aY* profit, where *Y* is the ex ant level of industry's sales. Therefore, Sutton's escalation parameter would be the $\alpha = {}^{a}\!/_{k}$. This is what is intended to measure here, the ability of an expenditure in innovative efforts to create new markets or displace competitors and obtain profits.

2.5 The Contribution of the Paper

This paper uses a *probit* model run at the firm level data for each of 65 sectors to measure the sector's level of TO. The model has two independent variables: the level of innovative effort and its quadratic form, as it is represented in equation (1), where *IE* is innovative effort. The dependent variable assumes value 1 whenever the firm has introduced a product innovation that constitutes a novelty to the Brazilian market or a process innovation that is new to the Brazilian productive sector.[1] The sectoral level of TO is represented by the *level of expenditure (innovative effort) that maximizes the firms probability to innovate*, represented by $\left|\frac{\beta_1}{2\beta_2}\right|$.

$$P(y = 1|x) = \alpha + \beta_1 IE + \beta_2 (IE)^2 + \varepsilon \qquad (1)$$

The equation is run with two different indicators for innovative efforts: R&D and total cost of innovation (TCI), which includes costs of investment in embodied knowledge and the introduction of the innovation in the market (expenditures on R&D, external acquisition of R&D, external knowledge acquisition, acquisition of machinery and equipment, personnel training, introduction of the innovation in the market and industrial projects and other preparations for production and distribution). This is an attempt to address a second issue, that is, the relevance of non-R&D innovative efforts in the definition of TO.

3 DATABASE DESCRIPTION

The paper uses the Brazilian Technological Innovative Industrial Survey (PINTEC) applied by the Instituto Brasileiro de Geografia e Estatística (IBGE) for 2003 to obtain information on innovative variables. The PINTEC was applied to about 11,000 manufacturing and mining industrial companies. It includes all companies that have records on official Brazilian innovative databases, such as financial institutions, registration of technology transfers and all companies over 500 employees. It covers a random representative sample for companies over 10 employees. The sample is representative for companies in 10 to 29,

[1] It is important to note that it is a quite narrow definition of innovation when compared to the usual definition present in Oslo Manual surveys.

30 to 99, 100 to 499 employees size cohorts. The survey uses a questionnaire based on the Oslo manual.[2]

Companies are classified in four-digit sectors according to Classificação Nacional das Atividades Econômicas (CNAE). CNAE is based on ISIC. The paper aggregates companies in a adaptation of the three-digit CNAE-ISIC classification. CNAE has 104 three-digit sectors in the mining and manufacturing industries and the aggregation here used has 65 sectors (see annex 1).

3.1 THE VARIABLES

The dependent variable used is obtained from two questions of PINTEC referring to the introduction of process and product innovation. The first question is: *Did your company introduce a new or significantly technologically improved process that constituted a novelty to the sector in Brazil during the 2001-2003 period?* The second question is: *Did your company introduce a new or significantly technologically improved product that constituted a novelty to the market in Brazil during the 2001-2003 period?* If the answer to at least one of these questions was *yes*, the dependent variable assumed 1 and 0, otherwise.

The paper uses two different measures of innovative effort:

(i) The level of R&D expenditures (RD); and

(ii) The total cost of innovation (TCI), represented by the sum of expenditures on R&D, external acquisition of R&D, external knowledge acquisition, acquisition of machinery and equipment, personnel training, introduction of the innovation in the market and industrial projects and other preparations for production and distribution.

In order to test the quality of the results in terms of TO sectoral ordering, the paper uses two other sets of information:

(i) R&D and TCI intensity is obtained by the ratio of R&D and TCI to sales;

(ii) The relevance of different sources of information is obtained from PINTEC's questions 108 to 120 were it is asked to the answerer to rate the level of importance of different sources of information in high, medium, low and not relevant. This question is asked only to companies that have declared that they introduced product or process that were considered new at the firm level (not market or sector). The indicator elaborated is the ratio of high relevance to total firms of each information source.

Herfindahl-Hirschman concentration of sales indexes were obtained from IBGE – Industrial Annual Survey for 2003.

[2] A detailed description of the database may be found in IBGE, *Pesquisa Industrial de Inovação Tecnológica.* http://www.ibge.gov.br.

4 RESULTS

4.1 TO VALUES

One important characteristic of the measure proposed is that there is got to be a maximum, that is, in order for the $\left|\frac{\beta_1}{2\beta_2}\right|$, obtained from equation (1), to make sense, the sign for β_1 has to be positive and significant and the sign for β_2 has to be positive and signigicant. Table 1 and Table 2 summarize the sign of the coefficients for both innovative effort indicators, respectively, TCI and R&D. Model (1) was tested for both variables in 65 sectors. The results are shown in annex 2. Table 1 shows the signs of the coefficients for TCI. It shows that only 2 out of the 65 sectors in annex 2 have negative sign for the coefficient of TCI, but in no case the coefficient is significant; and for 63 sectors the coefficient assumes a positive sign for TCI and in 2 cases the coefficient is non-significant. As for the square of the TCI, the negative sign is dominant. In only 6 cases the coefficient for the square of the TCI assumes a positive value; however, in all of them the coefficient is non-significant. In 45 out of the 59 cases where the coefficient for the square of the TCI assumes a negative sign, the coefficient is significant.

Table 1 Signs and Significance of the Coefficients for the Total Cost of Innovation and the Square of the Total Cost of Innovation (number of sectors)

		Sign of TCI2							
		Negative					positive		
Sign of TCI	Significance of TCI	1%	5%	10%	non-significant	Total	non-significant	Total	Total
negative	non-significant						2	2	2
	Total						2	2	2
positive	1%	29	9	5	2	45			45
	5%		2		7	9			9
	10%				3	3			3
	non-significant				2	2	4	4	6
	Total	29	11	5	14	59	4	4	63
Total		29	11	5	14	59	6	6	65

Source: Own elaboration from micro-data from IBGE – Pesquisa Industrial de Inovação Tecnológica, 2003.

The results for R&D independent variable are summarized in Table 2. They look quite alike the results presented for equation (1). Only 5 sectors out of 65 present negative value of the coefficient of the R&D variable; but in all five cases the sign is non-significant. Only 6 out of the 57 sectors that have positive sign for the coefficient of the R&D variable, are non-significant. In only 8 cases the square of R&D had positive sign. However, in no case it was statistically significant. In 18 out of the 57 cases where the coefficient for the square of R&D was negative, the coefficient was not statistically significant.

Annex 2 presents the results of the 65 regressions and the value of innovative effort (R&D and TCI) for the 65 sectors of the sample. Using the information from Table 1, sectors that have non-significant β_1 and a positive non-significant β_2 should be eliminated for it becomes impossible to obtain the level of TCI where the probability to innovate achieves its maximum level, that is, $\left|\frac{\beta_1}{2\beta_2}\right|$. This leaves only 57 sectors into the analysis. Petroleum refining, vehicles and other food products are the most highly TO sectors graded by the TCI criterion, while other instruments, Forging, pressing, stamping and roll-forming of metal and weapons and ammunition show the lowest values.

Table 2 Signs and Significance of the Coefficients for R&D and the Square of the R&D (number of sectors)

		Sign of R&D square							
		negative					positive		Total
Sign	Significance	1%	5%	10%	non-significant	Total	Non-significant	Total	
negative	non-significant						5	5	5
	Total						5	5	5
positive	1%	32	6		6	44			44
	5%			1	2	3			3
	10%				4	4			4
	non-significant				6	6	3	3	9
	Total	32	6	1	18	57	3	3	60
Total		32	6	1	18	57	8	8	65

Source: Own elaboration from micro-data from IBGE – Pesquisa Industrial de Inovação Tecnológica, 2003.

When the same approach is used to estimate TO by the R&D criterion, only 51 sectors are left in the analysis. Petroleum refining, manufacture of television and radio transmitters and rubber products achieve the highest values (see annex 2). On the other hand, manufacture of structural metal products, building and repairing of ships and processing and preserving of fruits and vegetables achieve the lowest TO levels.

0 summarizes information on the estimations of the TO level for the 57 sectors according to the TCI criterion and 51 sectors according to the R&D criterion. It divides each sample into five quintiles according to the assessed TO level. It shows that there is a large dispersion of the level of expenditure in innovative effort that maximizes the probability to innovate. When total cost of innovation is the reference measure, the dispersion rate (standard deviation/mean) is 1.69; it is even greater when R&D is the reference value (3.28).

In this paper we have proposed two different measures of TO, according to the type of expenditure. The TO measure based in R&D expenditures has a much narrower view of innovative effort, while TCI based TO measure has a wider scope of innovative expenditures. The narrower approach has some trouble in capturing the real effort executed in a catching-up country like Brazil, where most efforts are done in the adoption of new techniques and a great part of the knowledge absorbed by companies is embodied. On the other hand, because TCI measures include expenditures in equipment and machinery it may have a great variation across years, due to the discrete characteristic of these investments. One important question however is whether these two measures are correlated. In principle, there is a high correlation between the two rankings, according to the Pearson correlation index has a value of 0.81. Although there is a very high correlation, the information presented in 0 suggests that the sectoral rankings vary across the two criteria. Only 3 out of the 11 sectors in the first quintile of TCI expenditures are at the first quintile according to the R&D expenditures criterion. Production, processing and preservation of meat and fish and Manufacture of knitted and crocheted fabrics and articles are classified respectively as medium and low opportunity sector according to the R&D criterion, but it is considered a very high opportunity sector by TCI criterion.

Table 3 Descriptive Statistics of the Measurement of Technological Opportunity, Research and Development and Total Cost of Innovation, R$ thousands*

	Total Cost of Innovation				
Level of Opportunity	Number of Sectors	Mean	SD	Max	Min
Very high	11	202012	148484	560978	79614
High	11	54621	8949	75400	43653
Medium	11	27453	7709	41604	19017
Low	11	12810	2440	15834	9122
Very low	13	4354	2207	8397	766
Total Sample	57	58289	96398	560978	766
	Research and Development				
	Number of Sectors	Mean	SD	Max	Min
Very high	10	46089	85463	288253	12485
High	10	9610	1363	11754	7216
Medium	10	3852	868	5212	3103
Low	10	2324	597	3035	1597
Very low	10	624	396	1383	132
Total Sample	51	12211	40119	46089	132

Source: Own elaboration from micro-data from IBGE – Pesquisa Industrial de Inovação Tecnológica, 2003.

*Prices of 2003. The average commercial R$/US$ exchange rate for 2003 was US$ 1 = R$ 3,07.

In this paper we have proposed two different measures of TO, according to the type of expenditure. The TO measure based in R&D expenditures has a much narrower view of innovative effort, while TCI based TO measure has a wider scope of innovative expenditures. The narrower approach has some trouble in capturing the real effort executed in a catching-up country like Brazil, where most efforts are done in the adoption of new techniques and a great part of the knowledge absorbed by companies is embodied. On the other hand, because TCI measures include expenditures in equipment and machinery it may have a great variation across years, due to the discrete characteristic of these investments. One important question however is whether these two measures are correlated. In principle, there is a high correlation between the two rankings, according to the Pearson correlation index has a value of 0.81. Although there is a very high correlation, the information presented in 0 suggests that the sectoral rankings vary across the two criteria. Only 3 out of the 11 sectors in the first quintile of TCI expenditures are at the first quintile according to the R&D expenditures criterion. Production, processing and preservation of meat and fish and Manufacture of knitted and crocheted fabrics and articles are classified respectively as medium and low opportunity sector according to the R&D criterion, but it is considered a very high opportunity sector by TCI criterion.

0 shows as well that the TO rankings for Brazilian industry is quite different than the TO rankings presented by scientific frontier countries. For instance, Medical and surgical instruments and Other instruments are considered as very low TO sectors according to TCI and low TO according to R&D criterion. On the contrary, Refining and Paints sectors are considered very high opportunity sector according to both criteria.

Table 4 Distribution of Sectors per Quintile According to Level of TO, R&D and Total Cost of Innovation Measures

TCI TO	R&D TO				
	Very high	High	Medium	Low	Very Low
Very High	Television and radio transmitters and apparatus for line telephony Paints, varnishes and similar coatings Refined petroleum products	Engines, pumps, compressors, taps and turbines Other chemical products Pharmaceuticals Paper and paper products Other food products	Production, processing and preservation of meat and fish	Knitted and crocheted fabrics and articles	
High	Mining and quarrying Autoparts Domestic appliances Basic iron and steel Rubber products Basic Petrochemicals	Soap and detergents		Inorganic Chemicals	Dairy products
Medium		Agricultural and forestry machinery	Electronic valves and tubes Electricity distribution and control apparatus Basic precious non-ferrous metals Other non-metallic mineral products Grain mill products	Spinning, weaving and finishing of textiles	Publishing, printing and reproduction of recorded media
Low		Bodies (coachwork) for motor vehicles; trailers Electric motors, generators and transformers	Other machinery of general purpose Plastics products	Machinery for mining, quarrying; construction Other fabricated metal products Ceramic products Tanning and dressing of leather	Manufacture of furniture
Very Low			Special-purpose machinery	Medical and surgical equipment Other instruments Wearing apparel	Other manufacturing Processing and preserving of fruit and vegetables Weapons and ammunition Forging, pressing, stamping and roll-forming of metal Structural metal products Glass and glass products Wood and of products of wood and cork

Source: Own elaboration from micro-data from IBGE – Pesquisa Industrial de Inovação Tecnológica, 2003.

* Non-significant includes those sectors that have the coefficient of R&D or CTI expenditures non-significant or the coefficient of their square values positive.

4.2 TO, INNOVATIVENESS AND SOURCES OF KNOWLEDGE

Do the rankings obtained from the analysis proposed above make sense? This subsection intends to provide an answer to this question by linking the results from the rankings to three sets of data:

(i) the level of innovativeness;

(ii) the R&D and TCI intensity of each sector; and

(iii) the sources of information.

Table 5 shows the descriptive statistics for the three sets of data. The level of innovativeness is measured by the ratio of innovative firms that introduced a new product to their markets in Brazil or introduced a new process to their sectors in Brazil. In total there were 2,844 innovative companies distributed in 65 sectors. Manufacture of office and computing machines showed the highest innovation, 0.404, while the Manufacture of ceramic products showed the lowest innovation rate. R&D and TCI intensity are measured by the ratio of expenditure to sales. In the PINTEC survey, firms that had innovative activities[3] were asked to rate each source of information in three levels of importance. The indicator presented is the ratio of the firms that rated the source of information as very important to total firms undertaking innovative activities (28 thousand in total).

Table 5 Descriptive Statistics for Sectoral Innovation Rate, R&D Intensity, TCI Intensity and the Relevance of Sources of Information

	N	Mean	Std. Dev.	Min	Max
Innovation Rate	65	0.068	0.068	0.0015	0.404
R&D Intensity	65	0.006	0.010	0.0002	0.079
TCI Intensity	65	0.028	0.020	0.0078	0.154
Sources of Information					
R&D department	65	0.194	0.113	0.037	0.632
Other areas in the company	65	0.087	0.085	0	0.493
Suppliers	65	0.360	0.128	0.068	0.646
Clients	65	0.419	0.145	0.072	0.809
Competitors	65	0.209	0.087	0	0.395
Consulting companies	65	0.065	0.064	0	0.365
Universities and research labs	65	0.073	0.066	0	0.261
Training centers	65	0.068	0.050	0	0.218
Certification centers	65	0.091	0.072	0	0.286
Licensing, patents and know how	65	0.032	0.037	0	0.216

Source: Own elaboration from micro-data from IBGE – Pesquisa Industrial de Inovação Tecnológica, 2003.

The data presented in Table 5 show that a very low percentage of firms have introduced innovations that were new to the market or sector (6.8% is the arithmetic average across sectors). The level of R&D expenditure is on average very low (less than 0.6%) and sectors show a great dispersion in their levels of R&D (the standard deviation to mean ratio is the highest in Table 5). The lowest R&D intensity is displayed by Manufacture of sugar and alcohol, followed by Publishing, printing and reproduction of recorded media and the highest level of R&D intensity is held by Manufacture of aircraft. TCI intensity is much higher, suggesting that most of the innovative effort in the Brazilian industry is non-R&D oriented. The sector with the lowest level of TCI intensity is Building and repairing of ships, while the highest TCI intensity is held by again Manufacture of aircraft.

The relevance of the different sources of information show a quite different hierarchy when compared to the work of Klevorick et al. (1995). The highest valued sources of information

[3] Innovative activities here are meant by firms that introduced a product or process between 2001 and 2003 that were new at the firm level (a wider concept than the market or sector) or firms that had an ongoing innovative project.

are clients and suppliers, while licensing, patents and know-how, consulting companies and Universities and labs rate very low.

Table 6 shows the Pearson correlation indexes of the two opportunity measures against the innovative characteristics presented in Table 5. TCI TO measure is positively and significantly correlated to innovation rate, R&D intensity, the relevance of the R&D department, other areas in the company and to the acquisition of licensing, patents and know-how. It is not significantly correlated to TCI intensity and to the relevance given to suppliers, clients, competitors, consulting companies, training centers and certification centers. Every variable that is positively and significantly correlated to TCI displays positive and significantly correlation to R&D intensity and innovation rate. The relevance of clients, training centers and certification centers are not significantly correlated to TCI TO but are positively and significantly correlated to R&D intensity and innovation rate. It may be said therefore that TCI TO attends the correlation that should be expected from a technological opportunity measures in terms of the relation it maintains to variables that technological opportunity should be explaining.

On the other hand, the R&D measure for TO is not significant in any innovation variable presented, though in general it shows the right sign. This may be a consequence of the low importance R&D has in the innovative activity of Brazilian companies. Therefore, it does not seem to describe correctly the technological opportunity in Brazilian industry.

Table 6 Pearson Correlation Indexes

Variables	R&D TO measure	TCI TO measure	Innovation Rate	TCI Intensity	R&D Intensity	R&D department	Other areas in the company	Suppliers	Clients	Competitors	Consulting companies	Universities and research labs	Training centers	Certification centers
R&D TO measure														
TCI TO measure	0.81													
Innovation Rate	0.212	**0.337**												
TCI Intensity	-0.106	0.136	**0.418**											
R&D Intensity	0.158	***0.259***	**0.613**	**0.691**										
R&D department	0.099	***0.253***	**0.555**	0.168	**0.399**									
Other areas in the company	0.216	**0.308**	**0.619**	***0.267***	**0.469**	**0.609**								
Suppliers	-0.172	-0.015	-0.153	-0.195	-0.131	0.167	0.079							
Clients	0.011	0.026	**0.417**	0.160	**0.382**	***0.244***	0.132	**0.319**						
Competitors	-0.093	-0.031	-0.036	-0.016	-0.196	0.104	-0.047	***0.266***	**0.277**					
Consulting companies	0.167	0.044	-0.205	-0.055	-0.112	0.163	0.123	0.213	0.002	0.009				
Universities and research labs	0.063	0.025	0.202	0.019	0.067	**0.335**	0.148	0.092	**0.296**	**0.318**	-0.016			
Training centers	-0.099	0.017	**0.275**	0.051	***0.254***	**0.318**	**0.332**	**0.383**	**0.478**	***0.253***	0.119	***0.259***		
Certification centers	0.161	0.129	***0.241***	***0.252***	**0.381**	**0.452**	**0.271**	-0.055	0.101	0.071	0.061	0.114	**0.305**	
Licencing, patents and know how	-0.068	**0.301**	**0.582**	**0.357**	**0.400**	**0.511**	**0.669**	0.149	0.180	0.153	-0.142	**0.296**	***0.248***	**0.291**
Number of Sectors	51	57	57	57	57	57	57	57	57	57	57	57	57	57

Source: Own elaboration from micro-data from IBGE – Pesquisa Industrial de Inovação Tecnológica, 2003.

* Whenever values are underlined, indexes are significant at 1%, whenever they are in bold letter, indexes indexes are significant at the 5% level, whenever they are in italics they are significant at the 10% level.

4.3 TO AND MARKET STRUCTURE

An important question about TO is its linkage to market structure. Figure 3 shows the Pearson correlation index of different technological measures to Herfindahl-Hirschman concentration index. (HHI).[4] All measures are positively and significantly correlated to concentration. The two TO measures elaborated in this paper have the best performance.

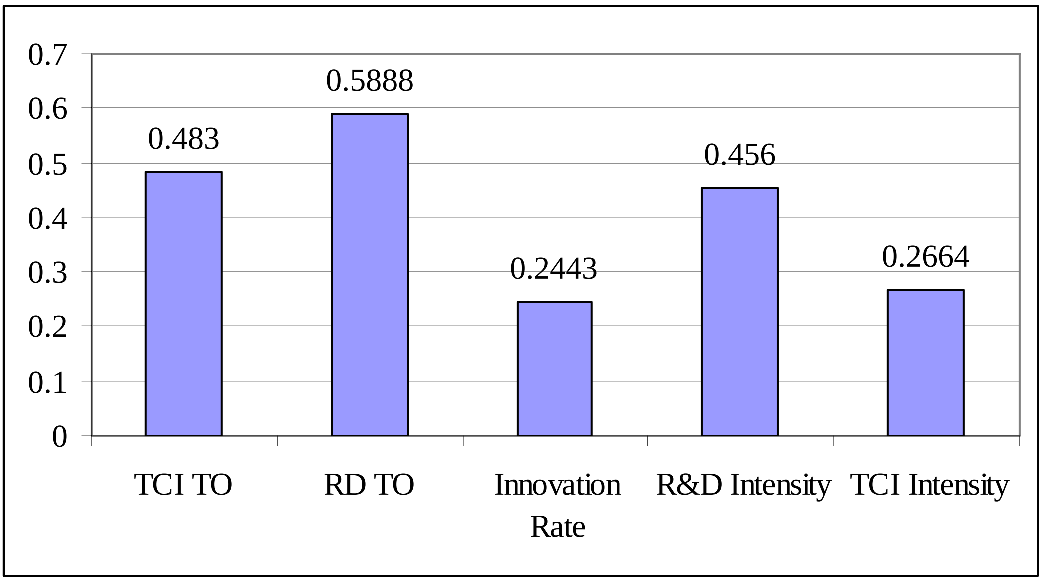

Figure 3 Correlation to Herfindahl-Hirschman Index

5 CONCLUSIONS

This paper aims to contribute to the discussion on the measurement of technological opportunity. The paper developed a methodology of measurement of TO that relates innovative effort to the probability to innovate. The paper used a *probit* model run at the firm level for 65 sectors to measure the level of TO. The model had two independent variables: a variable to measure technological effort and its quadratic form. Two models were run for each sector. One used R&D expenditures, the other used TCI expenditures. TO was measured as the level where the probability to innovate is maximum.

Most sectors showed decreasing static returns to technological effort. This means that there is a level of innovative effort where the probability to innovate achieves its maximum level. The ranking established by these measures is positively correlated to measures that express innovativeness, intensity of sectoral innovative effort and spillovers from other sources of information. However, these correlations showed to be stronger when TCI measure of TO was used. R&D measure of TO did not perform well in these correlations. This may be a consequence of the specificities of Brazilian industry where most of innovative effort in non-R&D. Both measures performed quite well in the correlation with Herfindahl Hirschman market concentration index.

The preliminary success obtained from the techniques developed in this paper suggests that further investigation must take place in order to relate the results here obtained with some important observations derived from the paper:

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[4] Due to problems of number of firms, some of the sectors at the three-digit level had to be aggregated. Therefore, from a initial number of 103 sectors, the classification finished in 65 sectors. The concentration indexes were elaborated from the three-digit aggregation and TO measures were repeated for some of the aggregated sectors.

(i) the sectoral TO ranking in the Brazilian case do not necessarily agree with the same ranking for scientific frontier countries;

(ii) TCI measures have different rankings when compared to R&D measures. The relevance of TCI for innovation in Brazil suggests that some further relationships and differences should be pursued;

(iii) The TO-structure relations obtained in this paper are still preliminary and the topic deserves further investigation; and

(iv) Performance consequences were not derived from the paper.

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Annex 1

ISIC two digit	ISIC Compatible	CODE USED	SECTOR DESCRIPTION	Number of Observations	Expanded Sample
15 Manufacture of food products and beverages	1511 + 1512	151	Production, processing and preservation of meat and fish	244	941
	1513	152	Processing and preserving of fruit and vegetables	88	520
	1514	153	Manufacture of vegetable and animal oils and fats	42	114
	152	154	Manufacture of dairy products	151	1040
	153	155	Manufacture of grain mill products, starches and starch products, and prepared animal feeds	173	1191
	1542	997	Manufacture of sugar and alcohol	208	373
	Part of 154	157	Manufacture of Coffee	47	221
	154-1542-coffee	158	Manufacture of other food products	445	5560
	159	159	Manufacture of beverages	157	764
16 Manufacture of tobacco products	160	160	Manufacture of tobacco products	39	63
17 Manufacture of textiles	171	170	Spinning, weaving and finishing of textiles	195	950
	173	179	Manufacture of knitted and crocheted fabrics and articles	296	2223
18 Manufacture of wearing apparel; dressing and dyeing of fur	180	180	Manufacture of wearing apparel; dressing and dyeing of fur	947	11726
19 Tanning and dressing of leather;	190	190	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	580	3843
20 Manufacture of wood and of products	200	200	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	493	5102
21 Manufacture of paper and paper products	210 - 2101	210	Manufacture of paper and paper products	274	1573
	2101	211	Manufacture of pulp, paper and paperboard	23	20
22 Publishing, printing	220	220	Publishing, printing and reproduction of recorded media	356	3733
23 Manufacture refined petroleum products	232	232	Manufacture of coke, refined petroleum products	47	63
24 Manufacture of chemicals and chemical products	2411	241	Manufacture of Inorganic Chemicals	80	391
	2,412,241	240	Basic Petrochemicals	91	526
	2423	245	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	165	622
	2424	247	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	128	920
	2422	248	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	72	391
	249	249	Manufacture of other chemical products n.e.c.	109	659
25 Rubber and plastics products	251	251	Manufacture of rubber products	149	1230
	252	252	Manufacture of plastics products	515	3819
26 Manufacture of other non-metallic mineral products	261	261	Manufacture of glass and glass products	48	285
	2694,27	260	Manufacture of cement, lime and plaster	153	1680
	2691, 2692, 2693	264	Manufacture of ceramic products	303	3290
	2696, 2699	269	Manufacture of other non-metallic mineral products	120	1430
27 Manufacture of basic metals	271	278	Manufacture of basic iron and steel	135	422
	272, 273	279	Manufacture of basic precious non-ferrous metals and casting of metals	142	977
28 Metal Products	281	280	Manufacture of structural metal products, tanks, reservoirs and steam generators	190	2029
	2,891,289	283	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	181	2086
	2893	284	Manufacture of cutlery, hand tools and general hardware	98	731
	2899	289	Manufacture of other fabricated metal products n.e.c.	282	2580
29 Manufacture of machinery and equipment n.e.c.	2911, 2912	291	Manufacture of engines, pumps, compressors, taps and turbines, except aircraft, vehicle and cycle engines	122	539
	2913, 2914, 2915, 291	292	Manifacture of other machinery of general purpose	165	1406
	2921	293	Manufacture of agricultural and forestry machinery	91	584
	2922	294	Manufacture of machine tools	46	317
	2924	295	Manufacture of machinery for mining, quarrying and construction	44	289
	2923, 2925, 2926, 292	290	Manufacture of other special-purpose machinery	197	1590
	2927	299	Manufacture of weapons and ammunition	40	436
	293	298	Manufacture of domestic appliances n.e.c.	48	250
30 Manuf. office and computing machinery	300	300	Manufacture of office, accounting and computing machinery	72	201
31 Manufacture of electrical machinery and apparatus n.e.c.	311	311	Manufacture of electric motors, generators and transformers	50	255
	312	312	Manufacture of electricity distribution and control apparatus	61	346
	313, 314, 315, 319	310	Manufacture of other electrical equipment n.e.c.	185	1090
32 Manufacture of radio, television and communication equipment and apparatus	322	322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	59	145
	323	323	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods	43	143
	321	321	Manufacture of electronic valves and tubes and other electronic components	59	308
33 Manufacture of medical, precision and	3311	331	Manufacture of medical and surgical equipment and orthopaedic appliances	61	402

Annex 2

	TCI Regression							R&D Regression						
SECTOR	intercept	ChiSq	TCI	ChiSq	TCI2	ChiSq	TCI TO	Intercept	ChiSq	RD	ChiSq	RD2	ChiSq	R&D TO
151	-1,963	500,616	7.00E-05	12,590	-3,1E-10	4,815	116363	-2,01	485,98	3,29E-03	20,49	-3,15E-07	17,76	2,39E+08
152	-1,649	281,484	1.00E-03	19,639	-2,2E-07	14,252	2874	-1,74	274,79	3,07E-02	40,80	-1,17E-04	26,07	651900,3
153	-3,258	10,657	3.00E-04	5,459	-2,6E-09	4,158	51788	-2,25	44,41	1,82E-03	1,61	-1,30E-07	0,59	5,9E+08
154	-2,669	253,340	3.00E-04	21,041	-2,3E-09	7,580	53332	-3,04	126,98	8,78E-03	16,61	-4,30E-06	4,95	17887992
155	-2,345	447,428	4.00E-04	33,943	-7,9E-09	7,146	22167	-2,25	500,95	2,45E-03	27,54	-3,53E-07	12,39	2,19E+08
157	-2,319	83,153	1.00E-03	15,416	-1,1E-07	10,938	6665	-1,93	118,43	4,26E-04	0,02	7,19E-07	0,14	-1,1E+08
158	-1,902	3,087,090	4.00E-04	50,674	-5,8E-10	42,487	306340	-1,92	3045,11	7,75E-03	40,00	-3,75E-07	27,70	2,11E+08
159	-2,126	359,904	4.00E-04	9,919	-1,3E-08	5,933	14170	-2,09	353,99	1,21E-03	1,67	9,90E-08	0,02	-8.00E+08
160	-1,740	32,924	-6.00E-05	0,014	1,03E-08	0,148	3145	-1,65	35,77	1,61E-03	1,42	-6,33E-08	0,70	1,26E+09
170	-1,916	510,552	4.00E-04	24,272	-1.00E-08	6,250	20803	-2,00	483,49	4,21E-03	56,94	-1,17E-06	29,74	72541969
179	-1,909	1,222,142	6.00E-05	5,165	-2,1E-10	1,258	129193	-2,02	1139,74	6,76E-03	58,84	-1,89E-06	37,67	47353426
180	-2,702	2,673,431	1.00E-03	44,247	-1,1E-07	14,358	4515	-2,66	2848,28	2,85E-03	8,14	-7,89E-07	0,56	1,14E+08
190	-2,337	1,468,828	5.00E-04	37,099	-2.00E-08	11,335	12223	-2,29	1556,86	2,33E-03	25,59	-4,22E-07	7,96	2,25E+08
200	-2,201	2,246,918	2.00E-03	120,144	-3,5E-07	45,664	2675	-2,20	2253,00	2,45E-02	79,92	-4,28E-05	28,91	2336999
210	-2,079	776,981	1.00E-04	28,095	-6,2E-10	10,218	96429	-2,07	776,93	1,33E-03	17,41	-7,80E-08	7,11	1,35E+09
211	-108,760	0,000	2.00E-02	0,000	-1,8E-07	0,000	52910	-1,89	9,42	8,95E-04	0,65	-4,18E-08	0,16	2,52E+09
220	-2,497	1,165,016	3.00E-04	28,186	-7,4E-09	5,779	22239	-2,46	1228,24	7,45E-03	20,98	-4,49E-06	9,30	24475802
232	-1,494	35,087	3.00E-04	3,830	-2,8E-10	1,842	560978	-1,51	34,94	1,15E-03	4,68	-2,00E-09	2,99	5,79E+10
240	-1,608	295,538	1.00E-04	29,529	-1,7E-09	6,128	45163	-1,55	304,72	3,61E-04	32,94	-8,95E-09	15,49	1,34E+10
241	-0,985	159,396	7.00E-05	2,973	-6,1E-10	0,541	53658	-1,14	176,44	3,42E-03	34,12	-9,32E-07	17,23	1,29E+08
245	-1,407	346,771	2.00E-04	46,802	-1,1E-09	20,813	82952	-1,35	342,00	7,44E-04	32,69	-3,43E-08	13,42	3,57E+09
247	-2,562	270,564	6.00E-04	40,286	-5,5E-09	27,146	55210	-2,59	259,96	5,00E-03	39,57	-2,13E-07	18,98	5,8E+08
248	-2,621	92,652	6.00E-04	4,072	-1.00E-09	0,000	271368	-2,61	107,23	2,08E-03	16,60	-8,08E-08	8,31	1,53E+09
249	-1,661	384,006	2.00E-04	34,770	-1,4E-09	18,850	79614	-1,61	383,18	9,19E-04	13,88	-5,56E-08	6,95	2,24E+09
251	-1,698	734,332	9.00E-05	4,269	-7,3E-10	1,734	62285	-1,70	733,67	2,87E-04	3,27	-6,77E-09	0,71	1,85E+10
252	-1,718	2,217,019	5.00E-04	55,600	-1,7E-08	14,615	14493	-1,70	2250,98	2,62E-03	77,16	-4,18E-07	27,69	3,01E+08
260	-2,402	592,545	2.00E-04	14,246	-2,1E-09	4,664	40199	-2,42	578,73	1,90E-03	1,74	3,38E-07	0,08	-3,8E+08
261	-2,442	91,369	1.00E-03	11,134	-8,9E-08	2,229	6259	-2,69	65,05	3,06E-02	16,04	-1,73E-05	0,38	7535690
264	-3,241	252,460	5.00E-04	9,595	-2,7E-08	3,192	10085	-3,59	109,35	7,33E-03	15,13	-1,23E-06	0,41	1,07E+08
269	-2,519	433,977	8.00E-04	38,086	-2,1E-08	18,011	19017	-2,57	406,16	5,50E-03	46,08	-5,36E-07	24,17	2,51E+08
278	-1,664	242,827	1.00E-04	27,676	-1.00E-09	17,151	60797	-1,60	246,40	8,03E-04	21,89	-2,74E-08	12,29	5,07E+09
279	-1,846	551,300	3.00E-04	27,485	-4,8E-09	8,852	27668	-1,87	547,33	3,19E-03	32,28	-5,15E-07	6,07	2,71E+08
280	-1,979	1,048,832	1.00E-03	25,473	-1,3E-07	12,642	4679	-2,07	977,52	2,39E-02	86,06	-4,46E-05	52,31	3139592
283	-1,892	1,076,351	9.00E-04	8,456	-2,4E-07	3,372	1949	-1,90	1133,37	7,19E-03	23,10	-5,30E-06	8,45	26719943
284	-1,352	417,259	2.00E-04	9,925	-2.00E-09	3,334	43653	-1,35	419,26	1,40E-03	12,15	-1,42E-07	6,15	9,97E+08
289	-1,927	1,358,770	5.00E-04	29,902	-3.00E-08	9,563	9182	-1,96	1375,40	6,94E-03	109,71	-1,14E-06	68,99	1,26E+08
290	-1,470	876,665	7.00E-04	31,627	-5,1E-08	16,260	6821	-1,41	920,53	1,83E-03	21,50	-2,83E-07	15,63	5,13E+08
291	-1,779	297,923	3.00E-04	47,940	-1,2E-09	18,690	105317	-1,78	303,78	9,96E-04	38,35	-5,08E-08	9,26	2,86E+09
292	-1,597	811,403	1.00E-03	110,685	-6,7E-08	75,118	9122	-1,60	820,71	3,65E-03	125,04	-5,37E-07	95,77	2,72E+08
293	-1,671	331,484	2.00E-04	10,786	-3,2E-09	2,928	33084	-1,63	341,66	5,95E-04	10,85	-3,40E-08	5,09	4,3E+09
294	-3,159	30,255	8.00E-04	7,913	-3,2E-08	0,968	13250	-2,27	115,13	-3,85E-01	0,00	3,12E-05	0,00	-4704806
295	-1,703	166,509	3.00E-04	5,935	-1,1E-08	1,491	15834	-1,73	165,17	2,45E-03	6,12	-4,35E-07	1,53	3,39E+08
298	-1,136	120,115	1.00E-04	8,155	-8.00E-10	2,774	75400	-1,18	121,34	1,57E-03	9,43	-4,74E-08	4,17	3,14E+09
299	-2,818	76,020	1.00E-02	33,528	-7,2E-06	16,087	766	-2,03	213,97	1,90E-02	35,28	-2,12E-05	21,61	7046737
300	-0,293	8,858	2.00E-05	0,266	1,48E-10	0,076	-58410	-0,23	4,94	-6,30E-05	0,16	5,34E-09	0,09	-2,8E+10
310	-1,313	583,082	4.00E-05	0,262	3,74E-09	0,430	-5850	-1,33	612,99	8,85E-04	14,42	-2,33E-08	2,21	6,66E+09
311	-1,851	134,943	8.00E-04	5,807	-3,2E-08	0,275	12491	-1,72	147,74	1,18E-03	3,46	-6,42E-08	0,97	2,42E+09
312	-1,966	178,315	5.00E-04	15,993	-1,1E-08	7,731	23421	-1,92	172,60	1,94E-03	8,60	-2,87E-07	2,64	5,44E+08
321	-1,317	167,779	2.00E-04	5,794	-1,9E-09	0,502	41604	-1,34	167,16	2,13E-03	5,66	-3,02E-07	0,28	5,31E+08
322	-1,472	79,439	2.00E-04	8,179	-7,7E-10	3,863	161913	-1,46	79,82	5,08E-04	10,87	-6,31E-09	4,90	2,55E+10
323	-1,457	81,791	2.00E-04	6,836	-4,9E-09	4,236	23878	-1,38	79,62	3,29E-04	0,41	-1,96E-08	0,12	8,25E+09
330	-1,216	159,386	3.00E-03	19,992	-4,7E-07	14,269	2657	-1,21	160,00	5,61E-03	21,03	-1,76E-06	6,76	93985317
331	-2,142	181,899	2.00E-03	46,469	-2,2E-07	16,051	4564	-2,14	182,83	4,76E-03	49,58	-8,45E-07	30,80	1,96E+08
332	-1,086	42,326	3.00E-04	2,980	-6,2E-09	0,674	27902	-1,09	41,82	6,08E-04	2,36	-2,21E-08	0,52	7,5E+09
340	-1,009	12,968	2.00E-05	6,223	-3,1E-11	4,961	311662	-0,79	9,65	1,59E-05	1,72	-3,79E-11	0,52	4,49E+12
343	-1,683	229,142	5.00E-04	15,002	-1,5E-08	3,851	15742	-1,59	231,13	9,25E-04	2,77	-5,40E-08	0,11	3,18E+09
344	-1,578	590,552	2.00E-04	44,404	-1,8E-09	16,700	48288	-1,54	592,02	5,54E-04	32,99	-2,22E-08	11,14	7,75E+09
345	-117,341	0,000	3.00E+00	0,000	-0,01213	0,000	105	-2,05	224,42	-8,66E-01	0,00	3,09E-02	0,00	-5575,94
350	-1,126	107,069	1.00E-04	0,009	8,07E-07	0,404	-80	-1,22	111,48	4,45E-02	17,60	-1,21E-04	8,54	1447517
353	-1,688	36,121	-2.00E-03	0,154	7,45E-08	0,116	15719	-1,54	41,22	-1,37E-02	0,05	1,09E-06	0,05	-1,6E+08
359	-1,524	124,110	8.00E-05	0,088	1,17E-08	0,222	-3204	-1,53	127,82	1,23E-03	9,28	-8,50E-08	2,07	2,11E+09
361	-2,013	2,396,540	5.00E-04	47,528	-1,9E-08	18,236	14318	-2,05	2330,27	1,09E-02	87,13	-7,26E-06	29,95	24855639
997	-2,870	55,195	9.00E-04	4,369	-1,2E-07	2,283	3786	-2,41	128,14	-8,31E-02	0,00	1,82E-05	0,00	-2,7E+07
998	-2,648	477,872	2.00E-04	21,466	-1,8E-09	11,947	51257	-2,49	590,54	6,82E-04	3,25	-2,21E-08	0,68	2,26E+10
999	-1,819	1,381,923	9.00E-04	29,482	-5,3E-08	10,839	8397	-1,80	1405,66	5,43E-03	29,23	-1,96E-06	17,46	2,55E+08