URBAN MOBILITY IN THE METROPOLITAN REGION OF BELO HORIZONTE UNDER THE PERSPECTIVES OF AGE AND PERIOD

Sarah Lima Queiroz (Cedeplar/UFMG)
Gilvan Ramalho Guedes (Cedeplar/UFMG)
Alisson Flávio Barbieri (Cedeplar/UFMG)
Carlos Moreto Herculano (DELT/UFMG)

ABSTRACT

This paper used APC model and the National Household Sample Survey (PNAD), from the year of 1988 to 2015 and the age of 18 to 45 years old to analyze the possible vulnerabilities of certain population groups in the Belo Horizonte Metropolitan Area (RMBH) reflected in their commuting patterns, through a perspective of age and period changes. The analysis showed a strong age effect, while no considerable period effects on the commuting time of residents of the RMBH. Furthermore, the results showed that a shorter commuting time does not always indicate a lower vulnerability. On the contrary, categories known to be vulnerable, such as women and informal workers, take less commuting time than their pairs.

BACKGROUND

Population mobility has gained momentum in Demography as traditional forms of internal migration have been partially replaced by circular mobility. One of these movements is the one made daily by the population in the municipality of residence and surroundings for reasons such as work, study, health, shopping and leisure. In this article, population mobility is studied from the perspective of the time spent between residence and work among residents living in metropolitan areas.

The saturation of large centers has pushed individuals, especially intra-metropolitan migrants, towards the metropolitan outskirts. Even the surrounding rural areas are now being converted into new residential settlements to accommodate the newcomers. However, migration towards the metropolitan fringe has resulted in increased distance between places of daily activities and the location of the new dwellings (LOO; CHOW, 2011) and reduction in accessibility of services and leisure, as individuals spend more time commuting to work. This is a characteristic of metropolitan areas, in which considerable portions of the population live in peripheral neighborhoods or in the surrounding cities and, for this reason, need to make long and lengthy daily commutes. Closely related to the concept of life space (COURGEAU, 1988), these daily flows are highly heterogeneous, influenced by the mode of transportation, the characteristics of individuals and their place of

residence. Patterns thus reflect the complex combination of demand for and supply of housing, transportation, and services. It is important to emphasize that the daily traveled distance does not determine the extension of the living space. Despite the vulnerable, in general, travel long distances daily, many of them use public transport and are unable to interact with the services offered along the way, a phenomenon known as the "tunnel effect" (MARANDOLA JR., 2011). Furthermore, the shortly time left also reduces the possibility of increasing the living space, even if it is close to home.

This paper chose as object of study the Belo Horizonte Metropolitan Area (RMBH), one of the largest in Brazil, located in the state of Minas Gerais. It has about 10.0% of the country's population, while the RMBH represents a third of the inhabitants of the federative unit. However, the location lacks efficient transport infrastructure, especially in the most vulnerable regions. Despite having 34 cities, the urban train, for example, is only present in two of the most centralized ones (Belo Horizonte and Contagem). Thus, considering that jobs are still concentrated at the principal city and its surroundings, the population that inhabits other cities in the metropolitan area has costly commutes.

Thus, what motivates this study is the exclusion that lack of access to transport can bring. When access is absent or of low quality, the most vulnerable sections of the population are excluded from social and economic activities, resulting in a loss of well-being (DELBOSC; CURRIE, 2011). According to Lucas (2012), the locations with the greatest disadvantages in relation to transport are those where the poorest population lives. Thus, the growth of cities needs to be followed by a transport system's development to separate urban expansion from the exclusion of opportunities (leisure, health, education and work).

It is noteworthy that mobility patterns and associated vulnerabilities are selective by demographic attributes. The characteristics of the routes can change throughout the life cycle, but they are also influenced by period's contextual issues and possible generational effects. Glenn (2003) distinguishes the three effects as follows: (i) the age effect is related to differences between certain age groups at a specific point in time; (ii) period effect, arising from the environment, culture, society and circumstances in general at a given time; (iii) cohort effect, related to the fact of being born at a certain time and, therefore, having accumulated different experiences throughout life when compared to those who were born at another time. However, this study focuses on the first two effects, which in the literature on the subject are those that, in practice, have some influence on mobility patterns (NEWBOLD *et al.*, 2005; SCHEINER, 2011; SCHEINER; HOLZ-RAU, 2013; SCHOENDUWE *et al.*, 2015; CLARK, CHATTERJEE; MELIA, 2016; BEIGE; AXHAUSEN, 2017).

For everything above mentioned, this paper aims to analyze the possible vulnerabilities of certain population groups in the RMBH reflected in their commuting patterns, through a perspective of age

and period changes. In short, it is intended, with a demographic perspective, to understand the metropolitan dynamics of the RMBH through daily mobility for work reasons. With this, it is expected to generate inputs for the construction of urban planning policies that improve accessibility for all population groups. Specifically, it is intended to analyze how mobility patterns due to work (commuting time) in the RMBH reflect different effects of population composition by age and period.

DATA SOURCE AND METHOD

This study uses information on commuting time from the National Household Sample Survey (PNAD), from the year of 1988 to 2015 and the age of 18 to 45 years old, to elaborate an Age, Period and Cohort model (APC). Despite not interviewing the same individuals every survey, it is possible to set up people who share the same year of birth and, thus, generate a homogeneous group (pseudo-cohort). In addition, the PNAD commuting time is presented in four categories: (i) up to 30 minutes; (ii) more than 30 minutes to 1 hour; (iii) more than 1 hour to 2 hours; (iv) more than 2 hours. However, to conduct the APC model it was necessary to transform the variable into continuous through the application of the Probability Integral Transformation Theorem (ANGUS, 1994).

The elaboration of the pseudo-panel was made through a square matrix, in which the lines correspond to the simple age of the individuals, while the columns correspond to the periods – the selected PNAD years (1988 to 2015). Considering the 28 years of analysis, it was decided to start the series at 18 years old, when the individual is still young in the labor market. This minimum age strategy allowed the series to include individuals up to 45 years old, when they already have approximately consolidated work experience. The matrix format allows viewing the cohorts, which are represented in diagonals, as shown in Table 1. In this one, the most recent cohort is the one with 18 years old in 2015 (C1) and has only one analysis point, while the oldest starts aged 18 in 1988 and ending up with 45 years old in 2015 (C28). The matrix cells contain the average commuting time for each age and corresponding research period. For the descriptive analysis, other matrices were made by categories of sex, education, income and employment status. After performing these procedures, the final sample for each year of PNAD was between 3555 and 4668 individuals.

Table 1 – Representation of the age, period and cohort matrix

Period / Age	1988	1989	1990	⋯	2013	2014	2015
18 years	C28	C27	C26	⋯	C3	C2	C1
19 years	C29	C28	C27	⋯	C4	C3	C2
20 years	C30	C29	C28	⋯	C5	C4	C3
⋮	⋮	⋮	⋮	⋱	⋮	⋮	⋮
43 years	C53	C52	C51	⋯	C28	C27	C26
44 years	C54	C53	C52	⋯	C29	C28	C27
45 years	C55	C54	C53	⋯	C30	C29	C28

Source: self-elaboration

The estimation of the APC model was based on the proposal by Mason and Mason (1973), with the dependent variable in logarithmic form. To identify which model best fits the data, simulations were executed with only one variable (A, P or C), two variables (AP, AC or PC), and with all variables (APC). The complete one has the identification problem, which means that each variable can be calculated by using the other two. To correct this problem, a restriction was imposed on the last two ages, equating 44 years old to 45 years old.

RESULTS

First, there are the descriptive analyses, which present graphs with period and age relationships, along with comparative analyses between categories. Furthermore, considering that consecutive years must have similar characteristics, biannual groups for age and period were used, in addition to the **LOESS** method to smooth the graphical visualization.

Figure 1 shows the changes in commuting time over the periods. It shows that, albeit the period, older workers – represented by the lighter colors – take, on average, longer in their daily commute. In addition, the younger ones show greater variation over the periods. In this context, it is important to highlight the profile of workers according to their time in life. Considering that the sample in this paper is limited to individuals between 18 and 45 years of age, the older the age, the lower the possibility of key events that modify mobility characteristics, as shown by Beige and Axhausen (2017). Individuals who are recent in the labor market and, consequently, with little experience tend

to accept simpler jobs and change employments more frequently, in addition to having a higher proportion of informality (CAMARANO *et al.*, 2001).

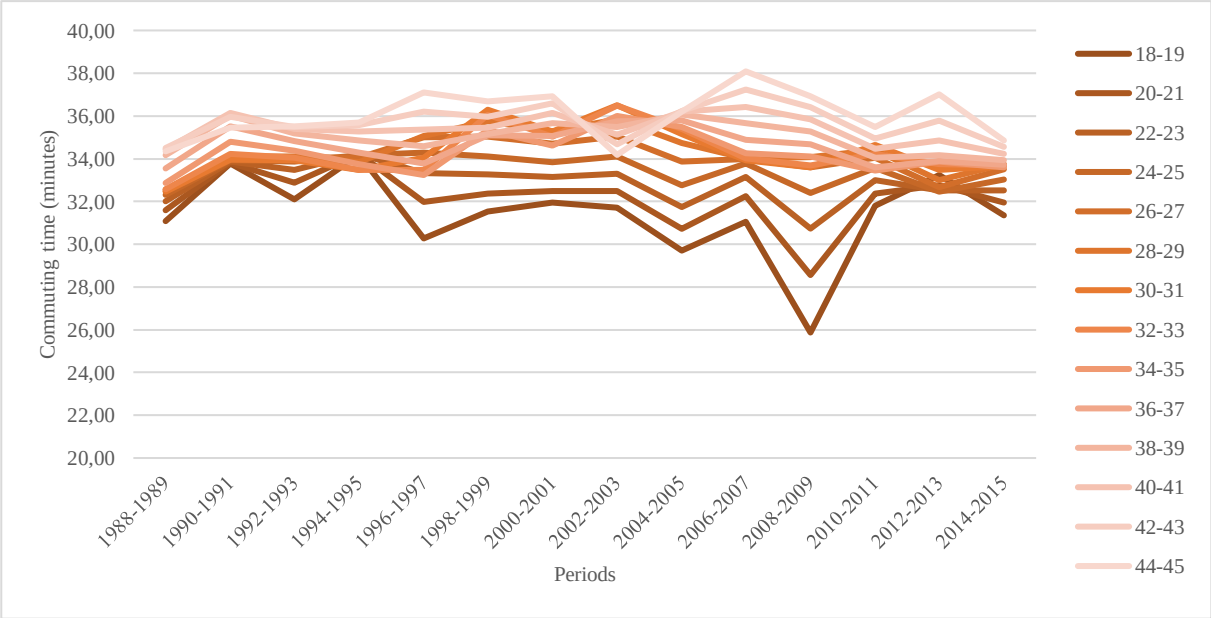
The behavior of younger people in the labor market can be explained by the fact that they have not yet experienced key events, such as marriage and paternity, which are important in the search for stability in their employment and housing, as well as in the literature of mobility biography (NEWBOLD *et al.*, 2005; SCHEINER, 2011; SCHEINER; HOLZ-RAU, 2013; SCHOENDUWE *et al.*, 2015; CLARK, CHATTERJEE; MELIA, 2016; BEIGE; AXHAUSEN, 2017). It is important to highlight that, when it comes to the young population, the socioeconomic context has an important impact on the possibility of choice; whether to work or not, and which job to accept (BASTOS, 2005). The poorest youngsters do not have the option of not working and, in addition to having no experience, they generally do not have access to quality education. Thus, this group tends to occupy underemployments offered also in the periphery of metropolitan regions, where these young people and their families reside. This is a consequence of the expansion process of large developing cities, which initially occurs with population displacement (OJIMA; HOGAN, 2009), that generates a favorable consumer market for the emergence of shopping centers (ALONSO, 1964; MUTH, 1969; MILLS, 1967; BRUECKENER, 2000). The same can be observed in the RMBH, whose growth, in recent years, has occurred mainly from the main municipality to the borders, due to high property prices in the central area (DE SOUZA, 2008; DE PINHO, 2016).

In some parts, an important reduction in the travel time of younger people can be seen, which did not occur so intensely for older ones. The period 2008-2009 stands out as a possible problem of sample selectivity, in which workers in the first age groups could be, in their majority, of lower socioeconomic status. Therefore, these individuals tended to work closer to their homes. It should be highlighted the reflection of the favorable economic situation between 1996 and 2011 – after the 1994 monetary policy, called “Plano Real”, which reduced high Brazilian inflation through the adoption of a new currency – and the impact of the increase in importance and access to schooling for young people from the mid-2000s onwards. This opportune moment, followed by the increase in credit, expanded the offer of jobs, with emphasis on micro and small companies, responsible for most of the opportunities and relevant to the reduction of poverty (ALVES, 2005; PEZZI, 2005; VIEIRA, 2007). The reduction of barriers to the opening of small businesses allowed the growth of local commerce, which contributed to the increase of opportunities for young people close to their homes. Together, greater accessibility to education, especially higher education – public policies such as the Student Investment Fund (FIES), the University for All Program (PROUNI), Restructuring and Expansion of Federal Universities (REUNI) and racial and socioeconomic quotas – increased perspectives of the

most vulnerable young people, who, in part, could choose to study instead of work (PEREIRA; DA SILVA, 2010; MARQUES; CEPEDA, 2015).

It is important to emphasize that the period analyzed was also marked by an increase in household income, which began to acquire more durable goods, such as cars. Households with higher per capita income could even have more than one motor vehicle, benefiting the other residents of the residence, in addition to the head of the family (LOPES, 2013). Thus, given this entire context, young workers in the highlighted period are made up of both the most vulnerable, who, with no prospect of improving their qualification, tend to occupy the simplest and even informal jobs closer to home; and of those who can use their own motor vehicle.

Figure 1 – Commuting time from home to work by age between 1988 and 2015 at RMBH

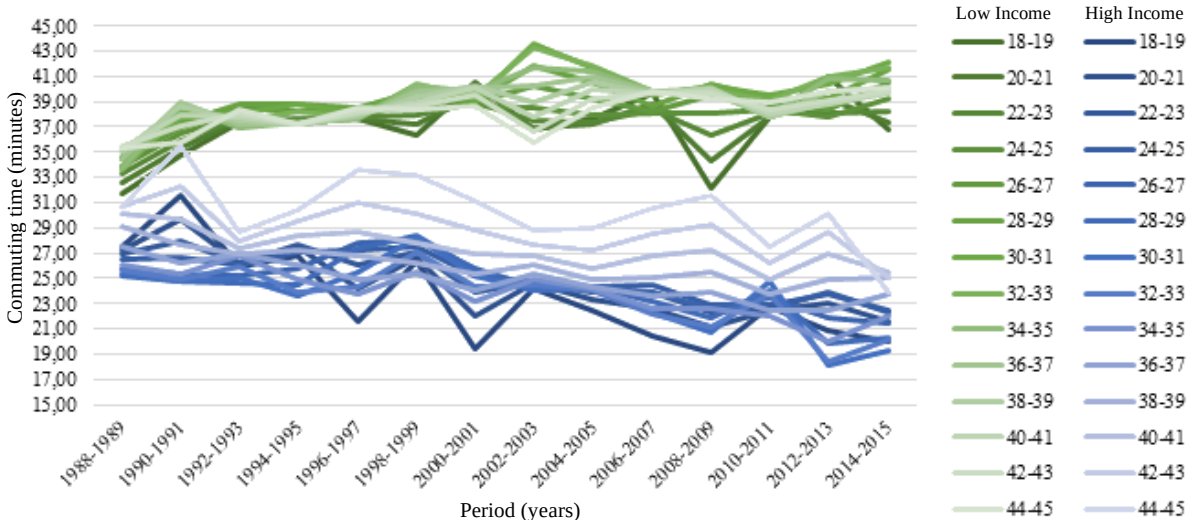


Source: self-elaboration based on PNAD data (1988 to 2015)

The result observed in Figure 1 can be further detailed in Figure 2, where there is a breakdown by per capita income. A disparity between the two income groups – low and high – is highlighted, while there is a separation by age group in the mobility of workers in the RMBH. Note that the average commuting time for those with low income is greater in all analyzed periods; moreover, the difference between the categories has grown over the years. It is also observed that the difference between commuting times of age groups is more evident for those with high incomes. There is a tendency for commuting time to decrease over the periods, contrary to what occurs for those with lower incomes. Specifically, for them, the decrease in time in 2008-2009 is clear regarding younger groups, following the context highlighted above. On the other hand, for high incomes, there is an increase in the travel time of older age groups, which can be explained by the increase in the number of vehicles in circulation, which caused a worsening in traffic, affecting the time of those who already travelled by

individual transport, as well as decentralized residential choices – urban saturation process (PEREIRA; HERRERO, 2009).

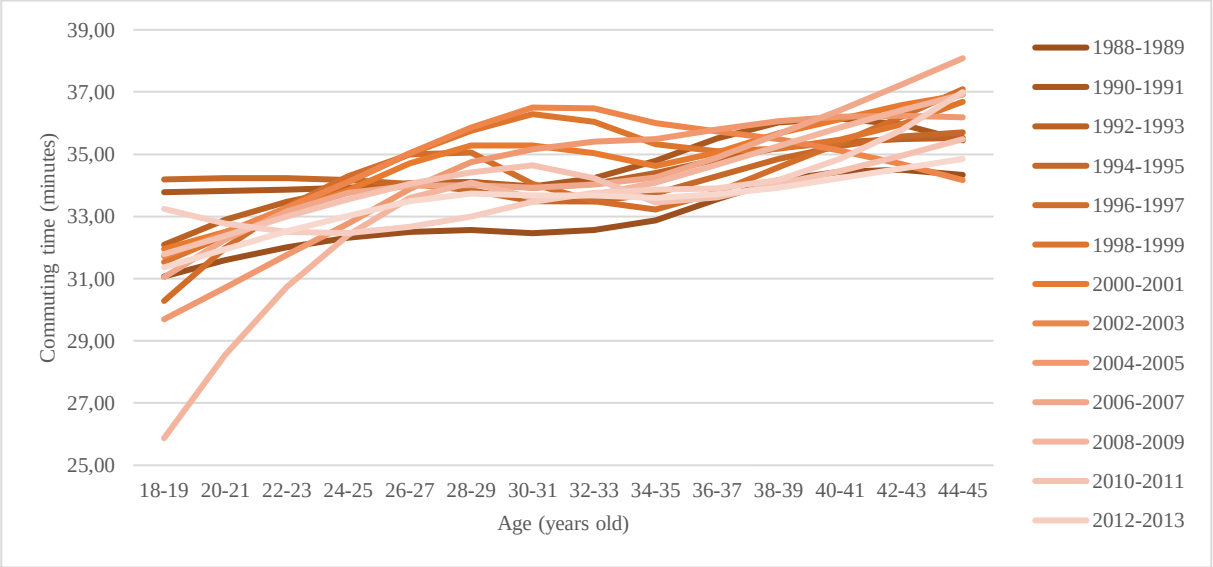
Figure 2 – Commuting time from home to work by age between 1988 and 2015 in the RMBH, low and high income



Source: self-elaboration based on PNAD data (1988 to 2015)

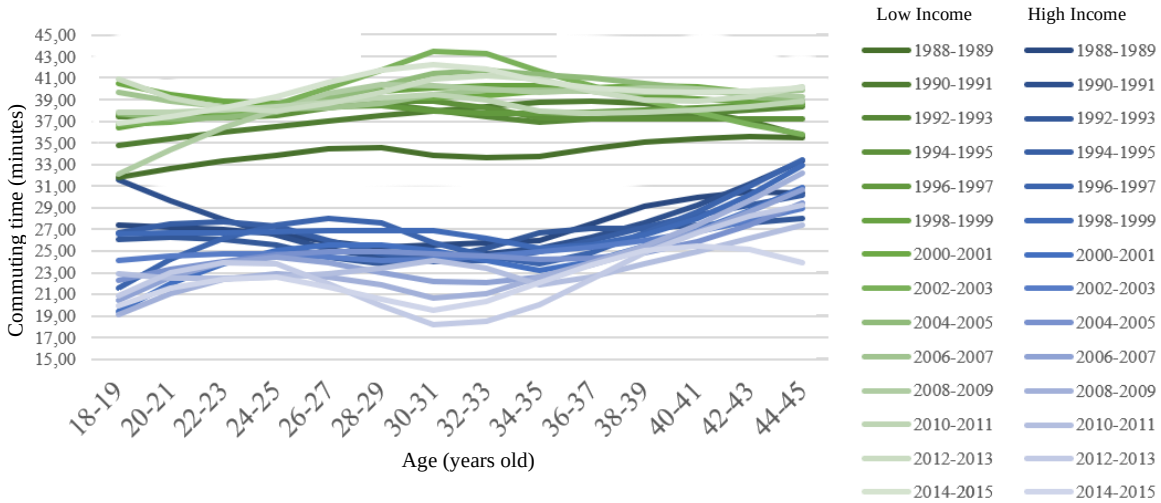
Figure 3, in turn, shows the behavior of travel time over the ages, separated by periods. In all periods, there is a tendency to increase commuting time by age. This is probably due to the tendency of increasing distances traveled by workers between youth and middle ages. Again, a separation by income groups was made to confirm whether there is any period behavior in these cases. In Figure 4, the difference between points in time is clearer for the high-income group, especially before the age of 36, in which there is less commuting time to more recent periods. For those with low incomes, the distinction between periods is not noticeable.

Figure 3 – Commuting time between 18 and 45 years at RMBH



Source: source elaboration based on PNAD data (1988 to 2015)

Figure 4 – Commuting time between 18 and 45 years in the RMBH, low and high income

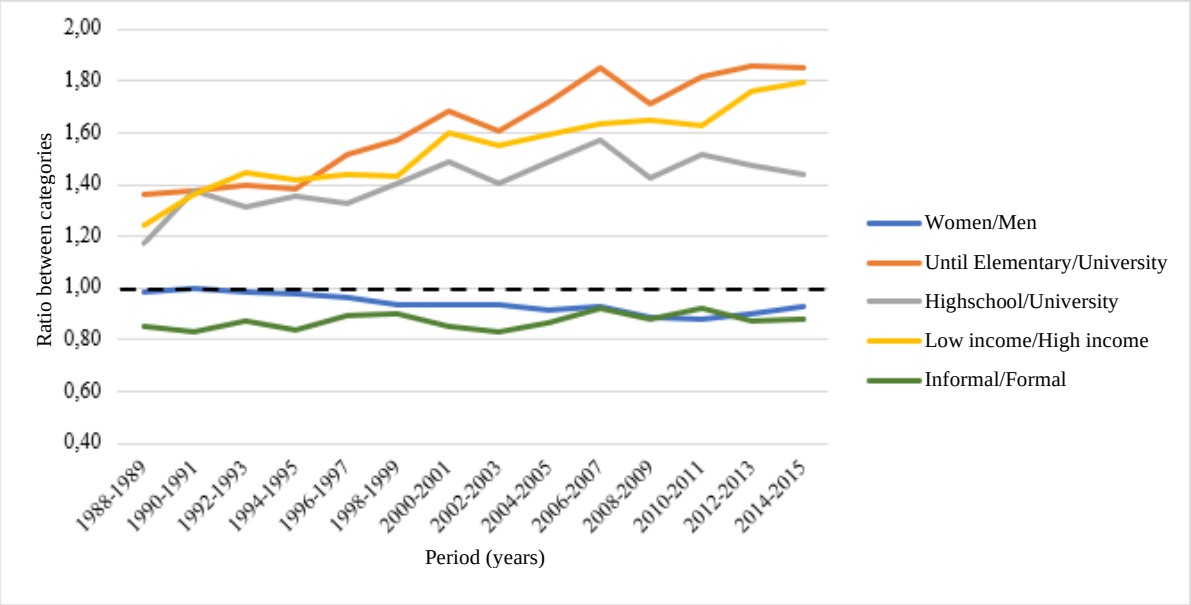


Source: self-elaboration based on PNAD data (1988 to 2015)

In addition to generalized analyses, it is also interesting to compare the travel time between distinct categories. These ratios were made over periods (Figure 5) and ages (Figure 6). The numerators are composed of the groups believed to be the socially vulnerable. Thus, Figure 5 shows the increase in the difference between travel times over periods for all categories, except between formal and informal. Figure 6, in turn, shows that the sex and labor market variables follow opposite trajectories, in which the groups in the former tend to become equal with increasing age, while those in the latter are increasingly distant. The two graphs show similar trajectories between education and income variables. While in the first one observes an approximately linear increase in the difference between the categories over the periods, in the second one notices particularities of age groups. In this case,

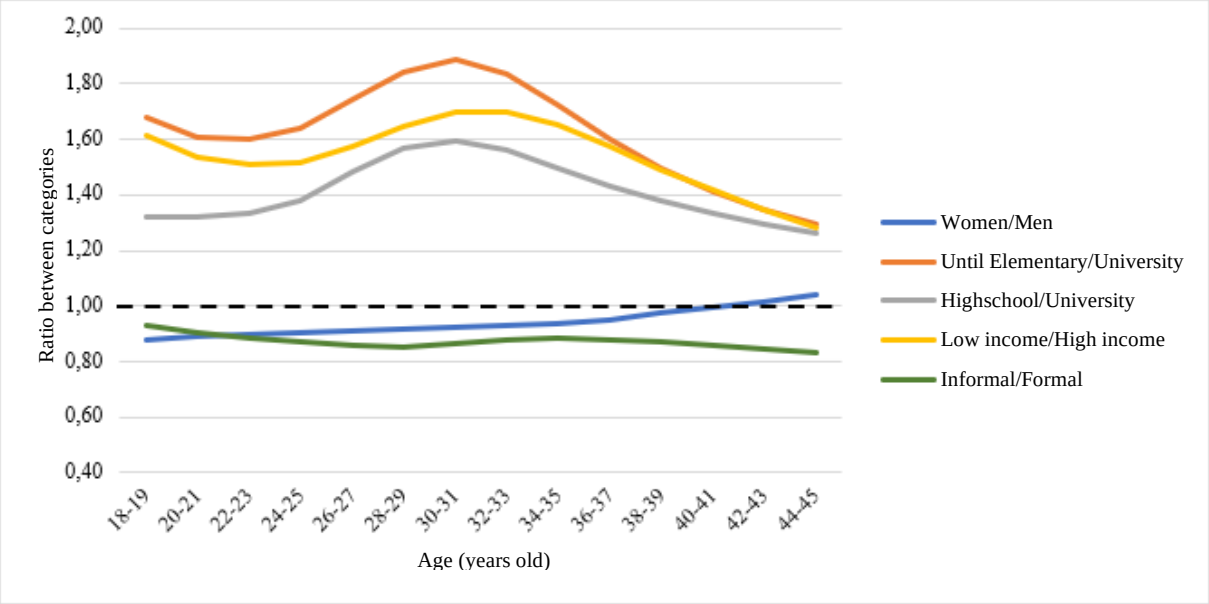
there is a smaller difference in the extremities, with emphasis on the older age groups, and a peak in the center of the series – 30 and 31 years old.

Figure 5 – Relation between commuting times for categories between 1988 and 2015



Source: self-elaboration based on PNAD data (1988 to 2015)

Figure 6 – Relation between commuting times for categories between the ages of 18 and 45



Source: self-elaboration based on PNAD data (1988 to 2015)

The behavior of gender and employment status variables is opposed to what is expected of a vulnerable group, which, in this case, would take longer to travel from home to work. Regarding gender, it is observed that women take less time to commute when compared to men over the years. At the beginning of their working life, women get to work faster than men do, but this difference tends to decrease among older people. These results are similar to the women's profile of home caretaker, who, especially when she is married and/or has children, prefers jobs closer to home (FAGNANI, 1987; CLARK *et al.*, 2003; SCHWANEN *et al.*, 2004). Even in Brazil, the childless woman is very close to the home-to-work commuting behavior of the man (QUEIROZ; PIMENTA, 2021).

In the analysis by periods, it is believed that exists an approximation of employment opportunities for women, as well as that, in the past, employed ones were more vulnerable and, therefore, did so mainly out of necessity (GOLDIN, 2006). In the case of age, the longer commuting time for women in the last age groups analyzed seems to have two explanations. For those who were able to educate themselves, age brings the experience necessary to access better jobs, which are not necessarily close to home (MC QUAID; CHEN, 2012). On the other hand, there are women from the lower classes who lived at a time when access to education was limited and who, therefore, find their livelihood in manual jobs, such as housecleaner. As such jobs are usually demanded by families with greater purchasing power, who reside in privileged regions and generally far from the poorest, the lower-class workers are forced to travel long distances.

As seen for the “sex” variable, shorter travel times do not always indicate less vulnerability. This is also the case for informal workers, who, over all periods and ages, are faster than formal workers. This is because the former seeks closer activities due to the frequent lack of benefits, such as transportation vouchers, in addition to low incomes, which imply an important impact on the costs of transporting these individuals (CARVALHO; PEREIRA, 2012). This is in line with the highlighted in the study by Jakobsen *et al.* (2018) in relation to the city of São Paulo. According to the authors, informal workers tend to seek occupations closer to their residence, in small businesses, workshops and autonomous services (electrician, bricklayer, plumber, among others), despite being spread across the territory. It is believed that, given the results of the PNAD, the same behavior observed in São Paulo seems to occur in the RMBH, which denotes that informal workers are not so dependent on motorized transport.

Then, finally comes the APC model results. Table 2 presents the adjustment statistics for the models with only one variable (A, P and C), with two variables (AP, AC and PC) and for the complete model (APC) with age restriction (44 years = 45 years old). Although the smallest Akaike information criterion (AIC) and the largest R^2 are from the complete model, the variance inflation factor (VIF)

presented a elevate coefficient, suggesting high multicollinearity. The adjustment statistics point to the AP model as the most suitable, as it is the only one among those with two variables that does not present high multicollinearity, in addition to having the lowest AIC. Furthermore, descriptive analysis indicated the presence of age and period effects on commuting time in the RMBH. This trend corroborates the visual analysis of the AP model (Figure 7 and Figure 8), which makes it interesting to investigate from this perspective.

Table 2 –APC model's fit statistics

	G^2	g.l.	R^2	AIC	VIF	LR	p-valor
Null model	2,31	783	-	-	-	-	-
Age	1,18	756	48,72%	-2809,20	-	1433,60	0,000
Period	2,01	756	12,96%	-2394,40	-	1226,20	0,000
Cohort	1,48	729	35,92%	-2580,60	-	1346,30	0,000
Age + Period	0,88	729	61,89%	-2988,00	1,92	1550,00	0,000
Age + Cohort	0,97	702	57,98%	-2857,40	11,20	1511,70	0,000
Period + Cohort	0,84	702	63,47%	-2967,10	11,20	1566,50	0,000
Age + Period + Cohort	0,72	676	68,80%	-3038,70	696,41	1628,30	-

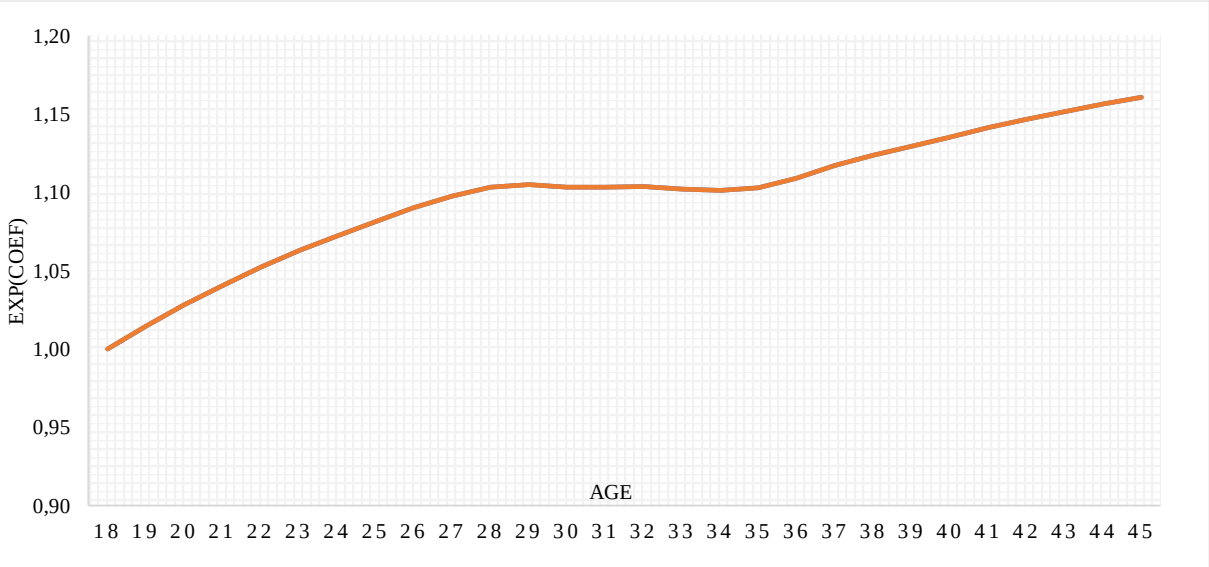
Source: self-elaboration based on PNAD data (1988 to 2015)

The plots of the coefficients of the AP model are shown below. Figure 7 presents the trend for age, with a greater slope between 18 and 27 years old, followed by a plateau between 28 and 34 years old, with a less significant increase between 34 and 45 years old. This suggests that the older the age, the greater the effect of this component on commuting time, and that this behavior increases as one gets older (life cycle effect). This result corroborates what has already been shown in the descriptive analyses, that younger people and, therefore, less experienced in the labor market, tend to occupy positions closer to their homes. On the other hand, the opportunities of older age groups are farther away and, even though they are more likely to use motorized individual transport, the distance seems to more than compensate the time they save with the faster mode. This can be explained by where housing and opportunities are concentrated. This may be linked to the horizontal expansion of residences in the RMBH towards the North and West vectors, while the central area underwent verticalization and concentrated jobs in the services and commerce sector (DE SOUZA, 2008; DE PINHO, 2016). Thus, workers in these sectors need to travel long distances and, regardless of the mode used, must face congestion, especially during rush hours. Furthermore, it is expected that, with this process of population peripheralization, there has been the emergence of small businesses outside the center (ALONSO, 1964; MUTH, 1969; MILLS, 1967; BRUECKENER, 2000). This explains the opportunities for less experienced workers to be, on average, closer to home.

Figure 8 shows the visual result of the AP model for the commuting time of the RMBH over the periods from 1988 to 2015, in turn, shows the period trend and presents, despite the variations, a

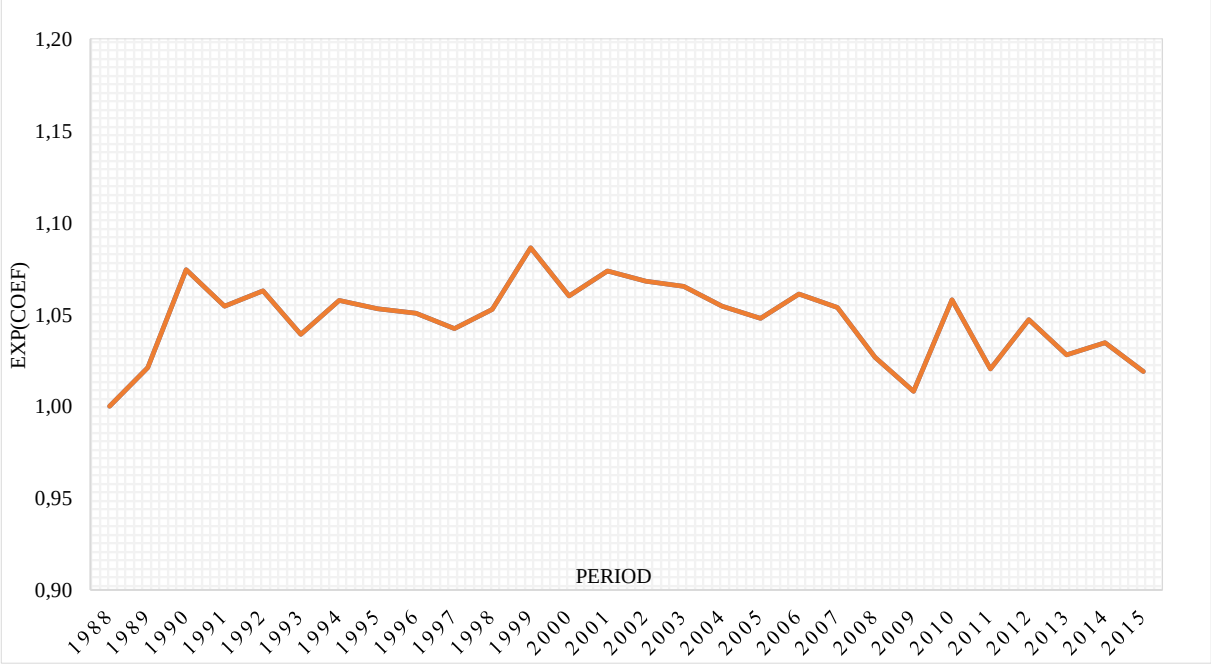
limited behavior within a track. Thus, despite specific contexts disturbing the commuting time, there is a tendency for it to return to a certain level. This shows that the period effect is weak and that no significant change occurred that would cause permanent impacts on the RMBH travel time during the analysis period. It is believed that transport infrastructure policies, such as the introduction of more urban train lines or openings of main roads connecting populated points of the RMBH, could cause long-term period effects.

Figure 7 – AP model's visual result of the commuting time in the RMBH over 18 to 45 years old



Source: self-elaboration based on PNAD data (1988 to 2015)

Figure 8 – AP model's visual result of the commuting time in the RMBH between 1988 and 2015



Source: self-elaboration based on PNAD data (1988 to 2015)

CONCLUSION

The analysis showed a strong age effect, while no considerable period effects on the commuting time of residents of the Belo Horizonte Metropolitan Area. For the life cycle, the results are according to the mobility biography literature, which points to a change in the mobility profile with the progression of age caused by the key effects of life. The analyzed age group (18 to 45 years old) encompasses the moments of life in which the main key events are concentrated, responsible for changes in the mobility patterns of individuals, such as entry into the labor market, marriage and the birth of a child.

The lack of period effects is also an interesting result, which indicates that the Belo Horizonte Metropolitan Area has not undergone large or efficient transport infrastructure works in recent decades. Otherwise, a long-term or permanent change in commuting time would be noticeable. The population has been waiting for several years for the expansion of the subway lines and the construction of the ring road, which would divert heavy vehicle traffic from the urban area.

The results showed that a shorter commuting time does not always indicate a lower vulnerability. On the contrary, categories known to be vulnerable, such as women and informal workers, take less commuting time than their pairs. In the case of women, their caretaker profile limits their living and working space, in addition to using public transport more often than men. For informal workers, who generally have low wages, it is difficult to use motorized modes (individual or collective), as they do not have the benefit of transport vouchers. Therefore, they do not usually stray too far from their homes. Moreover, the offer of nearby accessible opportunities, in addition to being scarce, are low paid. These set of evidences show that working close to home is not always a privilege.

REFERENCES

ALONSO, William. Location and land use. toward a general theory of land rent. Location and land use. Toward a general theory of land rent., 1964.

ALVES, Bruno V.. O papel das micro e pequenas empresas brasileiras na geração de empregos no período de 1990-2000. **Centro Universitário de Brasília (UniCEUB)**, Monografia (Bacharelado em Ciências Econômicas). 2005.

ANGUS, John E. The probability integral transform and related results. **SIAM review**, v. 36, n. 4, p. 652-654, 1994.

BASTOS, Juliana C.. Efetivação de escolhas profissionais de jovens oriundos do ensino público: um olhar sobre suas trajetórias. **Revista Brasileira de Orientação Profissional**, v. 6, n. 2, p. 31-43, 2005.

BEIGE, Sigrun; AXHAUSEN, Kay W. The dynamics of commuting over the life course: Swiss experiences. **Transportation Research Part A: Policy and Practice**, v. 104, p. 179-194, 2017.

BRUECKNER, Jan K. Urban sprawl: diagnosis and remedies. **International regional science review**, v. 23, n. 2, p. 160-171, 2000.

CAMARANO, Ana Amélia; PASINATO, Maria Tereza; ARRUDA, Marcela R.; LOVISOLO, Nicolas Emílio. Os jovens brasileiros no mercado de trabalho. Nota Técnica, **Instituto de Pesquisa Econômica Aplicada (IPEA)**, 2001.

CARVALHO, Carlos Henrique R.; PEREIRA, Rafael Henrique M. Gastos das famílias brasileiras com transporte urbano público e privado no Brasil: uma análise da POF 2003 e 2009. Texto para Discussão, **Instituto de Pesquisa Econômica Aplicada (IPEA)**, 2012.

CLARK, Ben; CHATTERJEE, Kiron; MELIA, Steve. Changes to commute mode: The role of life events, spatial context and environmental attitude. **Transportation Research Part A: Policy and Practice**, v. 89, p. 89-105, 2016.

CLARK, William A. V.; HUANG, Youqin; WITHERS, Suzanne. Does commuting distance matter?: Commuting tolerance and residential change. **Regional Science and Urban Economics**, v. 33, n. 2, p. 199-221, 2003.

COURGEAU, Daniel. Méthodes de mesure de la mobilité spatiale: migrations internes, mobilité temporaire et navettes. **Population (french edition)**, p. 877-880, 1988.

DE PINHO, Breno Aloísio T. D.. População e Pobreza: Uma Análise da Região Metropolitana de Belo Horizonte. 2016. Tese (Doutorado em Demografia) – **Cedeplar**. Universidade Federal de Minas Gerais, Belo Horizonte.

DE SOUZA, Joseane. *A Expansão Urbana de Belo Horizonte e da Região Metropolitana de Belo Horizonte: O Caso Específico do município de Ribeirão das Neves.* 2008. Tese (Doutorado em Demografia) – Cedeplar. Universidade Federal de Minas Gerais, Belo Horizonte.

DELBOSC, Alexa; CURRIE, Graham. The spatial context of transport disadvantage, social exclusion and well-being. **Journal of Transport Geography**, v. 19, n. 6, p. 1130-1137, 2011.

FAGNANI, Jeanne. Daily commuting time: the stakes for working mothers in France. **Transportation Research Record**, v. 1135, p. 26-30, 1987.

GOLDIN, Claudia; KATZ, Lawrence F.; KUZIEMKO, Ilyana. The homecoming of American college women: The reversal of the college gender gap. **Journal of Economic perspectives**, v. 20, n. 4, p. 133-156, 2006.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). Pesquisa Nacional por Amostra de Domicílios (diversos anos). Disponível em: <https://www.ibge.gov.br/estatisticas/sociais/populacao/9127-pesquisa-nacional-por-amostra-de-domicilios.html?=&t=microdados>. Acesso em 28 de dezembro de 2019.

JAKOBSEN, Kjeld; MARTINS, Renato; DOMBROWSKI, Osmir. Mapa do trabalho informal – Perfil Socioeconômico dos Trabalhadores Informais na Cidade de São Paulo. **Fundação Perseu Abramo**. 2018.

LI, He; RAESIDE, Robert; CHEN, Tao; MCQUAID, Ronald W.. Population ageing, gender and the transportation system. **Research in transportation economics**, v. 34, n. 1, p. 39-47, 2012.

LOO, Becky P. Y.; CHOW, Alice S. Y.. Jobs-housing balance in an era of population decentralization: an analytical framework and a case study. **Journal of Transport Geography**, v. 19, n. 4, p. 552-562, 2011.

LUCAS, Karen. Transport and social exclusion: Where are we now?. **Transport policy**, v. 20, p. 105-113, 2012.

LOPES, Flávia. As cidades para os pedestres. **A3 Revista de Jornalismo Científico e Cultural da Universidade Federal de Juiz de Fora**, n. 4, 2013.

MARANDOLA JR, Eduardo. Mobilidades contemporâneas: distribuição espacial da população, vulnerabilidade e espaços de vida nas aglomerações urbanas. Mobilidade espacial da população: desafios teóricos e metodológicos para o seu estudo. Campinas: **Nepo/Unicamp**, p. 95-115, 2011.

MARQUES, Antonio Carlos H.; CEPEDA, Vera A.. Um perfil sobre a expansão do ensino superior recente no Brasil: aspectos democráticos e inclusivos. **Perspectivas: Revista de Ciências Sociais**, v. 42, 2012.

MASON, Karen O.; MASON, William M.. Some methodological issues in cohort analysis of archival data. **American sociological review**, p. 242-258, 1973.

MILLS, Edwin S. An aggregative model of resource allocation in a metropolitan area. **The American Economic Review**, v. 57, n. 2, p. 197-210, 1967.

MUTH, Richard F.. CITIES AND HOUSING; THE SPATIAL PATTERN OF URBAN RESIDENTIAL LAND USE. 1969.

NEWBOLD, K. Bruce; SCOTT, Darren M.; SPINNEY, Jamie E. L.; KANAROGLOU, Pavlos; PÁEZ, Antonio. Travel behavior within Canada's older population: a cohort analysis. **Journal of Transport Geography**, v. 13, n. 4, p. 340-351, 2005.

OJIMA, Ricardo; HOGAN, Daniel Joseph. Mobility, urban sprawl and environmental risks in brazilian urban agglomerations: challenges for urban sustainability. Urban population-

environment dynamics in the developing world: case studies and lessons learned. **Paris: Committee for International Cooperation in National Research in Demography**, p. 281-316, 2009.

PEREIRA, Rafael Henrique M.; HERRERO, Verónica. Mobilidade pendular: uma proposta teórico-metodológica. Texto para Discussão, **Instituto de Pesquisa Econômica Aplicada (IPEA)**, 2009.

PEREIRA, Thiago I.; DA SILVA, Luís Fernando S. C.. As políticas públicas do ensino superior no governo Lula: expansão ou democratização?. **Revista debates**, v. 4, n. 2, p. 10, 2010.

PEZZI, Sérgio Luiz. Acesso ao crédito por parte das micro e pequenas empresas brasileiras no período pós-plano real. **Pontifícia Universidade Católica do Rio Grande do Sul (PUC-RS)**, Dissertação (Mestrado em Economia do Desenvolvimento). 2005.

QUEIROZ, Sarah L.; PIMENTA, Iracy S.. Gender, Motherhood, and Commuting Time in Brazil. In: IV ISA **Forum of Sociology** (February 23-28, 2021). ISA, 2021.

SCHEINER, Joachim. Changes in travel mode choice: the impact of period, cohort, and life-course effects. In: **Raum und Mobilität–Arbeitspapiere des Fachgebiets Verkehrswesen und Verkehrsplanung Nr. 24**. Technische Universität Dortmund Dortmund, 2011.

SCHEINER, Joachim; HOLZ-RAU, Christian. Changes in travel mode use after residential relocation: a contribution to mobility biographies. **Transportation**, v. 40, n. 2, p. 431-458, 2013.

SCHOENDUWE, Robert; MUELLER, Michel G.; PETERS, Anja; LANZENDORF, Martin. Analyzing mobility biographies with the life course calendar: a retrospective survey methodology for longitudinal data collection. **Journal of Transport Geography**, v. 42, p. 98-109, 2015.

SCHWANEN, Tim; DIELEMAN, Frans M.; DIJST, Martin. The impact of metropolitan structure on commute behavior in the Netherlands: A multilevel approach. **Growth and change**, v. 35, n. 3, p. 304-333, 2004.

VIEIRA, Maria L.. A contribuição das micro e pequenas empresas para a redução da pobreza no Brasil. **Universidade Federal do Ceará (UFC)**, Dissertação (Mestrado em Economia). 2007.