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Instituto de Economia e Relações Internacionais – Universidade Federal de Uberlândia

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Economic conjuncture and suicide in Brazil over the last four decades: an econometric analysis

Conjuntura econômica e suicídio no Brasil nas últimas quatro décadas: uma análise econométrica

Ademir Clemente [a]
Artur Kendi Clemente [b]

Abstract: This article examines the impact of economic conjunctural factors on suicide rates among Brazilian men and women over the last four decades. Data come from the Brazilian Ministry of Health - Mortality Information System (SIM) and cover the period from January 1979 to December 2022. We estimated monthly suicide rates among men and women by age group: up to 19 years old, 20 to 59 years old, and 60 and older, and we segregated the data according to family status. We used an econometric model to quantify the effects of economic conjuncture. Our findings show that economic conjunctural factors influence suicide rates, and that such an influence varies in terms of nature and degree.

Keywords: Suicide, Economic Conjuncture, Suicide Rates, Brazilian Economy.
JEL Classification: E66, N16, E32

Resumo: Este artigo examina o impacto de fatores conjunturais econômicos sobre as taxas de suicídio entre homens e mulheres brasileiros nas últimas quatro décadas. Os dados são do Ministério da Saúde – Sistema de Informações sobre Mortalidade (SIM) e abrangem o período de janeiro de 1979 a dezembro de 2022. Estimamos taxas mensais de suicídio entre homens e mulheres por faixa etária: até 19 anos, 20 a 59 anos, e 60 ou mais e segregamos os dados de acordo com o status familiar. Utilizamos um modelo econométrico para quantificar os efeitos da conjuntura econômica. Nossos resultados mostram que fatores conjunturais econômicos influenciam as taxas de suicídio, e que tal influência varia em termos de natureza e grau.

Palavras-chave: Suicídio, Conjuntura Econômica, Taxas de Suicídio, Economia Brasileira
Classificação JEL: E66, N16, E32

[a] Doutor e pós-doutor pela COPPE/UFRJ. Professor titular da UFPR (aposentado). E-mail: ademir@ufpr.br.
[b] Mestre em Políticas Públicas pela UFPR. E-mail: akenji47@gmail.com.

1. Introduction

Death itself is an unpleasant subject. Suicides and homicides are not even forms of natural death. As a result, these topics are quite unappealing. Indeed, suicide is a serious taboo, and many people just avoid addressing it. Additionally, most economists argue that suicide is not an economic issue. Despite this, Economics, as a social science, is responsible for advancing understanding of all social concerns, including suicide.

Indeed, suicide is not a pleasant topic. However, figures from around the world reveal that roughly 800,000 suicides occur each year, with a suicide rate of 9 per 100,000 people, accounting for 1.3% of all deaths. Furthermore, suicide is one of the leading 20 causes of death (WHO, 2023).

Unfortunately, Brazil's suicide rate has climbed from roughly 3 per 100,000 people in 1980 to 6 per 100,000 people 40 years later. In fact, Brazil has been facing steadily growing rates of suicide for a long time, and this has been observed for both men and women (Santos and Barbosa, 2018; Silva and Marcolan, 2022; Ribeiro et al., 2018; Soares; Stahnke; Lewandowski, 2022).

Brazil's economy has undergone tremendous changes over the previous four decades as a result of the implementation of economic plans. In addition, Brazil's economy has seen a wide range of economic conditions. To what extent, if any, have these distinct conjunctures influenced suicide rates? Does economic conjuncture affect suicide rates?

According to certain studies, during times of crisis, suicide rates increase. In the early nineteenth century, the seminal writings of Durkheim and Marx established that crises and societal pressure are important variables in understanding the level of suicide (Durkheim. 2006; Marx, 2006)

During the last four decades, the Brazilian economy had significant fluctuations in inflation rates, growth rates, exchange rates, unemployment rates and cost of living to name a few economic indicators. Furthermore, successive governments enforced a series of economic plans that resulted in fundamental changes in the basic operation of the economy. As a result, the Brazilian economy is a suitable subject for studying the potential impact of the economic conditions on suicide rates among men and women.

On the other hand, since January 1979, the Brazilian Ministry of Health has made available individualized data on the causes of death, including suicide, via the Mortality Information System (SIM) database, which can be sorted by age group and gender. These data enabled us to calculate mortality rates by age group and gender month by month, as well as econometrically assess the influence of various economic periods and events.

Authors have investigated suicide from a mental health perspective, emphasizing the consequences of depression, anxiety, hopelessness, and stress (Klonsky and May, 2015; Van Orden *et al*., 2010). We believe that unfavorable economic conditions may trigger or exacerbate these psychiatric illnesses. So, our central hypothesis is that unfavorable economic conditions may have an impact on suicide rates, with effects differing by gender and age group, because gender and age are important in defining social roles.

We selected four clearly distinct time periods from the last four decades: the "lost decade", the high inflation period, the poor GDP growth period, and the covid pandemic period; as well as three main economic plans: the Cruzado Plan, the Collor Plan, and the Real Plan. Then, we investigated the effects of these economic conjunctural factors on the suicide rates among men and women of three age groups, segregated according to family status, over the last four decades.

This article comprises five other sections: Economic Downturns and Suicide, Methodological Notes, Analysis, Discussion, and Conclusion.

2. Economic Downturns and Suicide

Most of the suicide literature comes from the health area and focuses on depression, hopelessness, anxiety, and stress as if these mental health difficulties happened in an environment unaffected by economic variables such as income distribution, cost of living, unemployment, and so on.

The Portuguese Society of Suicidology (2011), in tribute to Edwin Shneidman, discusses the elements that contribute to suicidal behavior, highlighting the feeling of intolerable pain caused by basic psychological needs that were frustrated and not met, self-deprecating attitudes, and low self-esteem. This diminished self-image gives place to an inability to bear acute and deep psychological pain.

Suicide is a choice between enduring existential setbacks and ending one's life (Ming-Wau *et al*., 2020) and is often linked to depression (Polakiewicz, 2021). The association between suicide and depression is present in almost all studies on suicidal behavior (Chachamovich *et al*., 2009).

Depression and suicide are variables related to hopelessness, which can arise because of psychological pressure resulting from social structure or life events (Zhang and Li, 2013). Hopelessness has been recognized as a key variable linking depression to suicidal behavior since the 1970s, and negative expectations as a cognitive element of the depression syndrome are considered a stronger indicator of suicidal intention than the depression itself (Minkoff *et al*., 1973; Beck *et al*., 1975). Depression, engendered over time and associated with hopelessness, anxiety, and other disorders, is a common psychological condition in cases of suicide.

Suicide is typically the sad conclusion to a story of anxiety, depression, and hopelessness, and the suicidal person views it as an escape, an interruption of excruciating pain (Brazilian Federal Council of Psychology, 2013). In this sense, recessive eras and events that have a significant impact on people's economic situations may exacerbate society's suicide rate.

Figueiredo *et al*. (2022) investigated suicide rates in Brazil before and after an economic recession, comparing 2012-14 to 2015-17, and demonstrated that there was a greater worsening among the poorest and most vulnerable population, which requires the implementation of specific public policies during recessions.

Setti (2017) investigates the reasons for public authorities' lack of attention to suicide prevention, pointing out the taboo, inadequate media coverage, a lack of health professional training, and underreporting of incidents. In this regard, the Brazilian government's newly proclaimed goal of "stopping the growth of suicide mortality" (Ministry of Health of Brazil, 2021) appears unconvincing when considering existing high levels and trends.

Ng *et al*. (2013), analyzing the impacts of the 2008's Financial Crisis on mental health, declare:

> The [economic] downturn is likely to exert its impact through a series of interlinked factors, but studies highlight those job-related problems, particularly unemployment, are the key determinant risk factors for mental-health-related difficulties. […] Those keeping their jobs are not immune to the effects of the crisis. Anxiety about job insecurity complicates existing depression and acts as a chronic stressor with cumulative effects over time.

No doubt, unemployment is a key factor because unemployed people frequently become indebted and suffer from anxiety and depression and are unable to maintain payments on their private health care plans (Kposowa, 2001; Blakely *et al.*, 2003). This circumstance reduces the likelihood of re-employment and can drive a jobless individual to hopelessness and mental illness. In addition, people who manage to keep their jobs suffer from anxiety and increased workload that can trigger mental problems. Even worse, employed people who experience anxiety and stress are the most likely candidates to be fired.

But not only that. Several studies have shown that during economic downturns, drug consumption, notably alcohol consumption, rises significantly (Frone, 2016; Mäkelä; Österberg, 2009; De Goeij *et al.*, 2015). Drug use appears to be a way to escape the suffering caused directly and indirectly by unemployment and may lead to suicide.

The rise in drug usage is in line with the increase in suicide rates, to the extent that, according to most psychologists and psychiatrists, suicide is primarily a way of ending the suffering that the individual considers unbearable.

Two studies carried out in China deserve to be mentioned. Chang *et al*. (2009) focused on developing and validating a Chinese version of the Positive and Negative Suicide Ideation Inventory to assess suicidal ideation among Chinese-speaking populations. In addition, in 2017, Chang *et al*. (2017) published "A Comparative Analysis of Suicide Attempts in Left-Behind Children and Non-Left-Behind Children in Rural China." This study examined the prevalence and factors influencing suicide attempts among left-behind and non-left-behind children in rural China.

Also, Chang *et al*. (2009) employed time-trend analysis to examine suicide rates before, during, and after the Asian Financial Crisis, 1997–1998. They found that suicide rates increased significantly in several of the countries studied during the crisis period. The increase was more pronounced among middle-aged men, suggesting a strong link between economic distress, job loss, and financial hardship. The authors argue that economic instability can be a major driver of suicide rates.

Most recent studies are in accordance with the fact that the suicide rate rises during periods of economic recession due to unemployment, financial pressure, especially debt, and psychological stress (Figueiredo *et al*., 2022; Reeves *et al*., 2012; Van Orden *et al*., 2010; Phillips and Nugent, 2014; and Ornell, 2022, Fountoulakis**,** 2014). These authors argue that recession, unemployment, and debt can affect people's emotional balance and lead them to suicide.

It is not a question of denying the importance of variables outside the domain of economics, which would be an unacceptable simplification, but simply of examining the capacity of economic variables to alter emotional well-being and predispose or increase the predisposition of individuals to suicide. Depending on individual characteristics, the accumulation of stress can cause depression, anxiety and hopelessness at levels that cause intense suffering and can lead to suicide (Nopporn, 2018; Feskanich *et al*., 2002).

2.1 Hypotheses

Based on these authors, we state the following hypotheses:

1. The deterioration of living conditions, uncertainty, and social anomie are factors that originate or worsen feelings of anxiety, depression, stress, and hopelessness, capable of leading to suicide.
2. Men and women of different age and family status react differently to economic conjunctural factors, and this reflects on their suicide rates.
3. Suicide rates among Brazilian men and women have been influenced by economic conditions during the past 4 decades.

3. Methodological Notes

This section includes the description of the data and the presentation of the model.

3.1 Data

Monthly data on suicides were gathered from the Ministry of Health's Mortality Information System (SIM). We approximated monthly population estimates by interpolating annual data from the Brazilian Institute of Geography and Statistics (IBGE). The monthly suicide rates per million persons were calculated individually for men and women in three age groups: up to 19 years old, 20–59 years old, and 60 and over. We also separated these three age groups by family status. This data classification was intended to consider people's different social and economic roles, and the way and extent to which economic conjuncture fluctuations may affect them.

The series of monthly suicide rates per million people include 528 (five hundred and twenty-eight) observations, beginning in January 1979 and ending in December 2022.

Initially, we checked the series for the presence of extreme points. Next, to eliminate any interference from seasonal variation or autocorrelation, we added 11 (eleven) seasonal binary variables for the months of the year, as well as 12 (twelve) dependent variable lags to ensure the absence of residual autocorrelation. We also included a dummy variable in the regressions for women because a prior study found a positive trend in suicide rates among women beginning in March 1999 (Clemente et al., 2024).

Table 1 shows four distinct economic conjuncture that occurred from January 1979 and December 2022.

Table 1: Different economic conjunctures between 1979 and 2022

	Sub-period	Conjuncture	Mnemonic
1	1980 to 1990	Lost decade, with lack of growth and high inflation	L_DEC
2	01/1988 to 06/1994	Very high inflation, averaging 1,618% per year	H_INFL
3	01/2011 to 12/2020	Poor GDP growth, averaging just 0.3% per year	P_GROW
4	03/2020 to 06/2022	Covid-19 Pandemic*	COVID

*The first case of Covid-19 in Brazil was officially recognized in February 2020.
Source: Author (2024).

We assigned binary variables to those sub-periods, with 1 for the months of each sub-period and 0 for the rest. Next, we aimed to identify the most significant economic events in the period under consideration. These events were identified as three economic plans that altered basic rules for the functioning of the economy, as indicated in Table 2.

Table 2: Relevant economic events between 01/1979 and 12/2022

Date	Event	Identification
02/1986	Cruzado Plan, implemented on 02/28/1986	CRUZADO
03/1990	Collor Plan, implemented on 03/16/1990	COLLOR
07/1994	Real Plan, implemented on 07/01/1994	REAL

Source: Author (2024).

The Cruzado Plan, launched on February 28, 1986, was a shock treatment based on the Inertial Inflation Theory, which included currency substitution and price freezing. People welcomed the Cruzado Plan with enthusiasm because it would finally bring inflation under control. However, it was short-lived since supply issues surfaced quickly. The price freeze lasted just until the elections on November 15, that year.

The Collor Plan, officially known as Plano Brasil Novo, involved the confiscation of financial assets, including bank accounts and financial investments, and impacted the daily lives of people and businesses' daily life. It was executed on March 16, 1990. The Collor Plan caused resentment and suspicion owing to the expropriation of financial assets, but it also provided promise for curbing inflation. Because inflation did not fall, fresh measures were imposed in January 1991 under the Collor 2 Plan.

The Real Plan's initial measure was the establishment of the Real Value Unit on March 1, 1994, to serve as a value reference throughout the transition period and to expire

on July 1st of the same year with the implementation of the Real. The Real Plan was effective in achieving its primary goal of controlling inflation and promoting long-term stability. This did not, however, prevent a sizable portion of the population from receiving it with reservations due to the previous unsuccessful economic plans.

3.2 The Model

We defined sub-period dummies as 1 for the months in each sub-period and 0 for the others, and event dummies as 1 for the six months following the event and 0 for the rest. This specification aims to capture solely the influence of each event, excluding extraneous conjunctural variations.

The adopted model is:

$$Y_t = \beta_0 + \beta_1 t + \sum_{k=1}^{K} \rho_k Y_{(t-k)} + \sum_{s=1}^{S} \psi_s D_s + \sum_{p=1}^{D} \pi_p D_p + \sum_{p=1}^{D} \theta_p t D_p + \S_t \qquad (1)$$

In this equation: $\boldsymbol{Y_t}$ represents suicide rate in month $\boldsymbol{t}$; $\boldsymbol{\beta_0}$, independent term; $\boldsymbol{\rho_k}$, autoregressive parameters; $\boldsymbol{\psi_s}$, seasonality parameters; $\boldsymbol{\pi_p}$, parameters of dummies for sub-periods and events; and $\boldsymbol{\S_t}$, stochastic term. All regressions comply with the Least Squares Assumptions Model, and all statistical tests are performed at the 1% significance level.

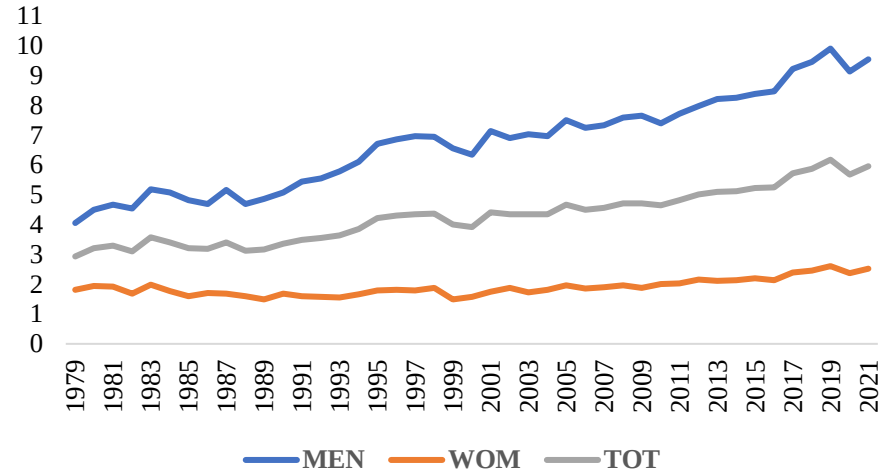
4. Analysis

This section is divided into three subsections: first, we examine the suicide rates of men and women separated by age groups; then, we focus just on men and separate them by age and family status; and finally, we do the same for women.

Suicide rates in Brazil over the last four decades

Graph 1 depicts the suicide rates among Brazilian men and women over the last four decades. Graph 1 demonstrates that all series are increasing: males exhibit an increasing trend throughout the time, while females show an increasing trend since the end of the millennium. We can see that suicide rates among men increase from 4 to 10 per 100,000, while suicide rates among women increase from 2 to 2.5 per 100,000.

Graph 1: Suicide rates among Brazilian men and women (last 4 decades)



Source of data: Brazilian Ministry of Health and Brazilian Institute of Geography and Statistics.

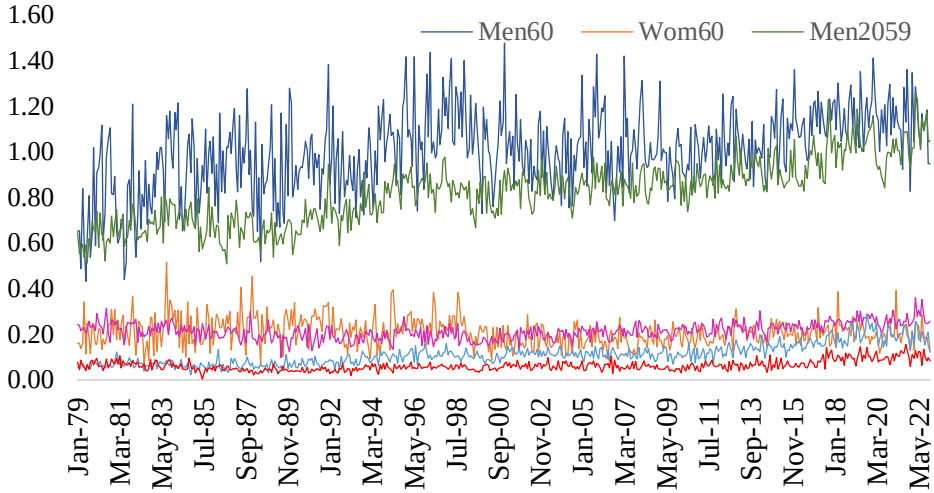
Men and women of different ages

Graph 2 exhibits the series of suicide rates of men and women segregated into age groups. We observe two groups of curves: men aged 60 and over and men aged 20 to 59 occupy the upper range, while all other segments are jointly located in the lower range. In addition, we perceive that the two upper curves present positive trends, especially the one relative to men aged 20 to 59.

Young men do not present significantly different suicide rates in relation to the other segments, but men aged between 20 and 59 years and those aged 60 years and over show suicide rates approximately four times higher than the other segments. Furthermore, the increasing trend among men aged 20 to 59 years persists throughout the investigated period.

Table 3 presents descriptive statistics relative to men and women by age group. Table 3 demonstrates significant gender and age differences. The lower average suicide rate occurs among women aged up to 19 years old, followed by men of the same age group. These segments also exhibit the highest variability during the period analyzed. Men aged 60 and older show the highest average suicide rate, followed by men aged 20 to 59.

Graph 2: Suicide rates of men and women by age groups



Source of data: Brazilian Ministry of Health (SIM) and Brazilian Institute of Geography and Statistics.

Table 3: Descriptive statistics for men and women by age group

	Men			Women		
	Up to 19	**20 to 59**	**60 and +**	**Up to 19**	**20 to 59**	**60 and +**
Minimum	0,022	0,508	0,432	0,003	0,098	0,064
Maximum	0,290	1,256	1,477	0,155	0,360	0,516
Average	0,111	0,820	1,003	0,062	0,214	0,208
Standard Deviation	0,046	0,138	0,177	0,023	0,036	0,061
Coef. of Variation	0,413	0,169	0,176	0,363	0,167	0,291

Source: Author (2024).

Table 4 contains the results of Ordinary Least Square Regressions (OLSR) for the series of suicide rates of men and women segregated into age groups. Some observations on Table 4 are immediate. In general, the influence of economic conjunctural factors on the suicide rates of men and women of different age groups seems to be sparse and heterogeneous.

The group of men aged 20 to 59 is markedly the most sensitive to economic conjunctural factors. The suicide rate of this group diminished with the Cruzado Plan and increased with the Collor Plan, almost by the same estimate. We also notice that this age group of men is unique in showing a tendency to increase suicide rates during the whole period, confirming the positive trend observed in Graph 1. We can also see that this segment follows an autoregressive pattern with clearly defined lags 1 and 2. The adjusted R-square indicates that this group is the one that presents the best fitness to the independent variables.

The group of men aged 60 or more also demonstrates sensitiveness to economic conjunctural factors, as it presents an expressive increase in suicide rates in the face of the

Real Plan. We also notice that men aged up to 19 years old do not show influence of economic conjunctural factors.

Still, according to Table 4, women do not show an expressive influence of economic conjunctural factors on their suicide rates all over the period 1979–2022, except for the segment aged 60 and more. The women aged 60 or more present a suicide rate pattern very distinct from the other two women's segments. We find a positive constant term indicating the abstraction of relevant variables and an indication that they reacted positively to the Real Plan, with a significant reduction in their suicide rates.

Table 4: The influence of economic conjuncture on the suicide rates of men and women by age group (coefficients significant at the 1% level)

	Men19	**Men2059**	**Men60**	**Women9**	**Women2059**	**Women60**
Const		0,0594	0,405			0,227
Month		**4,975e-06**				
Fev		−0,075		−0,008	−0,019	
Abr					−0,015	
Mai		−0,035				
Jun	−0,011	−0,083	−0,113		−0,012	
Jul		−0,050		−0,009		
Set					−0,012	
Dez				−0,007		
Cruzado		**−0,054**				
Collor		**0,034**				
Real			**0,101**			−0,**064**
Lag_1	0,213	0,234			0,191	
Lag_2		0,224	0,113	0,180		
Lag_5			0,133			
Lag_8	0,141					
Wom_Dum						−0,**065**
Adj. R^2	***0,778***	***0,838***	***0,322***	***0,541***	***0,465***	***0,172***

Notes: **M19** – Men up to 19 years old; **M2059** – Men aged between 20 and 59; **M60** – Men aged 60 or more; **W19** – Women up to 19 years old; **W2059** – Women aged between 20 and 59; **W60** – Women aged 60 or more. **JAN** to **DEC** – Seasonal dummies. **L_DEC** – The Lost Decade, 1980 to 1990, lack of growth and high inflation; **H_INFL -** Very high inflation, 01/1988 to 06/1994, inflation averaging 1,618% per year; **P_GROW** – Poor growth, 01/2011 to 12/2020, growth averaging 0.3% per year; **COVID** – Covid 19 Pandemic - 03/2020 to 06/2022; **CRUZADO** – Cruzado Plan, implemented on 02/1986; **COLLOR** – Collor Plan, implemented on 03/1990; **REAL** – Real Plan, implemented on 07/1994; **WOM_DUM –** Dummy variable relative to women. Monthly data from 1979/01 to 2022/12 (528 observations). Standard errors HAC. Coefficients with a significance level of less than 1%.

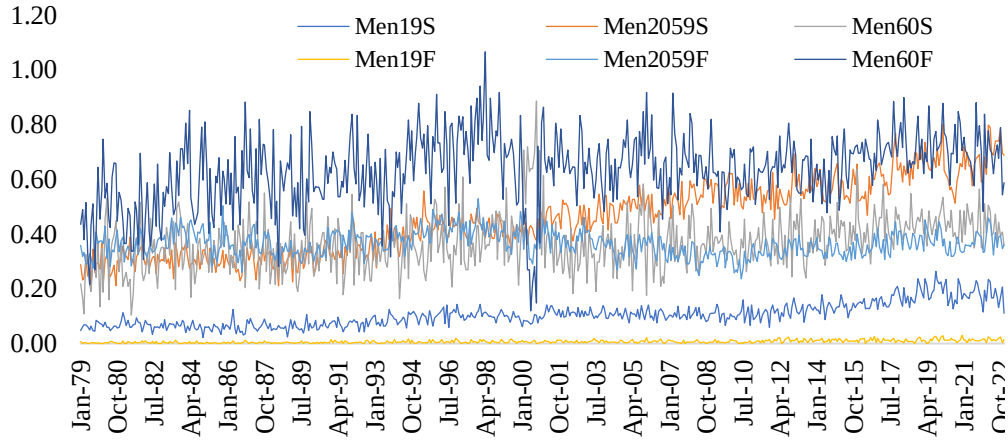
Source: Author (2024).

Table 4 also indicates that the suicide rates of women do not show a trend to grow. None of the age segments of women show a general trend to grow, although the segment aged 60 and more shows a trend to decrease in the period starting in March 1999. The absence of trend and the trend to decrease in the segment aged 60 and more are intriguing, contradict previous results (Clemente *et al*., 2024), and is further examined.

Men segregated according to age group and family status

By family status, we mean an individual's household budget: "single" if he or she lives alone and "family" otherwise. In Graph 3 we show the behavior of suicide rates of Brazilian males segregated by age groups and family status.

Graph 3: Suicide rates of men by age groups and family status



Source of data: Brazilian Ministry of Health and Brazilian Institute of Geography and Statistics.

We observe that the two lower series refer to young men, whose suicide rates are situated far below the others, even though we perceive a trend upward in the series of young men who live in families.

Males aged 60 and over who live in families present the highest pattern, but it is noticeable that the series related to males aged 20 to 59 who live alone shows a strong trend upward and is likely to become the highest one soon.

Table 5 exhibits descriptive statistics for men segregated by age groups and family status. Table 5 shows that young males living in families have the lowest average suicide rate but the highest variability across the study period. Males up to 19 years old who live alone have a very low average suicide rate and a considerable variability in the studied period.

Males in the middle age group had a somewhat high suicide rate, and the observed variability is substantially greater among those living alone. The greatest average is found among men aged 60 and older who live with their families. This is striking because the idea

that their suicide rate would be lower if they had more support from their relatives does not appear to prevail.

Table 5: Descriptive statistics for men by age group and family status

	Men - Single			Men - Families		
	Up to 19	**20 to 59**	**60 and +**	**Up to 19**	**20 to 59**	**60 and +**
Minimum	0,022	0,199	0,104	0,000	0,236	0,119
Maximum	0,264	0,802	0,886	0,030	0,529	1,066
Average	0,104	0,456	0,369	0,007	0,365	0,634
Standard Deviation	0,043	0,131	0,099	0,006	0,046	0,131
Coef. of Variation	0,409	0,288	0,268	0,837	0,127	0,207

Source: Author (2024).

In Table 6, we see the results of OLSR for men classified according to age group and family status. We notice in Table 6 that the suicide rates of men aged up to 19 do not present an influence of economic conjunctural factors, no matter if they live alone or in families. Young males living in families, however, show seasonality in their suicide rates, which could originate from the influence they receive from other family members. This seasonality has already appeared in Table 4, where this age group of men is considered without distinction of family status.

Men aged 20 to 59 present a remarkable difference depending on the family status. Those living alone present a high positive trend in their suicide rates over the whole period, while those living in families, on the other hand, present a negative trend. Interestingly, men living alone and men living in families reacted very similarly to the Cruzado Plan, indicating that both segments perceived it as a relief, reflected in an almost equal reduction in their suicide rates.

We also notice that men of this age group living alone present seasonal variation for 3 months of the year while those living in families show seasonal variation for 6 months of the year, and that the seasonal variations for the coinciding months are similar. Furthermore, the breakdown adopted in Table 6 demonstrates that the seasonal pattern observed in Table 4, in which the age group is considered altogether, is misleading.

Table 6 also shows that the suicide rates of men aged 60 and older are unaffected by economic conjunctural conditions, regardless of family status. When we break down this age group by family situation, we find no evidence of the Real Plan's influence, contrary to what Table 4 indicates. This is surprising because one would expect older males who do not rely on family assistance to be more sensitive to economic issues in their suicide rates.

Table 6: The influence of economic conjuncture on the suicide rates of men by age group, and family status (coefficients significant at the 1% level)

	Men19S	Men2059S	Men60S	Men19F	Men2059F	Men60F
Const		−0,207			0,177	
Month		**9,850e-06**			**−2,455e-06**	
Jan		0,026			0,006	
Fev		−0,032			−0,028	
Abr					−0,023	
Mai				−0,004		
Jun		−0,032			−0,042	−0,092
Jul				−0,003	−0,021	
Out					0,023	
Cruzado		**−0,028**			**−0,029**	
Lag_1	0,173	0,186			0,234	0,155
Lag_2		0,200	0,214		0,148	0,156
Lag_5						0,128
Lag_8	0,158					
Lag_9					−0,121	
Adj. R^2	***0,760***	***0,906***	***0,173***	***0,332***	***0,493***	***0,295***

Notes: **M19S** – Men up to 19 years old, single; **M2059S** – Men aged between 20 and 59, single; **M60S** – Men aged 60 or more, single; **M19F** – Men up to 19 years old, family; **M2059F** – Men aged between 20 and 59, family; **M60F** – Men aged 60 or more, family. **JAN** to **DEC** – Seasonal dummies. **L_DEC** – The Lost Decade, 1980 to 1990, lack of growth and high inflation; **H_INFL -** Very high inflation, 01/1988 to 06/1994, inflation averaging 1,618% per year; **P_GROW** – Poor growth, 01/2011 to 12/2020, growth averaging 0.3% per year; **COVID** – Covid 19 Pandemic - 03/2020 to 06/2022; **CRUZADO** – Cruzado Plan, implemented on 02/1986; **COLLOR** – Collor Plan, implemented on 03/1990; **REAL** – Real Plan, implemented on 07/1994. Monthly data from 1979/01 to 2022/12 (528 observations). Standard errors HAC. Coefficients with a significance level of less than 1%.

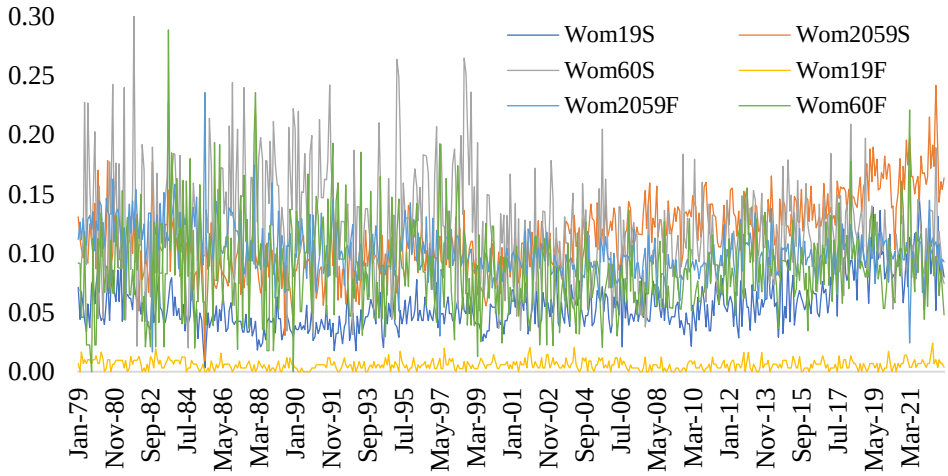
Source: Author (2024).

Women segregated according to age group and family status

Graph 4 shows the evolution of suicide rates among females segregated by age group and family status. As with men, the younger age groups have the lowest suicide rates. However, we find that young women who live alone and do not count on family support have significantly higher rates.

In a recent study, an increasing trend in the suicide rates among women aged 20 to 59 years after the turn of the century was found (Clemente *et al.*, 2024). Graph 4 demonstrates that this trend is specific to single women and is not apparent in the series of women of this age group who live in households.

Graph 4: Suicide rates of women by age groups and family status



Source: Brazilian Ministry of Health and Brazilian Institute of Geography and Statistics.

Table 7 shows descriptive statistics for women grouped by age and family status. As with males (Table 5), young females living in families have the lowest average suicide rate and the greatest variability. Also similar to what we found in respect to males, the second lowest average refers to young men who live alone, who also show high variability in the period studied.

The average suicide rates of women aged 20 to 59 years old who live alone and in families are similar, accounting for roughly a quarter of those observed among men in the same age group.

Table 7: Descriptive statistics for women by age group and family status

	Women - Single			Women - Families		
	Up to 19	**20 to 59**	**60 and +**	**Up to 19**	**20 to 59**	**60 and +**
Minimum	0,003	0,009	0,020	0,000	0,017	0,000
Maximum	0,148	0,242	0,302	0,024	0,236	0,289
Average	0,056	0,113	0,122	0,006	0,101	0,087
Standard Deviation	0,022	0,031	0,045	0,004	0,021	0,037
Coef. of Variation	0,382	0,271	0,366	0,732	0,207	0,426

Source: Author (2024).

In the women's older age group, we observe something different compared to what happens in elderly men. Women aged 60 and up who live alone have a higher average suicide rate, suggesting the efficacy of family support.

Table 8 contains the results of OLSR for women segregated according to age group and family status. Examining the segment of women aged up to 19 in Table 8, we observe that those who live alone do not show the influence of economic conjunctural factors on suicide rates. However, the young women who live in families present a reduction in suicide rates when the Collor Plan was implemented. If we look back to Table 4, we see that the influence of the Collor Plan does not appear when young women are not segregated according to family status.

When we break down the segment of women aged 20 to 59 according to family status, a trend not apparent in Table 4 comes out in the group of women who live alone. As the corresponding group of men, this group presents an increasing trend in the suicide rates all over the analyzed period. However, we note that the trend among women is much smaller, less than one fifth of that for men. It is also worth noting that there is no trend in suicide rates among those aged 20 to 59 who live in families.

While women aged 20 to 59 who live alone do not show the influence of economic conjunctural factors, those who live in families appear to have their suicide rates strongly influenced. The lost decade, L_DEC, the long period of stagflation in the 1980's decade, had a positive effect, and the same occurred in relation to the poor growth period, P_GROW, another decade starting in 2011.

However, the period of high inflation prior to the Real Plan, 1986–94, indicates an effect opposite to the expected one, as it appears to diminish the suicide rates of women aged 20–59 who live in families. In fact, that period of high inflation presented a relatively low unemployment rate and a stable cost of living, which together may have depressed the suicide rates (Clemente, A. *et al*, 2024). It is also noticeable that the suicide rates of women of this segment presented a reduction in face of the Real Plan.

The suicide rates of women aged 60 and up when considered altogether show the Real Plan as the only economic conjunctural factor relevant, as in Table 4. However, when we segregate them into living alone and in families, some important features appear. Initially, we note that the two segments present a similar reaction to the Real Plan and that the suicide rates of older women living alone diminished more significantly. We also note that older women living alone as well as those living in families tended to reduce their suicide rates since March 1999, and that such a trend is stronger among women living alone (variable WOM_DUM).

We note two other results. First, older women living alone presented a reduction in their suicide rates with the advent of the Covid Pandemic. Second, the suicide rates of older women living in families increased during the period of poor growth.

Table 8: The influence of economic conjunctural factors on the suicide rates of women by age group, and family status (coefficients significant at the 1% level)

	Women19S	Women2059S	Women60S	Women19F	Women2059F	Women60F
Const					0,124	0,096
Month		2,573e-06	4,067e-06			
Fev	−0,007					
Jul					−0,012	
Set		−0,009				
Dez	−0,007					
L_Dec					**0,011**	
H_Infl					**−0,009**	
P_Grow					**0,010**	**0,016**
Covid			−0,**021**			
Collor				**−0,003**		
Real			**−0,046**		−0,**010**	−0,**022**
Lag_1		0,147		0,101		
Lag_2	0,175	0,148				
Lag_3	0,134					
Lag_11				0,132		
Wom_Dum			**−0,053**			−0,**022**
Adj. R^2	**0,54 5**	**0,620**	**0,131**	**0,051**	**0,253**	**0,043**

Notes: **W19S** – Women up to 19 years old, single; **W2059S** – Women aged between 20 and 59, single; **W60S** – Women aged 60 or more, single; **W19F** – Women up to 19 years old, family; **W2059F** – Women aged between 20 and 59, family; **W60F** – Women aged 60 or more, family. **JAN** to **DEC** – Seasonal dummies. **L_DEC** – The Lost Decade, 1980 to 1990, lack of growth and high inflation; **H_INFL -** Very high inflation, 01/1988 to 06/1994, inflation averaging 1,618% per year; **P_GROW** – Poor growth, 01/2011 to 12/2020, growth averaging 0.3% per year; **COVID** – Covid 19 Pandemic - 03/2020 to 06/2022; **CRUZADO** – Cruzado Plan, implemented on 02/1986; **COLLOR** – Collor Plan, implemented on 03/1990; **REAL** – Real Plan, implemented on 07/1994; **WOM_DUM –** Dummy variable relative to women. Monthly data from 1979/01 to 2022/12 (528 observations). Standard errors HAC. Coefficients with a significance level of less than 1%.

Source: Author (2024).

5. Discussion

The conjunctural changes in the Brazilian economy over the previous four decades appear to have had a significant impact on its population. The econometric model results show that men and women of different ages and family status perceive economic conjunctural issues differently, which influences their suicide rates.

In general, we demonstrate that family status matters. A simple comparison between Tables 4, 6, and 8 shows that the results obtained with no distinction between people living alone and people living in families may hide important characteristics and may be misleading.

Our findings show that suicide rates among young individuals, regardless of gender or family status, are only modestly influenced by economic considerations. Only one result supported our hypothesis on the influence of economic conjuncture: women up to 19 years old living in households had lower suicide rates after implementing the Collor Plan. This is significant since we discovered no other evidence that the Collor Plan could have lowered suicide rates in other demographics.

To summarize, we can say that economic conjunctural factors do not have significant influence on young people's suicide rates. This result was to be expected given that people under the age of 19 are largely unemployed and rely heavily on their parents.

Indeed, the age group of 20 to 59 years old is the most engaged in the labor market and bears the most financial responsibility for their own and their families' support. Our findings support this, as the suicide rates in these groups appear to be more responsive to the economic conjuncture, except for women who live alone. This finding could be attributed to the social role and psychological characteristics of those women, who generally earn a higher income and soon require some form of economic reserve.

According to a previous study (Clemente *et al*., 2024), since the end of the last century, women have significantly entered the labor market and have begun to be responsible for the domestic budget in many cases. This shift in women's social role is likely to explain the appearance of a rising trend in suicide rates since the turn of the century, as well as the impact of the economic conditions on those rates.

It is well acknowledged that men's suicide rates are at least three times greater than women's rates globally (WHO, 2019). In general, men's socialization promotes strength and the avoidance of discussing their feelings and emotions. Therefore, it is understandable that males suffering from depression, anxiety, stress, or hopelessness find it difficult to address their problems, particularly when such a suffering stems from economic hardship.

The Cruzado Plan has a nearly identical negative impact on the suicide rate patterns of men aged 20 to 59 who live alone and those who live in families, although the trends in the series differ significantly. While men living in families exhibit a negative trend, those living alone show a strong upward trend. This could be due to two factors: (1) males living alone would have fewer opportunities to express their sentiments and suffering, and (2) men living in families would feel a sense of duty to other family members.

Although the suicide rate of women aged 20 to 59 living alone is unaffected by economic conditions, the suicide rate of those living in families is influenced by four of the seven economic variables. The Lost Decade (the 1980s) and the Poor Growth Period (2011-2018), both of which had nearly zero growth on average, had very similar effects on increasing suicide rates. This outcome is most likely due to the increased difficulty in finding and retaining a job during protracted periods of recession, whether for herself or her partner. On the other hand, the High Inflation Period preceding the Real Plan, as well as the Real Plan itself, appears to be reliefs, pushing the suicide rate trend lower. There is no conflict in the fact that suicide rates fall during the High Inflation Period because the

cost of living and job possibilities remained satisfactory despite high inflation (Clemente *et al.*, 2024).

When subdivided by family situation, the Real Plan's impact on suicide rates among males aged 60 and up is unclear. There is evidence that changes in the economic condition have no major impact on suicide rates in this age range. This result is surprising given the proportion of retired males in this age bracket, many of whom rely on social security benefits for a living. Consider Table 9, which shows the life expectancy of Brazilian men and women over the last 40 years.

Table 9: Life Expectancy of Brazilian Men and Women

Year	Men	Women
1980	59.6	65.7
1991	63.2	70.9
2000	66.0	73.9
2010	70.2	77.6
2022	72.0	79.0

Source: The Brazilian Institute of Geography and Statistics.

Table 9 shows that life expectancy of Brazilian men and women grew during the study period, and that around 40 years ago, men lived on average for less than 60 years.

It is well known that the longevity distribution has a long tail on the right, which drags the mean upward. Furthermore, males who manage to reach the upper age stratum are mostly those with better economic conditions and, as a result, are prepared to enjoy a peaceful old age. This suggests that mainly at the beginning of the research period and throughout it, male survivors aged 60 and up were members of an economic elite who had planned for a peaceful old age. Therefore, the indication that the suicide rates among Brazilian males aged 60 and up are not considerably affected by economic conjuncture may well stem from the fact that they have always enjoyed solid economic stability.

As for women aged 60 or over, we identify a downward trend in the suicide rates, both for those living alone and in families, since the end of the last century. According to Table 9, the average life expectancy for women was approximately 74 years in 2000. The indication that a strong downward trend occurred since the turn of the century among women living alone could be attributed to their significant and increasing participation in the labor market.

In the last 40 years, the average age of couples has climbed from 27 to 33 years for males and 24 to 30 years for women, maintaining a three-year age difference. (BRAZIL, 2019, p. 4). This fact, together with the discrepancy in life expectancies, indicates that a substantial proportion of married women have become widows in their old age. As a result, women aged 60 and up who live alone include those who have never married, those who have married and separated, and a large proportion of widows. Women aged 60 and up who live in families include non-widows, widows who live with relatives, and those who never married and have always lived with relatives.

In Table 8, we noticed an intriguing decline in the suicide rates among women aged 60 and up during the Covid Pandemic. One could expect the opposite result because, during the Pandemic, most people stayed at home to avoid crowds. Nonetheless, relatives and neighbors during that time paid considerably closer care to one another, particularly to the elderly, who were considered the most vulnerable group. This could be a key element in explaining the decline in suicide rates among women aged 60 and up.

Another noteworthy finding for women aged 60 and older is an increase in the suicide rates among those living in families throughout the period of low GDP growth that began in 2011 and lasted a decade. This increase is even bigger than that observed among women aged 20 to 59 who live in households.

What could have happened? It is true that some women in this age group continue to work and may be impacted by a lack of job opportunities. In addition, pensions are rarely sufficient for these women to maintain their previous quality of life, either because the amounts are insufficient or because considerable health care costs occur. Women in this age range who live in families do not earn enough to meet their expenses and are thus financially dependent on the head of the household, at least in part. As a result, they were heavily influenced by the economic crisis, even though indirectly.

Conclusion

Our analysis of the preceding four decades shows that Brazil's suicide rate has been rising, and that Brazil has seen significant shifts in both the quantity and nature of suicide. The significant increase in suicide rates among men, as well as the emergence of a significant positive trend among women in the last two decades, stand out.

Our findings put doubt on the quality of growth in the Brazilian economy over the past four decades, as rising suicide rates would reflect a deterioration in the population's quality of life. Furthermore, our study shows that meeting the announced suicide rate reduction targets is nearly impossible, requiring increased attention from public authorities.

Based on the last four decades, we can say that the deterioration of economic conditions and the uncertainty produced by economic plans affected the Brazilian people in different ways depending on gender, age, and family status, resulting in higher suicide rates.

Among our findings we highlight one that appears to have generally received little attention: suicide rates can be increased by factors other than worsening living conditions. A significant negative expectation or a high level of uncertainty in the face of a major change in economic order can have a similar effect on suicide rates.

It is understandable that suicide among young people attracts greater attention from researchers and authorities, but it is worth remembering that suicide in the age range of 20 to 59 has serious economic significance and that when it occurs among the elderly it can leave deep scars on the family and friends. As a result, we believe that other population segments should get the same level of attention that experts give to suicide among teenagers and young people.

Our findings from the analysis of the effects of the economic conjuncture on suicide rates in Brazil over the last four decades lead us to conclude that the development and implementation of public policies to effectively combat suicide are dependent on the definitive inclusion of the issue among the themes of economic analysis. As a rapidly growing psychological and social phenomenon which is responsive to economic conditions, it stands to reason that economic analysis should help effective public policies.

A modest recommendation for further research is to look at the distribution of suicides by income bracket. In this context, we note that the SIM database includes information on the occupations of suicide victims, which might be used as a proxy for income level.

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