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Life tables of disability beneficiaries by morbidity cause. Brazil, 1999-2002

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Abstract

The main goal of this paper is to estimate a Disability Beneficiaries Life Table from the General Social Security Regime for Private Sector Workers (rgps) by sex, age and disability cause in Brazil using multiple-decrement models. We used administrative records from Technological Enterprises and Social Security Information (dataprev 1999-2002), and the information of social beneficiaries given by National Records of Social Information (cnis 1999-2002).The results show that –in contradiction with the disability life tables used in the private sector– the male disability retirement hazard increases steadily until age 65 and decreases afterwards. However, for females, these risks increase continuously up to the oldest age. More sex differentials show that, among women, the risk of disability retirement is larger due to circulatory diseases, musculoskeletal diseases and neoplasms. Among males, mental disorders are the most responsible for an overweight in the number of pensioners, especially among the young and adult age groups. This paper contributes to a better understanding of work and disability, especially in the field of social security and retirement.

Key words: Life Tables, Disability, Social Security, Brazil.

Introduction

The Brazilian demographic transition process, during the last half century, caused expressive changes in the Brazilian population age structure (Carvalho, 2004). The first important change is characterized by a fast child mortality decline beginning in the 1940s. The direct consequence of this process of mortality decline was the increase in life expectancy (Prata, 1992; Carvalho e Garcia, 2003). In a period of almost sixty years, the country's life expectancy rose from 44 years in 1940 to 73 years in 2009 (Carvalho, 2004; Ministério da Saúde, 2010). In the Southern and Southeastern parts of Brazil, the most socioeconomic developed regions of the country, it has been verified that there is an increase in the number of deaths by external causes and non-transmissible diseases, but a decrease in the number of deaths by transmissible diseases (Ferreira and Castiñeiras, 1996, 1998; Gawryszewski and Jorge, 2000; Nunes, 2004; Schramm *et al.*, 2004). Moreover, fertility has followed a similar path of continuous decline. Total Fertility Rate (TFR) fell from 6.3 to 5.8 in 1970 and to 4.4 in 1980. After the end of the 1980s, the reduction in the national TFR was more pronounced, achieving the value of 2.9 in 1991. Finally, in 2006, the TFR reached the below replacement level (Rios-Neto, 2005; Ministério da Saúde, 2010; Alves, 2008).

This demographic transition process had important implications to labor market and social security system due to the changes in the age structure. In addition to that, due to the Brazilian demographic transition process characterized by a fast fertility decline and an increase in life expectancy, the country might experience a shortage in future active population together with an increase population aging. Therefore, the amount of taxpayers decreases as the number of social beneficiaries' increases, and the social security system becomes deficient (Brito, 2007).

The social security system becomes more fragile in the extent that occurs early retirements. In many cases, the main cause of this early withdraw is commonly associated with any kind of disability. In Latin-American countries, the costs with social security associated with disability withdraws range from 8% to 18% at the beginning of this century (Grushka and Demarco, 2003), while in Brazil this cost currently is round 17% (AEPS, 2011).

Due to distinguished ways to manage the pension systems and different definitions adopted, it is very difficult to establish international comparison. According to Grushka and Demarco (2003), many Latin-American pension systems followed the Chilean experience, since the 1981 pension reform. The criteria for retirement disability depends of the country pension used definition –such as partial or total disability, permanent or temporary work disability– and whether or not the disability cause is related to work (Grushka and Demarco, 2003).

In Brazil, the public social security allows early retirement and it also covers any income lost to all insured laborers and victims of permanent work disability due to illness or work injuries. This retirement benefit shall be granted to the employee, even if he or she does not have illness assistance (Gomes, 2008). In this case, the work disability is defined as the incapacity to develop any kind of labor activity, without the possibility of recovering or exercising any payment work activity and the illness assistance is a benefit given in the cases of temporary incapacity to work, due to illness or injury that exceeds 15 days (Brazil, 1999). The state of work incapacity is verified by periodical medical evaluation. For the worker, the possibility of a health evaluation by his own trusted physician is permissible. In any case, there is no possibility to get retirement disability when the disease or injury was notified on the day of social security membership. However, there is an exception in the case of incapacity due to progression or aggravation of this disease or injury (Brasil, 1999).

According to the regulation of Brazilian Social Security (Brasil, 1999), the benefit of retirement disability is granted for those who pay at least twelve months to the pension public system, this being the minimum time length of contribution until the pensioner starts to receive social retirement benefits. For those who lost the benefit of retirement, and instead, renew their membership to Brazilian General Social Security Regime (RGPS), the retirement disability is given after four months of payment to the social security system. However, in two cases the benefit of retirement is independent of the time of contribution: first, the benefit is given to employees victims of work accidents of any nature; second, the worker is qualified to retire when he falls victim to any specific illness or injury, according to the disease list of the Health Ministry and Social Security (Brasil, 1999).

According to the Ministerial Decree n° 2.998, 23 August 2001 (Brasil, 2001), the following list of diseases allows early disability retirement: active tuberculosis, leprosy, mental alienation, malignant neoplasm, blindness, irreversible and disabling paralysis, serious cardiopathy, advanced state of the illness of Paget, Syndrome of the Acquired Immune Deficiency –AIDS–, radiation contamination, serious liver diseases, Parkinson's disease, Ankylosing spondylosis and Severe nephropathy. In addition to that, the Brazilian Annual Social Security Statistics (AEPS), the disabilities withdraw benefit can be classified into accidental or social security retirement. The main distinction among these two is that retirement by accident occurs when the worker exercises his work activity inside the occupational environment or during transportation to and from work. Moreover, the accidental withdraw is independent from the number of former financial contributions to the RGPS. Nonetheless, this benefit will be available once the worker has paid the minimum pension contribution established by law (AEPS, 2007).

In this context, the objective of this paper is to bring a better understanding and knowledge of the retirement benefit flows. In this context, it is important to investigate labor markets withdraw according to distinguished morbidity causes since Brazil lacks in studies related to this matter. As methodological approach, we estimate multiple decrement life tables for different morbidity causes, for each sex, between 1999 and 2002. We call these tables "disability beneficiaries' life tables". These tables contain the transition hazards from an occupational state to the status of permanent disability withdraw. Concerning the construction of these tables, it is remarkable that population age composition is highly correlated with the transition hazards (Gomes, 2008). The knowledge of these transition hazards of retirement, in relation to the disease and injury, can serve as guide for policy makers once they can apply this information in the labor environment to develop work and health prevention policies. This information can also be applied to forecast the costs of early labor market exits, since earlier withdraws generally create more costs for the social security system (Ribeiro, 2006). Therefore, our main goal is to estimate disability beneficiary life tables by sex, age and disability causes. Theses tables consider only the laborers who are insured by the public social security regime (RPSS) during the period of January 1st, 1999 to December 31st, 2002. The method applied in this paper is multi-decrement life tables. These tables allow us to study the effects of every disability cause, separately or together, and the resultant effect on the general retirement pattern.

It is important to say that these tables represent only the disability retirement experience of each individual. They do not include the entire population of disabled individuals. Therefore, these life tables include only the pensioners who retire due to some disability. All the other beneficiaries are not considered in the analysis. We also excluded from the analysis other beneficiaries who receive benefits from continuous payment since the Ministry of Social Security (INSS) does not recognize their benefits as a disability retirement. The benefits from continuous payment are characterized by continuous monthly payments, until some cause (for example, death) ceases it. In this category of retirement are pensions for death, lifetime monthly incomes, allowances of permanence in service, the wage-family and maternity, etc. (AEPS, 2007).

Furthermore, those who chose other pension system are discarded from the analyses as well. It is important to say that the risks of retirement are competitive, since there are different kinds of benefits offered by the security system. For this reason, the values of the disability retirement hazards may be affected by these competitive benefits. In order to get better estimates, we try to adjust the disability life table considering only the beneficiaries from the RGPS (Gomes, 2008).

Data and methods

Data set and population of study

The data is built up by administrative records gathered by Technological Enterprises and Social Security Information (DATAPREV 1999-2002) and combined with the information of beneficiaries given by the Social Information of National Social Security Registers (CNIS 1999-2002). The mortality tables, by sex and age, are estimated according to data from the Population Division and Social Indicators (DEPIS 1999-2002) and the Brazilian Institute of Geography and Statistics (IBGE 1999-2002).

The period of analyses is from 1999 to 2002. This period was chosen because it best represents the recent experiences of retirees. According to the Statistical Yearbook of Social Security (2007), in 2000, 22% of retirements occurred due to disability. In 2005, this proportion increased to over 30%. Moreover, between 1990 and 1995 it is observed an increase of 0.7% in the number of permanent disability retirees. The following periods of 1995-2000 and 2000-2005, the number of disability retirees increases respectively to 5.6% and 11.6%. At the same time, it is also a short period, which reduces the effects of changes in the benefits rules on the transitions from activity to disability state. The changes in benefit rules came after the Constitutional Emend n° 20, from 16 December 1998 (Brasil, 1998). It is important to mention that we do not analyze recent disability retirements, due to the lack of data. However, 1999-2002 is an important period of analysis since during those years it is observed a remarkable increment in disability retirement outflows.

For the estimation of the transition rates, both rural and urban beneficiaries are considered. However, the group of special retirees is discarded, once these pensioners make up part of the crude rural production, therefore they may be underestimated. This group comprehends the producers, the partners, the sharecroppers and the agricultural leaseholders, the artisan fishermen who exercise these activities individually or in familiar economy regime, receiving eventual assistance from a third party. Also it is taken to account the respective spouses, friends and children older than 16 years, since they work with the respective familiar group (AEPS, 2007). For the most part, these workers receive social security benefit after a minimum time of work exercise in some rural occupation. For these rural workers, the social security system guarantees health assistance or disability retirement according to the country's minimum wage rates (Brasil, 1999; AEPS, 2007; Gomes *et al*., 2010). Depending on which beneficiary group is considered, the transition rates will be biased, due to a lack of information about the exact number of employees who belongs to this group (Gomes, 2008).

Classifications of disabilities according to the ICD 10

In accordance with the 10th International Classification of Diseases (ICD10) (Ministério da Saúde-DATASUS, 2006) the disability retirement tables for the period of 1999-2002 were established. Among the disability withdraws in 1999, barely 20% were classified following the ICD 9. For the following periods, the classification of diseases by ICD 10 was applied. For this reason, the analyses of the retirement tables did not go to more disaggregated levels of illness, according to the ICD 10, since it is expected that more detailed levels of analyses might bring incorrect classifications (Ribeiro, 2006).

The data was processed following the footsteps of a previous work by Ribeiro (2006). This way, the structure of disability causes included information from the initial physician visit until the last physician visit. If information from the first medical visit was not available, such that a comparison could not be made, then only information from the last medical record was considered.

During the classification of diseases, two important changes that occurred between the 9th and 10th ICD were taken into account. The first change concerns the split of the single chapter on nervous and sensory system diseases from the former ICD 9 into three new chapters in the ICD 10. Chapter VI now contains diseases of the nervous system, Chapter VII diseases of the eye and adnexa, and Chapter VIII contains information on the diseases of the ear and mastoid process. The second change concerns Chapters I, III and IV from ICD 10. In the former classification the immune deficiency disorders, including HIV infection, belong to Chapter III (endocrine glands, nutrition and metabolism diseases, and disorders involving the immune mechanism). In the new classification of ICD 10, HIV infection became part of other chapters, namely Chapter I detailing certain infectious and parasitic diseases, and Chapter III which covers diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism. The endocrines, nutritionals and metabolic diseases have been placed in a separate chapter in ICD 10 (Grassi and Laurenti, 1998). Furthermore, the retirement disability causes from Chapter VI in ICD 9 have been divided into other chapters in the ICD 10.

To facilitate the construction of the transition tables, we introduce the category of "non-information", gathering all unexpected disability retirement causes. For example, the causes of disability classified in Chapter XV concerning pregnancy, childbirth and puerperium and in Chapter XVI covering certain conditions originating in the perinatal period and Chapter XX detailing external causes of morbidity and mortality were placed into the category "non- information" because there were no retirement benefits concerning these causes (see Table 1). We also create the category of "others" gathering less representative disability information. The category contains the following chapters and diseases: Chapter III: diseases of the blood and blood, forming organs and certain disorders involving the immune mechanism; Chapter VIII: diseases of the ear and mastoid process; Chapter XI: diseases of the digestive system; Chapter XII: diseases of the skin and subcutaneous tissue; Chapter XVII: congenital malformations, deformations and chromosomal abnormalities; Chapter XVIII: symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified; and Chapter XXI: factors influencing health status and contact with health services. The Table 1 brings the disability causes according to ICD chapter.

Table 1
Disability cause according to Chapter ICD 10

Disability causes	Chapter ICD 10
Infectious/parasitic	I
Neoplasms	II
Nutritional/metabolic	IV
Mental disorders	V
Nervous system	VI
Eye diseases	VII
Circulatory	IX
Respiratory	X
Musculoskeletal	XIII
Genitourinary	XIV
Injuries	XIX
Non-information	XV, XVI, XX
Others	III, VIII, XI, XII, XVII, XVIII, XXI

Source: Ministério da Saúde-datasus, 2006.

Decrement life tables: disability retirement life tables according to morbidity causes

In order to estimate the multi-decrement life table, we assume that the workers are at risk of labor market exit due to different morbidity causes, and each singular cause of retirement can be regarded as decrement or transition rates. We also assume that, at the time of retirement, every possible cause of morbidity could be experienced by the retiree (Seal, 1977; Winklevoss, 1993).

Once all transition states are known, the next step is to estimate the whole life table and the retirement hazards. Thus, disability retirement hazards by a particular cause are estimated, as well as the gain in years after a singular morbidity cause is discarded (Namboodiri and Suchindran, 1987). The estimates are obtained via the following steps:

• First step: it is estimated the disability retirement probabilities for all morbidity causes, according to the information on the Table A.1 (in Appendix). The main idea behind it is to estimate the disability retirement rates according to all morbidity causes – ${}_{\mathbf{n}}\mathbf{r}_{x,C_+}$ – between the ages x and x+n, in the time interval t:

$$ {}_{n}r_{x,C_+} = \left(\frac{{}_{n}I_{x,C_+}}{{}_{n}L_x} \right) \qquad (1) $$

where:

${}_{\mathbf{n}}\mathbf{I}_{x,C_+}$: Number of pensioners among the ages *x* and *x+n*, at the observation period, according to the all causes C_+ ;

${}_{\mathbf{n}}\mathbf{L}_{\mathbf{x}}$: Number of person-years exposed to the risk disability withdraw in ages *x* and *x+n*, during the observation period.

It is important to mention that the number of permanent disabled pensioners is estimated by the number of social benefits given during the period between January 1st, 1999 and December 31st, 2002, regarding the time of exposure to the risk of retirement disability (see Gomes, 2008).

Once the disability retirement rates are estimated (${}_{\mathbf{n}}\mathbf{r}_{x,C_+}$), the next step is to estimate the disability retirement probabilities – ${}_{\mathbf{n}}\mathbf{r}_{x,C_+}{}'$ – according to following specification, given by Namboodiri and Suchindran (1987):

$$ {}_{n}r_{x,C_+}{}' = \frac{{}_{n}r_{x,C_+}}{1 + 0,5 \times \; {}_{n}r_{x,C_+})} \qquad (2) $$

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Considering a table of initially 100.000 insured workers exposed to these disability retirement risks, the number of disabilities retirees ${}_{n}\mathbf{i}_{x,C_+}$ is estimated by all causes and between the ages x e $x+n$, according to the following specifications.

$$ {}_{n}i_{x,C_+} = {}_{n}r_{x,C_+}{}' \times l_{x,C_+} \quad (3) $$

$$ {}_{n}l_{x+n,C_+} = {}_{n}l_{x,C_+} - {}_{n}i_{x,C_+} \quad (4) $$

where:

${}_{n}\mathbf{l}_{x,C_+}$: The number of insured workers at the exact age x for the initial cohort of 100.000 individuals exposed to all combined morbidity causes C_+;

${}_{n}\mathbf{l}_{x+n,C_+}$: The number of insured workers at the exact age $x+n$ for the initial cohort of 100.000 individuals exposed to all combined morbidity causes C_+.

• *Second step*: after estimating the total numbers of retirees (${}_{n}\mathbf{i}_{x,C_+}$), this amount is distributed into distinguished disability causes – C_a – in each age. It is done considering the proportional distribution of the number of retirees by each observed morbidity reason:

$$ {}_{n}i_{x,C_\alpha} = {}_{n}i_{x,C_+} \times \left(\frac{{}_{n}I_{x,C_\alpha}}{{}_{n}I_{x,C_+}} \right) \quad (5) $$

where:

${}_{n}\mathbf{i}_{x,C_a}$: Estimated number of pensioners by each disability cause C_α, between the ages x and $x+n$, in the period of study;

${}_{n}\mathbf{i}_{x,C_+}$: Estimated number of pensioners submitted to the disabilities probabilities (1) exposed to all combined disability causes C_+, between the ages x and $x+n$, in the period of study;

${}_{n}\mathbf{I}_{x,C_a}$: Number of observed pensioners, between the ages x and $x+n$ and in the study period according to cause C_a ;

${}_{n}\mathbf{I}_{x,C_+}$: Number of observed pensioners, between the ages x and $x+n$ and in the study period, by cause C_a according to cause C_+.

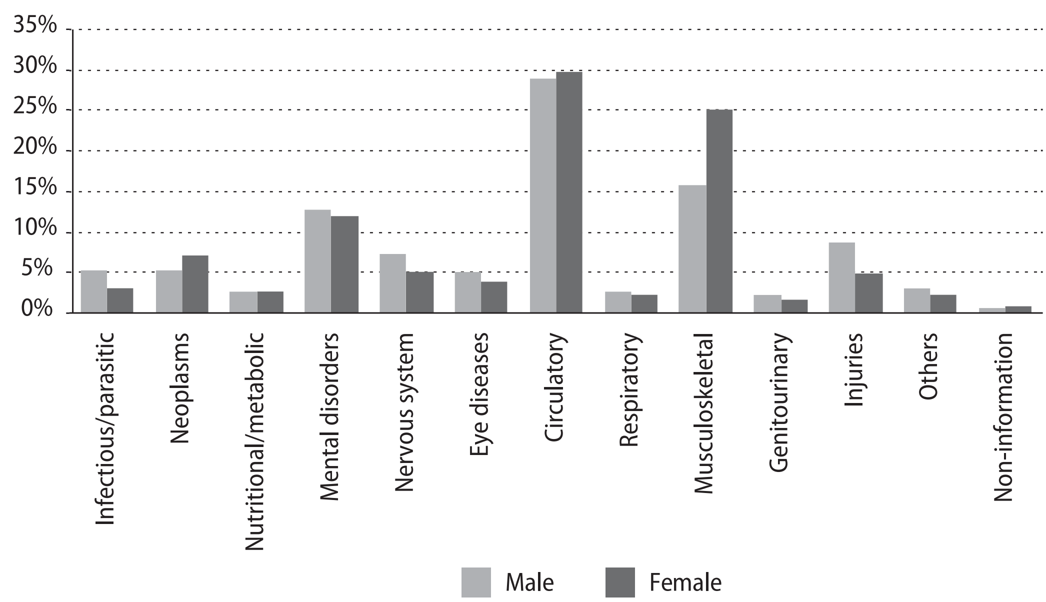
• *Step three:* we estimate the retirement probabilities according to each morbidity cause, by the ratio of ${}_{n}\mathbf{i}_{x,Ca}$ to $\mathbf{l}_{x,C_+}$. The assumption behind rationality is that the whole population at risk to survive until exact age x can retire due to any disability cause C_a since each cause of morbidity can be experienced by the pensioner (Namboodiri and Suchindran, 1987). These estimated probabilities are then so-called "crude disability retirement probabilities according to morbidity cause".

It is important to note, however, the RGPS beneficiary is at risk of disability withdraw at the commencement of his membership. This can happen as long as he is aged 15 (while the employee is a trainee) or aged 17 and above for the other beneficiaries. Although, in this paper we consider just those who retire between the age limits of 20 and 70 years old. The choice of 20 as lowest age limit was due to the small number of pensioners below that age during the observation period. The upper limit was chosen based on the same idea proposed by Ribeiro (2006). We consider the age for retirement as the highest age limit; however, the population in our sample contains rural and urban retirees, and these two population groups have distinguished ages to retire. Moreover, we verified an overweight in the number of pensioners after the age of 60. For that reason, we found it reliable to consider age 70 as a consistent upper limit, although after this age we verify a small number of labor market exits –barely 1.4% of all retirement benefits–. Once the retirement probabilities were estimated, the next step was to build up the disability life table by sex and age for the period of analysis.

Results

Figure 1 shows the distribution of the disability labor market exits by sex and disability causes. As we can see, for both sexes, circulatory diseases were the most responsible for an overwhelming number of retirement benefits, corresponding to 29.2% of the total amount of retirees. In other countries, like Canada, this number is somewhat lower, representing only 13% to 12% of the disability causes from 1998 to 2000 (Office of the Chief Actuary, 2002), being it the third most incident morbidity causes that leads to early retirement. However, in the US, according to Dwyer and Mitchell (1999), the likelihood of retirement is greatest for chronic health conditions such as functional limitations and circulatory disorders.

Figure 1
Disability labor market by sex and causes. Brazil. 1999-2002



Source: Microdata from MPS/DATAPREV.

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Moreover, in Brazil between 1999 and 2002, the musculoskeletal diseases and mental disorder are the second and third more prevalent diseases, representing, respectively, 19.5% and 12.4% of the total number of conceived pension benefits. In North American countries like Canada, between 1980 and 2000, these two diseases are also the most responsible for granted early retirement benefits. During this period, the musculoskeletal disorders have increased from 24% to 29% and the mental disorders double its incidence from 11% to 23% (Office of the Chief Actuary, 2002). These findings are also very consistent with other international study. Zayatz (2005), for example, affirms that in the United States, during the period 1998-2002, the musculoskeletal diseases and the mental disorders were also the most responsible diseases in granting retirement benefits. In many European countries, the mental illnesses are becoming more and more responsible for inflows into disability (OECD, 2009). In countries like Netherlands, Denmark, Sweden and Switzerland, in 2007, more than 40% of the inflow into disability happened due to bad mental health conditions. On the other hand, in the same countries, the musculoskeletal diseases have reduced its contribution to disability retirements between 2000 and 2007 (OECD, 2009).

Among the sexes, men have higher percentages of injuries than women; however, it is clearly visible that musculoskeletal diseases affect a larger percentage of women than men. The same findings are reported in many European countries. According to European Community (2000), the reason for it is that many workplaces are designed for the physical characteristics of men rather than women, leaving women more prone to repetitive strain injuries related complaints.

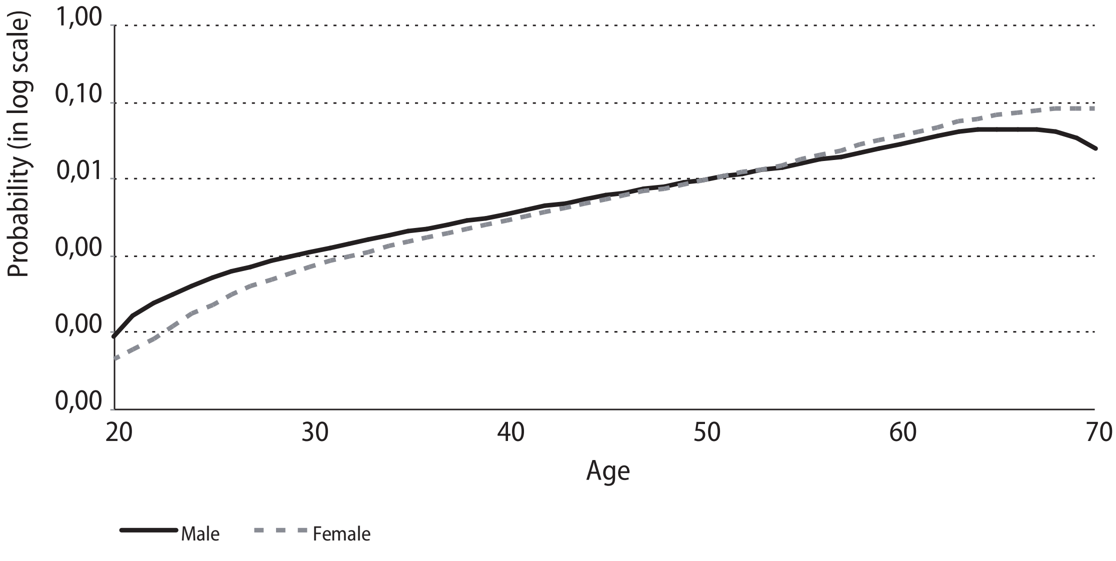
Other important point to highlight is relationship between disability benefits and its progression with age. According to Zayatz (1999 and 2005), the distribution of retirement benefits by disability causes are highly correlated with the age of the pensioner. In Brazil, Ribeiro (2006) also verifies that the health conditions of a laborer tend to deteriorate once the individual becomes older. As a direct consequence, we expect that the number of other disabilities increases with the age of the employee. According to OECD (2011), the same situation is found in European countries as Finland, the Slovak Republic, Spain, Sweden and the United Kingdom, where half of workers aged 50-64 leaves jobs through either unemployment or disability.

The Figure 2 and Tables A.2 and A.3 (in Appendix) show the disability hazards progression by age and sex of the retirees.

As we can see in the Figure 2, generally, the male retirement hazards by disability cause increases steadily until age 65 and after that it decreases. For females, however, these risks increase continuously up to the oldest age. If all insured workers had satisfied the minimum requirements to retire (like time of contribution and age), considering the minimum age of retirement and that every retiree will receive retirement benefits, we should expect neither the existence of entries in disability retirement for insured females aged over 60 years old nor insured men over 65 years old since this benefit is not granted to retirees. However, there are still entries on disability retirements after these ages. This is probably due to the fact that a high proportion of insured workers, especially women, do not meet the minimum requirements needed to retire (minimum age and/or years of service) and, thus, they remain insured and at risk of disability retirement (Gomes *et al*., 2010). This happens either because they have later joined the RGPS or due to the fact that they have very irregular trajectories of retirement contribution (Gomes *et al*., 2010). Additionally, it is also found that the majority of surveyed women enjoyed an individual and voluntary insurance program, especially after the age 60.

Other factor to highlight is the dropping risk of disability retirement among men after age 65. This seems to indicate that these workers –who remain active after this age– are belonging to a selective group, characterized by employees with good health conditions. It may also indicate that many workers who are presenting vulnerable health characteristics are granted with a regular retirement benefit (or a care benefit), because these individuals are unable to work and, therefore, cannot contribute and maintain their membership. In addition to that, the drop in male probabilities after 65 years old might occur due to the overestimation of the denominator at these ages, possibly because it includes insured workers who meet the minimum period necessary to planned retirement, but they are delaying the application of this benefit.

Figure 2
Disability retirement probabilities for rgps insured workers, by sex and age. Brazil. 1999-2002



Source: Microdata from MPS/DATAPREV.

In Tables A.2 and A.3 we see that, for both sexes, the risk of disability retirement is larger due to circulatory and musculoskeletal diseases. Among women, the crude disability retirement risk due to neoplasm is somewhat larger than for men. Among men, however, mental disorders are the most responsible for an overwhelming number of pensioners, especially among the young adult age groups. Moreover, the two tables also show that the risk of retirement due to injuries and mental disorders decreases with age. On the other hand, circulatory and musculoskeletal illnesses, especially among women, tend to increase with age.

Discussion

In this paper, we try to describe the transition from occupational status to disability retirement for all workers from the Social Security Regime. In order to fulfill this objective, we estimate multi-decrement disability retirement life tables by sex and age for the period of 1999-2002, using the DATAPREV/MPS and administrative information from the CNIS as sources for our analysis.

After we analyzed the intrinsic pattern of the table, we observed that for men the disability hazards increase progressively until age 65 and after that they decrease, although they still show high values until the age 70. Among women we observed that these risks increase continuously up to the oldest age. The decline in the male retirement hazards after age 65 may guide us to two conclusions. First, there is some kind of selective group among the retirees with better health conditions keeping them active in the labor market. Second, it is because the fragile retirees acquire another sort of benefit, or they simply cannot financially contribute to RGPS and keep their social benefit. Moreover, there are still a number of labor market exits, even after the upper age limit to retire. This can be explained by the presence of female employees who did not fulfill the prerequisites to retire until the minimum age of pension. In this way, they still belong to the risk group of disability retirement for a longer period.

During the period of analysis, we verified that for both sexes the risk of disability retirement is largest due to circulatory diseases and musculoskeletal diseases. As the employee age increases injuries, mental disorders and nervous system illnesses tend to decrease. However, other illnesses like circulatory and musculoskeletal diseases become more common, especially among women. Differences in the pattern of disability retirement between the sexes can be partially explained by the age structure of retirement.

A word of caution is necessary since comparison with other studies regarding the same subject are difficult to be carried out, either because of the distinguished retirement definition adopted in each study and country or due to pre-requisites for the grant of retirement benefits. In addition to that, many studies are limited by displaying only graphics, not providing the values of probabilities by age and sex. Additionally, as Grushka (2010) notes, the people exposed to the risk of disability retirement can be affected by different levels of selectivity. Thus, the aim of this work was only to present results of disability retirement in Brazil and, when possible, establishes short comparisons with other countries; however, given the difficulty to define disability retirement in each country, we have avoided further deeper assessments.

The knowledge of these disability retirement hazards creates opportunity to develop policies of work prevention and health and to promote a better work environment. In this way, we expect that these tables can be used to forecast or simulate the numbers of beneficiaries in later periods. Thus, we can predict the future social security costs. The retirement hazards are another utility provided by this work. They can be used by the social security market as a reference point for planning future pension costs because our disability life tables better replicate the reality of the country than the tables used by the private sector. This makes sense given that all beneficiaries from private security are linked with the RGPS (Coletânea, 2007).

Last but not least, this study also hopes to give an initial understanding about the disability retirement hazards in Brazil, since in international as well as in national literature few studies are known concerning these matters (Gomes, 2008; Zayatz, 2005).

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Appendix

Table A.1. Number and population at risk of disability retirement, by sex and age. Brazil. 1999-2002

Age	Male		Female		Total		Age	Male		Female		Total	
	nLx	nlx,C+	nLx	nlx,C+	nLx	nlx,C+		nLx	nlx,C+	nLx	nlx,C+	nLx	nlx,C+
20	2,383,343	218	1,550,307	72	3,933,650	290	50	1,124,173	10,948	687,060	6,666	1,811,234	17,614
21	2,732,673	408	1,754,625	94	4,487,297	502	51	1,002,048	11,000	620,084	7,025	1,622,132	18,025
22	2,873,070	578	1,834,833	175	4,707,903	753	52	932,610	10,776	581,704	7,376	1,514,315	18,152
23	2,949,847	883	1,899,026	268	4,848,873	1,151	53	818,965	10,372	525,887	7,296	1,344,852	17,668
24	2,955,062	1,123	1,892,079	355	4,847,141	1,478	54	726,839	10,304	479,607	7,596	1,206,446	17,900
25	2,931,142	1,504	1,872,846	445	4,803,988	1,949	55	640,154	10,200	435,405	7,632	1,075,560	17,832
26	2,915,927	1,726	1,852,451	627	4,768,378	2,353	56	574,503	9,925	403,588	7,926	978,091	17,851
27	2,812,059	2,083	1,778,895	707	4,590,953	2,790	57	513,728	10,032	372,847	8,302	886,575	18,334
28	2,831,066	2,368	1,775,255	900	4,606,322	3,268	58	466,054	9,758	346,988	8,456	813,041	18,214
29	2,701,811	2,652	1,704,224	1,007	4,406,035	3,659	59	399,515	9,898	320,895	8,776	720,411	18,674
30	2,685,729	3,043	1,668,074	1,210	4,353,803	4,253	60	378,723	10,311	251,940	9,096	630,663	19,407
31	2,582,866	3,410	1,610,934	1,423	4,193,800	4,833	61	326,992	10,315	181,138	8,063	508,129	18,378
32	2,576,920	3,697	1,587,976	1,581	4,164,896	5,278	62	298,878	10,013	149,369	7,364	448,247	17,377
33	2,479,184	4,059	1,550,378	1,793	4,029,563	5,852	63	260,019	9,730	120,324	6,816	380,343	16,546
34	2,455,349	4,457	1,535,355	1,958	3,990,704	6,415	64	241,781	9,240	97,477	5,961	339,259	15,201
35	2,416,227	4,950	1,529,315	2,310	3,945,542	7,260	65	172,179	7,738	75,180	5,073	247,359	12,811
36	2,358,543	5,270	1,494,809	2,562	3,853,352	7,832	66	125,690	5,689	57,649	4,218	183,339	9,907
37	2,288,525	5,532	1,461,067	2,838	3,749,592	8,370	67	95,643	4,053	42,395	3,648	138,038	7,701
38	2,186,709	6,012	1,400,606	3,112	3,587,315	9,124	68	78,122	2,652	32,272	2,711	110,395	5,363
39	2,066,345	6,452	1,330,716	3,435	3,397,061	9,887	69	61,127	1,901	24,387	2,120	85,514	4,021
40	2,025,729	7,100	1,295,443	3,716	3,321,172	10,816	70	54,681	1,329	19,699	1,668	74,381	2,997
41	1,901,729	7,693	1,228,440	4,089	3,130,169	11,782	71	42,257	857	14,845	1,196	57,102	2,053
42	1,852,413	8,071	1,185,313	4,421	3,037,726	12,492	72	35,860	530	11,915	956	47,775	1,486
43	1,767,359	8,538	1,127,801	4,945	2,895,160	13,483	73	28,488	295	9,467	657	37,956	952
44	1,674,091	9,056	1,065,845	5,075	2,739,936	14,131	74	22,954	193	7,542	491	30,496	684
45	1,588,079	9,554	1,006,006	5,425	2,594,084	14,979	75	18,498	127	5,934	383	24,432	510
46	1,506,724	10,035	946,860	5,655	2,453,583	15,690	76	14,896	83	4,661	260	19,557	343
47	1,387,377	10,173	873,079	5,995	2,260,456	16,168	77	11,687	51	3,763	197	15,450	248
48	1,320,524	10,526	812,139	6,050	2,132,663	16,576	78	9,438	39	3,023	143	12,461	182
49	1,186,692	10,463	730,480	6,077	1,917,173	16,540	Total	77,869,616	329,993	49,242,221	216,392	127,111,838	546,385

Source: Microdata from MPS/DATAPREV.

Table A.2. Male probability disability retirement hazards according to health cause and age (by 10.000). Brazil. 01/01/1999 to 31/12/2002

Age	Probability						
	Infectious	Neoplasms	Nutritional/ metabolic	Mental disorders	Nervous system	Eye diseases	Circulatory
20	0.025	0.101	0.000	0.185	0.164	0.080	0.034
21	0.050	0.150	0.011	0.388	0.221	0.128	0.146
22	0.104	0.184	0.019	0.627	0.293	0.176	0.213
23	0.182	0.207	0.026	0.893	0.379	0.228	0.257
24	0.280	0.227	0.035	1.177	0.476	0.283	0.296
25	0.396	0.252	0.044	1.470	0.583	0.344	0.351
26	0.530	0.277	0.055	1.779	0.701	0.411	0.409
27	0.686	0.296	0.066	2.109	0.831	0.481	0.456
28	0.861	0.318	0.078	2.452	0.970	0.556	0.512
29	1.049	0.348	0.093	2.798	1.118	0.638	0.598
30	1.247	0.394	0.112	3.141	1.273	0.729	0.733
31	1.465	0.458	0.132	3.466	1.430	0.834	0.897
32	1.707	0.533	0.154	3.780	1.591	0.951	1.075
33	1.956	0.620	0.180	4.101	1.762	1.073	1.300
34	2.196	0.715	0.213	4.450	1.947	1.194	1.603
35	2.410	0.819	0.256	4.846	2.150	1.306	2.018
36	2.600	0.918	0.302	5.304	2.378	1.401	2.484
37	2.775	1.016	0.347	5.814	2.629	1.483	2.982
38	2.935	1.128	0.405	6.348	2.891	1.566	3.598
39	3.080	1.270	0.487	6.883	3.157	1.665	4.420
40	3.208	1.459	0.606	7.392	3.415	1.794	5.534
41	3.311	1.693	0.763	7.888	3.650	1.947	6.922
42	3.390	1.963	0.949	8.389	3.868	2.116	8.525
43	3.457	2.269	1.164	8.874	4.094	2.308	10.373
44	3.526	2.612	1.404	9.326	4.352	2.533	12.492
45	3.610	2.995	1.670	9.725	4.665	2.800	14.910
46	3.699	3.415	1.964	10.057	5.040	3.114	17.569
47	3.784	3.873	2.286	10.336	5.463	3.469	20.449
48	3.881	4.369	2.633	10.581	5.921	3.857	23.640
49	4.001	4.904	3.000	10.811	6.405	4.270	27.230
50	4.161	5.480	3.382	11.048	6.905	4.701	31.311
51	4.360	6.043	3.779	11.272	7.416	5.107	35.712
52	4.590	6.593	4.194	11.470	7.946	5.494	40.376
53	4.848	7.210	4.628	11.670	8.500	5.925	45.553
54	5.132	7.972	5.080	11.898	9.083	6.460	51.496
55	5.440	8.958	5.548	12.181	9.702	7.160	58.458
56	5.809	10.209	6.027	12.505	10.277	8.010	66.475
57	6.241	11.674	6.516	12.852	10.806	8.969	75.380
58	6.680	13.290	7.027	13.243	11.405	10.061	85.116
59	7.067	14.994	7.569	13.702	12.192	11.309	95.627
60	7.346	16.724	8.154	14.249	13.285	12.738	106.857
61	7.556	18.911	8.953	15.131	15.099	14.741	121.456
62	7.736	21.595	9.961	16.331	17.555	17.300	139.461
63	7.825	24.132	10.918	17.484	20.030	19.828	156.898
64	7.766	25.877	11.566	18.221	21.903	21.736	169.788
65	7.498	26.186	11.645	18.177	22.551	22.437	174.157
66	7.062	25.488	11.328	17.595	22.388	22.322	172.654
67	6.496	24.213	10.788	16.721	21.831	21.783	167.931
68	5.742	21.717	9.765	15.187	20.256	20.233	156.012
69	4.741	17.354	8.002	12.627	17.041	17.083	132.919
70	3.433	10.480	5.240	8.673	11.564	11.744	94.677

Table A.2. Continuation

Age	Probability						Total
	Respiratory	Musculoskeletal	Genitourinary	Injuries	Others	Non-information	
20	0.000	0.029	0.021	0.252	0.000	0.025	0.915
21	0.005	0.020	0.077	0.414	0.006	0.047	1.661
22	0.011	0.038	0.127	0.565	0.011	0.065	2.433
23	0.018	0.082	0.172	0.712	0.016	0.081	3.253
24	0.027	0.149	0.216	0.858	0.022	0.098	4.144
25	0.038	0.235	0.259	1.010	0.027	0.119	5.130
26	0.049	0.344	0.302	1.163	0.033	0.143	6.195
27	0.062	0.476	0.341	1.315	0.038	0.166	7.323
28	0.076	0.629	0.380	1.470	0.044	0.193	8.539
29	0.091	0.800	0.421	1.634	0.050	0.226	9.865
30	0.108	0.986	0.465	1.812	0.056	0.268	11.324
31	0.124	1.172	0.514	2.007	0.062	0.318	12.877
32	0.140	1.359	0.565	2.214	0.067	0.373	14.510
33	0.158	1.571	0.619	2.430	0.073	0.437	16.280
34	0.180	1.832	0.673	2.652	0.080	0.509	18.246
35	0.207	2.166	0.728	2.878	0.091	0.591	20.466
36	0.232	2.576	0.780	3.100	0.104	0.677	22.858
37	0.256	3.044	0.832	3.322	0.118	0.767	25.384
38	0.286	3.568	0.886	3.551	0.135	0.868	28.167
39	0.334	4.145	0.942	3.797	0.156	0.992	31.327
40	0.409	4.770	1.005	4.065	0.182	1.148	34.988
41	0.517	5.440	1.068	4.362	0.217	1.346	39.125
42	0.652	6.158	1.129	4.681	0.258	1.579	43.658
43	0.804	6.928	1.198	5.016	0.303	1.833	48.621
44	0.965	7.757	1.283	5.362	0.346	2.092	54.050
45	1.124	8.651	1.394	5.713	0.383	2.342	59.980
46	1.252	9.519	1.545	6.059	0.405	2.579	66.215
47	1.355	10.357	1.730	6.404	0.414	2.813	72.732
48	1.478	11.301	1.927	6.763	0.425	3.049	79.824
49	1.666	12.486	2.113	7.152	0.453	3.293	87.787
50	1.965	14.049	2.266	7.586	0.513	3.550	96.915
51	2.368	15.921	2.378	8.028	0.617	3.809	106.807
52	2.844	18.012	2.462	8.465	0.753	4.067	117.266
53	3.404	20.423	2.533	8.957	0.906	4.339	128.895
54	4.059	23.255	2.602	9.562	1.058	4.642	142.298
55	4.820	26.610	2.681	10.337	1.193	4.990	158.077
56	5.617	30.368	2.752	11.304	1.309	5.394	176.056
57	6.444	34.462	2.808	12.423	1.416	5.841	195.833
58	7.403	39.070	2.874	13.664	1.518	6.320	217.672
59	8.599	44.370	2.980	14.996	1.618	6.818	241.840
60	10.133	50.537	3.152	16.385	1.719	7.320	268.601
61	12.439	59.124	3.465	18.186	1.841	7.946	304.847
62	15.446	70.014	3.901	20.418	1.981	8.705	350.403
63	18.509	80.877	4.347	22.553	2.109	9.419	394.929
64	20.979	89.386	4.693	24.065	2.198	9.909	428.087
65	22.210	96.391	4.828	24.425	2.215	9.997	439.539
66	22.633	103.397	4.826	23.985	2.182	9.803	436.177
67	22.680	95.819	4.760	20.580	2.119	9.444	424.893
68	21.704	88.242	4.520	17.530	1.994	8.743	395.348
69	19.057	77.221	3.994	14.479	1.780	7.521	337.206
70	14.093	57.638	3.072	12.467	1.445	5.601	240.126

Source: Microdata from MPS/DATAPREV.

Table A.3. Female probability disability retirement hazards according to health cause and age (by 10.000). Brazil. 01/01/1999 to 31/12/2002

Age	Probability						
	Infectious	Neoplasms	Nutritional/ metabolic	Mental disorders	Nervous system	Eye diseases	Circulatory
20	0.026	0.090	0.000	0.071	0.052	0.013	0.026
21	0.052	0.093	-0.003	0.151	0.051	0.040	0.002
22	0.093	0.097	0.003	0.217	0.077	0.004	0.009
23	0.147	0.105	0.016	0.287	0.125	0.042	0.042
24	0.209	0.123	0.032	0.374	0.188	0.094	0.096
25	0.278	0.155	0.048	0.497	0.262	0.149	0.166
26	0.354	0.197	0.067	0.642	0.349	0.215	0.255
27	0.440	0.247	0.090	0.801	0.453	0.297	0.367
28	0.533	0.309	0.114	0.990	0.570	0.386	0.497
29	0.629	0.387	0.137	1.222	0.692	0.471	0.640
30	0.725	0.485	0.156	1.516	0.815	0.539	0.791
31	0.826	0.604	0.167	1.883	0.937	0.587	0.921
32	0.933	0.739	0.172	2.312	1.062	0.621	1.032
33	1.040	0.892	0.176	2.785	1.192	0.649	1.169
34	1.140	1.064	0.185	3.284	1.327	0.679	1.379
35	1.228	1.255	0.203	3.790	1.470	0.719	1.705
36	1.299	1.450	0.224	4.300	1.619	0.760	2.105
37	1.358	1.651	0.246	4.828	1.774	0.798	2.546
38	1.410	1.877	0.276	5.377	1.936	0.844	3.097
39	1.462	2.149	0.322	5.950	2.105	0.911	3.824
40	1.519	2.490	0.393	6.552	2.282	1.010	4.795
41	1.576	2.900	0.480	7.213	2.450	1.148	5.963
42	1.629	3.367	0.576	7.931	2.611	1.318	7.284
43	1.687	3.886	0.696	8.659	2.786	1.508	8.826
44	1.756	4.454	0.853	9.352	3.002	1.710	10.658
45	1.844	5.066	1.061	9.963	3.281	1.913	12.848
46	1.948	5.746	1.319	10.456	3.657	2.087	15.278
47	2.062	6.498	1.617	10.860	4.112	2.237	17.904
48	2.193	7.284	1.958	11.233	4.599	2.411	20.900
49	2.344	8.071	2.341	11.630	5.070	2.654	24.443
50	2.520	8.821	2.767	12.109	5.475	3.013	28.708
51	2.721	9.431	3.203	12.636	5.760	3.456	33.306
52	2.941	9.924	3.650	13.175	5.956	3.953	38.120
53	3.185	10.458	4.156	13.773	6.148	4.551	43.734
54	3.456	11.188	4.767	14.480	6.419	5.297	50.732
55	3.757	12.272	5.533	15.345	6.853	6.238	59.697
56	4.075	13.907	6.497	16.389	7.474	7.377	70.383
57	4.408	15.990	7.628	17.577	8.226	8.680	82.402
58	4.776	18.223	8.859	18.881	9.074	10.146	96.123
59	5.197	20.309	10.121	20.271	9.982	11.776	111.913
60	5.692	21.950	11.346	21.716	10.917	13.568	130.143
61	6.361	23.178	12.592	23.486	11.922	15.646	152.255
62	7.191	24.191	13.905	25.600	13.020	18.012	178.004
63	8.031	24.942	15.197	27.655	14.146	20.478	205.224
64	8.729	25.386	16.382	29.249	15.233	22.857	231.750
65	9.136	25.477	17.371	29.981	16.213	24.963	255.416
66	9.351	25.246	20.918	32.917	17.131	29.439	277.667
67	9.475	24.722	22.389	35.053	18.033	33.922	299.945
68	9.357	23.861	24.979	37.766	18.850	37.469	320.086
69	8.847	22.616	26.329	35.368	19.517	41.262	335.924
70	7.792	20.942	19.968	23.377	19.968	32.630	345.294

Table A.3. Continuation

Age	Probability						Total
	Respiratory	Musculoskeletal	Genitourinary	Injuries	Others	Non-information	
20	0.000	0.032	0.013	0.071	0.026	0.045	0.464
21	0.017	0.065	0.042	0.081	0.027	0.042	0.610
22	0.027	0.103	0.070	0.100	0.027	0.046	0.873
23	0.032	0.152	0.097	0.129	0.027	0.056	1.256
24	0.037	0.215	0.125	0.165	0.026	0.071	1.756
25	0.043	0.299	0.155	0.208	0.027	0.091	2.376
26	0.048	0.399	0.186	0.259	0.027	0.116	3.114
27	0.051	0.513	0.218	0.319	0.028	0.146	3.970
28	0.054	0.645	0.252	0.386	0.029	0.181	4.945
29	0.060	0.800	0.288	0.460	0.031	0.221	6.039
30	0.072	0.983	0.330	0.539	0.036	0.264	7.251
31	0.084	1.175	0.377	0.626	0.042	0.311	8.538
32	0.095	1.374	0.430	0.720	0.048	0.362	9.900
33	0.113	1.606	0.486	0.821	0.057	0.417	11.403
34	0.144	1.899	0.542	0.925	0.069	0.475	13.112
35	0.196	2.280	0.595	1.032	0.085	0.536	15.093
36	0.278	2.742	0.642	1.132	0.106	0.594	17.253
37	0.386	3.266	0.686	1.226	0.130	0.652	19.547
38	0.505	3.864	0.729	1.329	0.158	0.714	22.116
39	0.622	4.547	0.777	1.455	0.190	0.788	25.101
40	0.725	5.326	0.832	1.619	0.224	0.879	28.644
41	0.800	6.146	0.899	1.822	0.260	0.991	32.648
42	0.857	6.999	0.974	2.055	0.299	1.119	37.018
43	0.914	7.969	1.053	2.316	0.341	1.259	41.900
44	0.989	9.140	1.130	2.603	0.387	1.406	47.440
45	1.100	10.598	1.200	2.915	0.436	1.556	53.781
46	1.230	12.229	1.260	3.251	0.483	1.712	60.656
47	1.364	13.980	1.316	3.614	0.527	1.875	67.967
48	1.533	16.015	1.369	4.003	0.579	2.043	76.119
49	1.764	18.503	1.422	4.415	0.646	2.211	85.513
50	2.086	21.611	1.477	4.852	0.739	2.375	96.554
51	2.488	24.956	1.530	5.265	0.867	2.514	108.133
52	2.950	28.428	1.577	5.655	1.023	2.629	119.982
53	3.490	32.600	1.628	6.093	1.194	2.753	133.762
54	4.125	38.043	1.691	6.651	1.366	2.921	151.135
55	4.872	45.330	1.776	7.399	1.525	3.165	173.762
56	5.738	54.276	1.894	8.322	1.631	3.464	201.426
57	6.709	64.499	2.041	9.370	1.691	3.798	233.020
58	7.779	76.278	2.197	10.570	1.769	4.196	268.869
59	8.937	89.891	2.342	11.947	1.925	4.687	309.300
60	10.176	105.619	2.456	13.529	2.222	5.302	354.637
61	11.626	125.023	2.549	15.436	2.767	6.132	408.974
62	13.294	147.916	2.634	17.652	3.518	7.157	472.094
63	14.982	171.957	2.697	19.993	4.315	8.240	537.857
64	16.493	194.803	2.724	22.276	4.997	9.245	600.125
65	17.628	214.112	2.702	24.319	5.404	10.037	652.759
66	18.520	231.445	2.640	26.243	6.192	10.704	699.851
67	19.300	248.365	2.548	28.171	7.237	11.340	745.494
68	19.771	262.527	2.410	29.919	7.745	11.806	783.549
69	19.735	271.592	2.215	31.304	6.245	11.968	807.878
70	18.994	273.215	1.948	32.143	4.383	11.688	812.341

Source: Microdata from MPS/DATAPREV.