Pontifícia Universidade Católica
do Rio de Janeiro

Pedro Henrique Santos Carvalho

Essays on Labor Market Informality

Tese de Doutorado

Thesis presented to the Programa de Pós–graduação em Economia of PUC-Rio in partial fulfillment of the requirements for the degree of Doutor em Economia.

Advisor: Prof. Yvan Becard

Rio de Janeiro
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Abstract

Carvalho, Pedro Henrique Santos; Becard, Yvan (Advisor). **Essays on Labor Market Informality**. Rio de Janeiro, 2025. 97p. Tese de doutorado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

This dissertation investigates labor market informality through three chapters. In the first chapter, I examine how income and income inequality relate to informality across local labor markets in Brazil. I also evaluate how the increase in household income resulting from the implementation of Auxílio Emergencial, a large-scale cash transfer program introduced during the COVID-19 pandemic, affected formal employment. I find that lower income levels and higher income inequality are associated with higher levels of informality. Moreover, states that received larger cash transfers experienced greater formal job creation. In the second chapter, I develop a theoretical model to explore the mechanisms through which rising income reduces informality. I argue that the declining share of agriculture in national output drives formalization, since agriculture tends to operate more informally than industry and services. I also show that as income rises, individuals increase their consumption of goods and services supplied through formal channels, reinforcing the expansion of formal sectors. In the final chapter, I assess the effects of legislative reforms that reduced the statutory limit on weekly working hours. I apply a synthetic control approach to analyze the case of Colombia, where a reform approved in 2021 lowered the maximum number of working hours per week. My results indicate that even the anticipation of shorter working hours was sufficient to shift labor market behavior and reduce informality in the short term.

Keywords

Labor Market Informality Inequality Employment Working Hours Regulation

Resumo

Carvalho, Pedro Henrique Santos; Becard, Yvan. **Ensaios sobre informalidade no mercado de trabalho**. Rio de Janeiro, 2025. 97p. Tese de Doutorado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

Esta tese investiga a informalidade no mercado de trabalho por meio de três capítulos. No primeiro capítulo, examino como a renda e a desigualdade de renda se relacionam com a informalidade em mercados de trabalho locais no Brasil. Também avalio como o aumento da renda das famílias decorrente da implementação do Auxílio Emergencial, um programa de transferência de renda em larga escala introduzido durante a pandemia de COVID-19, afetou o emprego formal. Os resultados indicam que níveis mais baixos de renda e maior desigualdade estão associados a maiores níveis de informalidade. Além disso, estados que receberam transferências mais elevadas apresentaram maior criação de empregos formais. No segundo capítulo, desenvolvo um modelo teórico para explorar os mecanismos por meio dos quais o aumento da renda reduz a informalidade. Argumento que a redução da participação da agricultura no produto nacional impulsiona a formalização, uma vez que a agricultura tende a operar de forma mais informal do que a indústria e os serviços. Também mostro que, à medida que a renda aumenta, os indivíduos ampliam o consumo de bens e serviços ofertados por canais formais, reforçando a expansão dos setores formais. No capítulo final, avalio os efeitos de reformas legislativas que reduziram o limite legal da jornada semanal de trabalho. Aplico o método de controle sintético para analisar o caso da Colômbia, onde uma reforma aprovada em 2021 reduziu o número máximo de horas trabalhadas por semana. Os resultados indicam que até mesmo a antecipação da redução da jornada foi suficiente para alterar o comportamento no mercado de trabalho e reduzir a informalidade no curto prazo.

Palavras-chave

Mercado de Trabalho Informalidade Desigualdade Emprego Regulação da Jornada de Trabalho

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The only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others. His own good, either physical or moral, is not a sufficient warrant.

John Stuart Mill, *On Liberty.*

List of Abbreviations

2SLS	Two-Stage Least Squares
CNAE	Classificação Nacional de Atividades Econômicas (National Classification of Economic Activities)
CLT	Consolidação das Leis do Trabalho (Consolidation of Labor Laws)
CST	Código Sustantivo del Trabajo (Colombian Labor Code)
GDP	Gross Domestic Product
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
ILO	International Labour Organization
IPEA	Instituto de Pesquisa Econômica Aplicada (Institute of Applied Economic Research)
IV	Instrumental Variable
HDI	Human Development Index
OLS	Ordinary Least Squares
PME	Pesquisa Mensal de Emprego (Monthly Employment Survey)
PNAD	Pesquisa Nacional por Amostra de Domicílios (Household Sample Survey)
PNADc	Pesquisa Nacional por Amostra de Domicílios Contínua (Continuous National Household Sample Survey)
POF	Pesquisa de Orçamento Familiar (Brazilian Household Budget Survey)
PPP	Purchasing Power Parity
PWT	Penn World Table
RMSPE	Root Mean Squared Prediction Error
TFP	Total Factor Productivity
UN	United Nations

1
The relationship between income, inequality and labor market informality in Brazil

Abstract: In this chapter, I investigate the relationship between income, income inequality, and labor market informality across local labor markets in Brazil. Using data from Brazilian Census, I document four key findings. First, regions with higher per capita income exhibit lower levels of informality. Second, areas with lower income inequality also present lower informality rates. Third, faster-growing regions experience more rapid declines in informality. Fourth, regions with the greatest reductions in inequality show the largest decreases in informality. In the second part of the analysis, I provide causal evidence on the link between income and informality by exploiting cross-state heterogeneity in exposure to Auxílio Emergencial, a large cash transfer program implemented during the COVID-19 pandemic. My findings suggest that states receiving larger transfers experience greater formal job creation.

Keywords: Income; inequality; labor informality; regional disparities; Emergency Aid

1.1 Introduction

Labor market informality is a persistent challenge in developing economies.[1.1] For workers, informality leads to job instability, lack of social protection, and limited opportunities for upward mobility, thereby increasing economic insecurity. For firms, informality limits access to credit, is often associated with lower productivity, and constrains growth potential.

Despite these drawbacks, many workers and firms remain in the informal sector due to the high costs associated with formalization. Operating formally entails entry costs, such as fees and regulatory requirements, as well as compliance costs, including taxes and bureaucratic obligations.[1.2] While informality allows firms to avoid these expenses, it also exposes them to penalties and limits their legal protections. Formal workers face higher taxes but benefit from greater security, while informal workers incur lower costs but are exposed to greater risk (Ulyssea, 2010).

Labor markets in developing economies also differ in their dynamics. Workers experience frequent transitions across employment states, reflecting low match quality and limited job stability. Higher turnover makes employment relationships more temporary and contributes to the prevalence of informal arrangements. The presence of a large informal sector is a defining feature of many developing economies (Ulyssea, 2020; Donovan et al., 2023).

The correlation between income and labor market informality is well established at the international level. Higher-income countries tend to have a smaller share of workers in informal employment. Figure 1.1 illustrates this relationship across countries. The relationship between informality and income inequality is less explored in the literature. Nevertheless, a clear correlation is observed. Figure 1.2 illustrates this association.

Although well documented at the international level, the relationship between income, inequality, and informality remains less explored within countries. By focusing on a single country, we can control for factors that may influence informality, such as culture, legal institutions and geography. This approach enables a better understanding of how income and inequality are associated with informal labor dynamics.

In this chapter, I explore the relationship between income, inequality,

[1.1] Schneider et al. (2011) estimate that between 1990 and 2007, the informal economy accounted for approximately 31% of global GDP. United Nations (2023) report that 58% of the global workforce is engaged in informal employment.

[1.2] Many firms, although formal, choose to hire informal workers, which is referred to as the intensive margin of informality. Informal workers are present in firms of all sizes, and their characteristics are very similar to those of formal employees (Brotherhood et al., 2024).

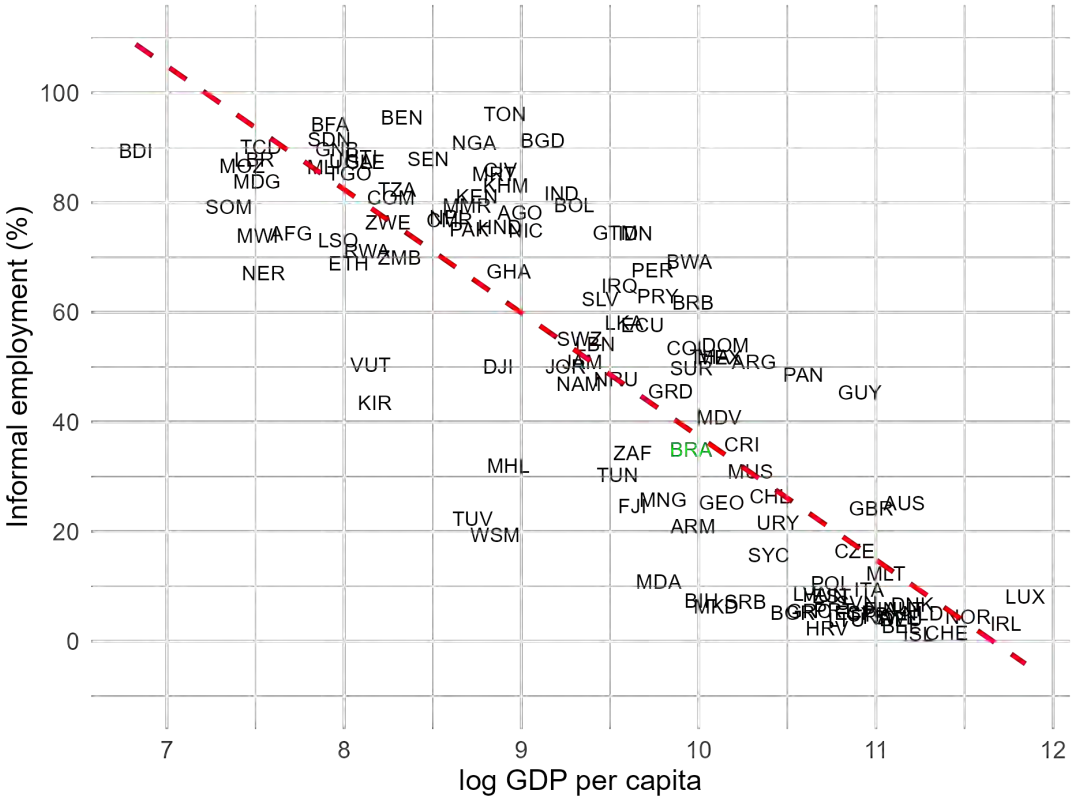

Figure 1.1: Relation between GDP per capita and labor market informality across countries

Note: The figure shows the relationship between non-agricultural informal employment and GDP per capita across countries. Informal employment is measured using the United Nations SDG database and includes workers in unregistered or small scale private unincorporated enterprises. GDP per capita (current US$) comes from the World Bank. All observations refer to 2023 or the closest available year.

and informality in Brazil, a large developing country where about 40% of the workforce is employed informally.[1.3] I use data from the Brazilian Census to compute the share of the informal labor force in Brazilian microregions.[1.4] I establish four main findings. First, regions with higher levels of income per capita exhibit lower informality. A one-percent increase in income per capita is associated with a reduction of approximately 0.18 percentage points in informal employment. Second, regions with lower income inequality also exhibit lower levels of informality. A one-point increase in the Gini index within a microregion is associated with a 0.9 percentage point rise in informality. Third, regions that grow faster tend to experience more rapid reductions in informality. A one-percent increase in income is associated with a decline

[1.3] According to the most recent National Household Sample Survey (PNAD).

[1.4] Brazilian microregions are statistical geographical units defined by the Brazilian Institute of Geography and Statistics (IBGE), composed of groups of neighboring municipalities with similar socioeconomic characteristics. There are 558 microregions in Brazil.

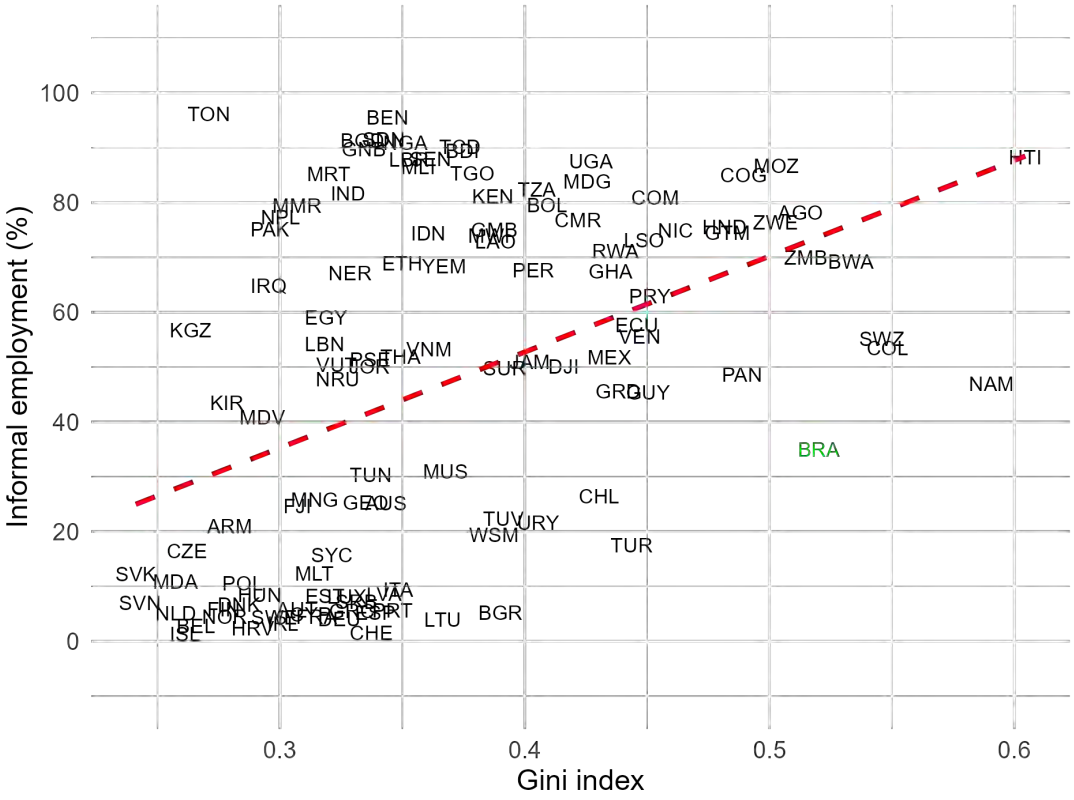

Figure 1.2: Gini index and labor market informality across countries

Note: The figure shows the relationship between the Gini index and non-agricultural informal employment across countries. Informal employment is measured using the United Nations SDG database and includes workers in unregistered or small scale private unincorporated enterprises. The Gini index is obtained from the World Bank. All observations refer to 2023 or the closest available year.

in informality of approximately 0.13 percentage points at the microregion level. Fourth, regions with the largest reductions in inequality also display the greatest declines in informality. A one-point increase in the Gini index over time is associated with a 0.58 percentage point rise in informality at the microregion level. These findings suggest that the pattern observed at the international level also holds within countries. Therefore, I run a regression including several control variables, such as demographic, migration, and sectoral factors, and conclude that, although the magnitude is reduced, income and income inequality remain strongly associated with the level of informality.

In the second part of the chapter, I move beyond correlations and identify an income shock to study its causal effect on informality. I use data from the National Household Sample Survey (PNAD) to measure informality in each Brazilian state and employ a Bartik-type instrumental variable strategy to estimate the impact of Auxílio Emergencial (Emergency Aid), a large cash transfer program, on formal employment. Although the program was centrally designed and applied uniformly to eligible individuals nationwide, its effective

intensity varied across states depending on the size of their eligible populations. I exploit this heterogeneity by interacting a nationwide income shock with pre-pandemic cross-state differences in the share of individuals registered in the national social registry (Cadastro Único), which proxies for state-level exposure to the program. This approach allows me to separate the common national component of the shock from its state-specific intensity, and to estimate the effect of income on formal employment.

I find that states receiving a larger share of their GDP in transfers experience significantly better outcomes in terms of labor formalization. While informality increases overall, these states show either smaller increases in informal employment or, in some cases, actual growth in formal jobs. My findings suggest a strong relationship between income, inequality, and the level of informality. One mechanism through which income and formal employment are connected is the composition of household consumption. As income rises, consumers increasingly demand goods and services provided through the formal sector. This increase in demand leads to higher demand for formal employment. In Chapter 2, I present a model that explores this mechanism.

This paper contributes to two strands of the literature. The first explores the relationship between per capita income, income inequality, and the share of economic activity classified as informal. Several studies document a negative relationship between income and informality across countries (La Porta and Shleifer, 2014; Dell'Anno, 2016), while others examine the role of income inequality in shaping informality (Chong and Gradstein, 2007; Rosser Jr et al., 2000; Dell'Anno, 2021; David et al., 2023). Within-country analyses are comparatively fewer. One example is Winkelried (2005), who studies Mexican cities and finds that greater income inequality is associated with an expansion of the informal sector, and that redistribution policies targeting the middle class can reduce informality. I show that the well-established link between income and informality not only holds within countries, but is even stronger than what cross-country evidence suggests.

The second strand of the literature to which this paper contributes examines the benefits of cash transfer programs (Benhassine et al., 2015; Marinescu, 2018; Attanasio et al., 2021; Egger et al., 2022). Regarding the labor market, Gerard et al. (2025) analyze the impact of Bolsa Família, Brazil's largest cash transfer program, and find that such transfers are associated with improved economic outcomes, including an increase in formal employment. Mendes et al. (2024) also examine Bolsa Família using a Bartik-style identification strategy to assess its macroeconomic effects and report comparable results. I contribute by studying a different cash transfer program, Auxílio Emergencial, a tempo-

rary program that represents an exceptionally large fiscal intervention in Brazil, reaching a substantial share of the population in a short period.[1.5]

The rest of the chapter is organized as follows. Section 1.2 presents the data sources and the main variables used in the analysis. Section 1.3 establishes the stylized facts linking income and inequality to informality levels. Section 1.4 examines the relationship between changes in income and informality, using Auxílio Emergencial program as an empirical setting. The results of the empirical analysis are presented in Section 1.5. Section 1.6 concludes.

1.2 Data

To investigate the effects of income and income inequality on labor market informality in Brazil, I use data from the 1991, 2000, and 2010 Censuses. Earlier censuses do not provide sufficient information to define a consistent criterion for measuring informality levels.[1.6] Moreover, the most recent Census, conducted in 2022, has not yet made its full dataset publicly available.

Labor market informality is typically defined as the market-based production of goods and services that remains hidden from public authorities due to monetary, regulatory, or institutional factors. The International Labour Organization (ILO) defines the informal economy as encompassing "all economic activities by workers and economic units that are, in law or in practice, not covered or insufficiently covered by formal arrangements" (ILO, 2015). In recent years, ILO has systematically applied standardized criteria to produce comparable estimates of informal employment, as more countries have incorporated questions into their national surveys to assess informal work (Chacaltana et al., 2022). Therefore, I define an informal worker as someone employed without a formal labor contract, or a self-employed individual who does not contribute to social security.[1.7]

[1.5] The program aimed to support low-income and vulnerable populations who were severely affected by the economic downturn, particularly informal workers. The program represents one of the most effective international responses to the COVID-19 (De Arruda et al., 2021; Nazareno and Castro Galvao, 2023).

[1.6] For data predating 1991, the PNAD survey, initiated in 1967, can be consulted. However, as a sample-based survey, PNAD is less comprehensive than census data, making the latter more appropriate for analyses requiring detailed and representative information. PNAD is a nationally representative household survey conducted by IBGE to provide detailed information on various socioeconomic indicators, including employment, income, and education.

[1.7] In 2009, Brazil implemented a major program aimed at helping small business owners formalize their enterprises, gain access to benefits, and simplify tax processes. Monteiro and Assunção (2012) identify significant impacts in sectors eligible for the program compared to non-eligible sectors.

I conduct an analysis of the relationship between income, inequality, and informality at the Brazilian microregional level.[1.8] Furthermore, I consider the five major geographic regions: Central-West (CW), Southeast (SE), South (SO), North (NO), and Northeast (NE). This regional division is used throughout the chapter to highlight spatial disparities across Brazil. The South and Southeast regions exhibit higher levels of per capita income and greater industrialization, while the North and Northeast present lower income levels.

Table 1.1 provides descriptive statistics of the main variables, divided across Brazil's regions.

Table 1.1: Descriptive statistics

		SE	SO	NE	CW	NO	Brazil
	States	4	3	9	4	7	27
	Mesoregions	37	23	42	15	52	137
	Microregions	160	94	188	52	64	558
	GDP	53,3%	16,2%	13,0%	10,6%	6,9%	100%
	Population	41,8%	14,3%	26,9%	8,0%	8,6%	100%
Informality	Mean	0.438	0.455	0.642	0.488	0.624	0.536
	Median	0.424	0.452	0.666	0.505	0.628	0.530
	SD	0.102	0.086	0.102	0.078	0.120	0.137
	Min	0.278	0.255	0.345	0.317	0.327	0.255
	Max	0.709	0.643	0.801	0.633	0.863	0.863
Income	Mean	804	812	363	742	431	638
	Median	463	510	199	408	218	346
	SD	2,602	2,016	1,262	2,345	1,680	2,091
	Max (k)	975	668.8	700	620	603.2	975

Note: Informality is aggregated at the microregion level. Income is expressed in Brazilian reais at constant 2010 prices. Source: IBGE (2010) Census.

1.3 Four facts about income, inequality and informality

In this section, I establish four facts about the relationship between income, inequality, and informality. I begin by examining the correlations among these variables, both in the cross-section and over time. I then introduce a set of control variables and estimate regression models to provide a more comprehensive assessment of these relationships.

[1.8] Brazil is divided into 27 states, which are grouped into five major regions. These states are further subdivided into 137 mesoregions and 558 microregions, which are groupings of municipalities (5,570) defined by the Brazilian Institute of Geography and Statistics (IBGE) for statistical purposes.

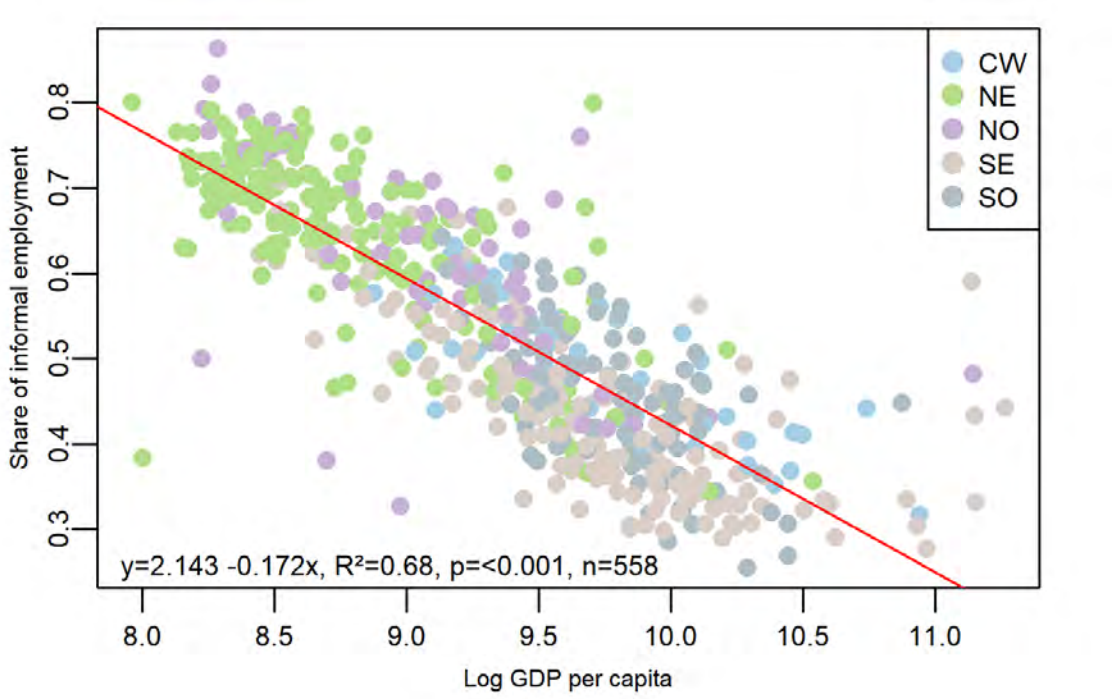

Figure 1.3: Income and informality

Note: Each observation corresponds to a Brazilian microregion. The figure relates the share of informal employment to log GDP per capita. Colors identify macroregions of the country, and the solid line represents the fitted OLS regression. Source: IBGE (2010) Census.

1.3.1
Regions with higher income exhibit lower informality

Figure 1.3 illustrates the relationship between GDP per capita and the level of informality across microregions, according to the most recent population census data available.

The findings suggest that regions with higher GDP per capita tend to have lower levels of labor market informality. The results are statistically significant at the 1% level across all specifications. A one-percent increase in GDP per capita is associated with a 0.172 percentage point reduction in informality.

1.3.2
Regions with lower inequality show less informality

Figure 1.4 illustrates the relationship between inequality and informality across Brazilian microregions.

Using the Gini index as a measure of income inequality, the results confirm that informality is correlated not only with income levels but also with the distribution of income. Regions with lower income inequality tend to have lower rates of informality, and this relationship is statistically significant

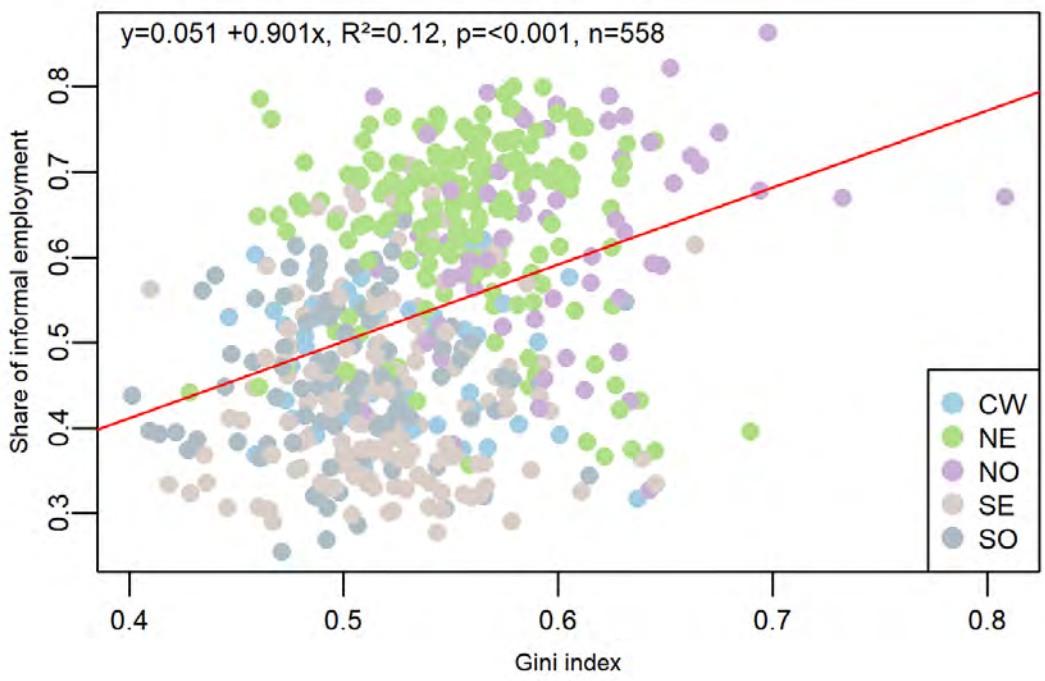

Figure 1.4: Inequality and informality

Note: Each observation corresponds to a Brazilian microregion. The figure relates the share of informal employment to inequality, measured by the Gini index. Colors identify macroregions of the country, and the solid line represents the fitted OLS regression. Source: IBGE (2010) Census.

at the 1% level across all specifications. The results indicate that a one-point decrease in the Gini index is associated with a 0.9 percentage point reduction in informality.

1.3.3 Regions that grow faster reduce informality more rapidly

In addition to examining cross-section data, it is essential to analyze the dynamic evolution of these variables. To do so, I use the most recent and the earliest available census data to document the correlation between income growth and the decline in informality levels. Figure 1.5 illustrates this dynamic across Brazilian microregions.

The results show a pattern similar to that observed in the cross-sectional analyses. Regions that experience income growth over time tend to have lower levels of informality. The coefficient is statistically significant at the 1% level, indicating that a one-percent increase in income over the period is associated with an approximately 0.13 percentage point reduction in informality.

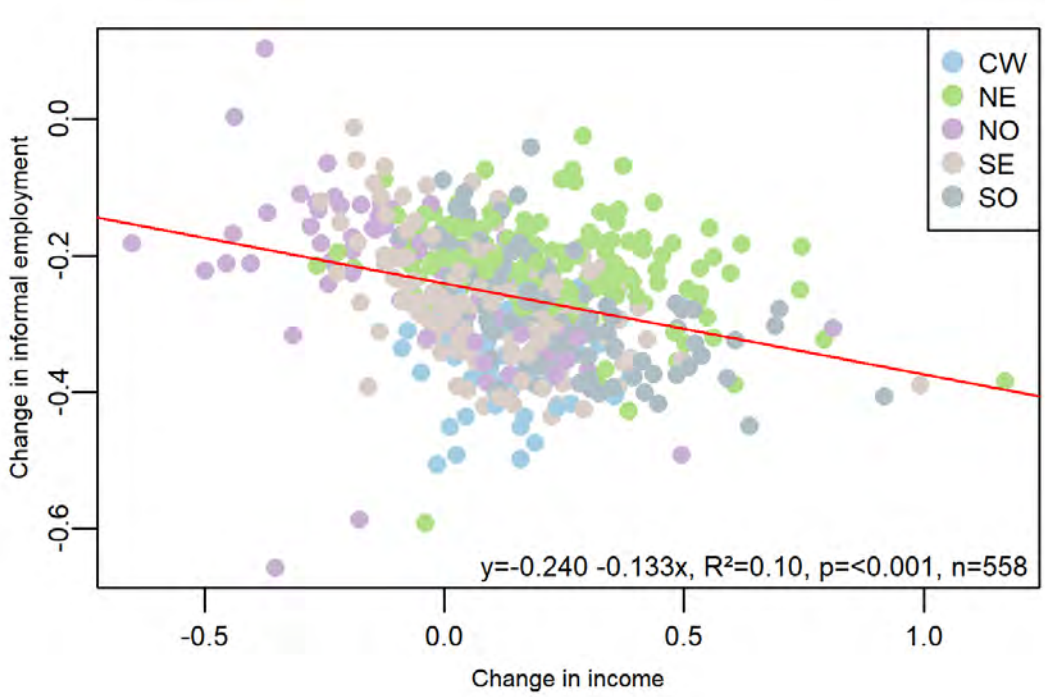

Figure 1.5: Change in income and change in informality

Note: Each observation corresponds to a Brazilian microregion. The figure relates the change in the share of informal employment between 1991 and 2010 to the change in income over the same period. Colors identify macroregions of the country, and the solid line represents the fitted OLS regression. Source: IBGE Census (1991 and 2010).

1.3.4 Regions with larger inequality declines experience greater formalization

Figure 1.6 illustrates the changes in inequality and informality levels between the 1991 and 2010 Censuses.[1.9]

Results are statistically significant across specifications, indicating that regions with declining inequality tend to have higher levels of formal employment. In microregions, a one-percent decrease in the Gini index is associated with a 0.58 percentage point reduction in informality.

1.3.5 Regression Analysis

The previous sections document the bivariate relationships between income and informality and between inequality and informality. While these patterns are informative, they may reflect the influence of demographic or structural characteristics that differ across regions. To assess whether these associations persist once such factors are taken into account, I estimate a series

[1.9]During the 1990s, most microregions in Brazil experienced an increase in inequality. However, the 2000s represent a period of significant prosperity, with rising income levels and declining income inequality across the country.

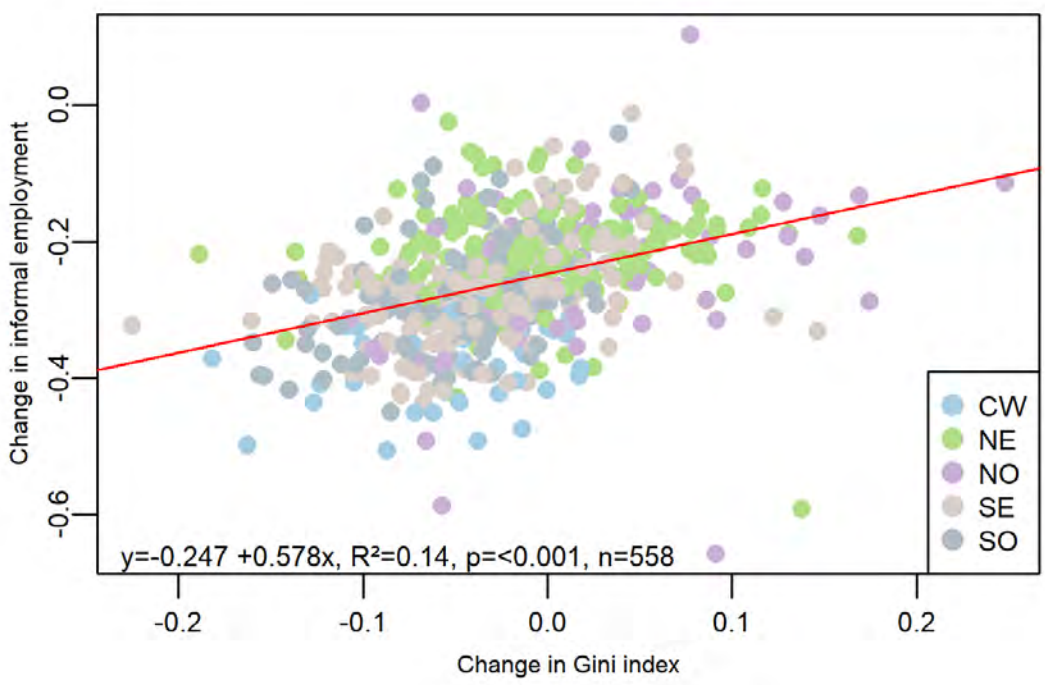

Figure 1.6: Change in inequality and change in informality

Note: Each observation corresponds to a Brazilian microregion. The figure relates the change in the share of informal employment between 1991 and 2010 to the change in inequality, measured by the Gini index, over the same period. Colors identify macroregions of the country, and the solid line represents the fitted OLS regression. Source: IBGE Census (1991 and 2010).

of regressions using the changes in the variables between the 1991 and 2010 Censuses and including additional sets of controls. The results are reported in Table 1.2.

Regressions (1) and (2) present the baseline specifications including only income and only inequality, corresponding to the relationships illustrated in Figures 1.5 and 1.6.

Regression (3) includes both income and inequality simultaneously. The coefficients remain statistically significant and maintain their expected signs. Higher income growth continues to be associated with lower informality, while increases in inequality are associated with higher informality. Although both relationships remain strong, the magnitude of the coefficients declines slightly when the two variables are included jointly, suggesting that part of their explanatory power reflects their correlation with one another.

Regressions (4) to (6) introduce additional controls to account for demographic and structural differences across regions. Regression (4) includes demographic variables such as population growth, the share of individuals with higher education, measured as the proportion of individuals with at least

completed secondary education, and the share of young individuals in the population, defined as those aged below 24 years. Regression (5) adds migration and urbanization controls, including the urban population share and the share of non-native residents, defined as individuals who were not born in the municipality where they resided at the time of the Census. These variables are included to account for the potential influence of internal migration and urbanization dynamics on local labor market outcomes. Finally, Regression (6) incorporates sectoral structure through the share of employment in agriculture.

Across all specifications, the coefficients on income and inequality remain statistically significant. The negative association between income growth and informality persists even after controlling for demographic composition, migration patterns, urbanization, and sectoral employment structure. Similarly, the positive relationship between inequality and informality remains robust across specifications. However, once the additional controls are included, the magnitude of the income coefficient decreases. In the specification with the full set of controls, a one-percent increase in income is associated with a reduction in informality of approximately 0.08 percentage points. For inequality, the estimated coefficient indicates that a one-percent decrease in the Gini index is associated with a reduction in informality of approximately 0.46 percentage points.

Among the control variables, the share of young individuals is positively associated with informality. This result is consistent with the idea that younger workers, who typically have less labor market experience, are more likely to enter the labor market through informal employment. In addition, the sectoral control, measured by the share of employment in agriculture, is also statistically significant in the most complete specification, indicating that regions experiencing increases in agricultural employment tend to display higher levels of informality.

These results suggest that the relationships documented in the descriptive analysis are not driven solely by observable regional characteristics. Instead, income growth and inequality appear to be systematically related to the evolution of informality across Brazilian microregions.

Table 1.2: Income, Inequality and Informality

	Informality					
	(1)	(2)	(3)	(4)	(5)	(6)
Income	-0.133***		-0.102***	-0.101***	-0.098***	-0.079***
	(0.017)		(0.017)	(0.018)	(0.018)	(0.018)
Inequality		0.578***	0.492***	0.451***	0.441***	0.458***
		(0.061)	(0.061)	(0.067)	(0.066)	(0.065)
Population				-0.060***	-0.059***	-0.045***
				(0.010)	(0.010)	(0.011)
High education share				-0.002*	-0.002*	-0.003***
				(0.001)	(0.001)	(0.001)
Young population share				0.416***	0.393***	0.303***
				(0.113)	(0.113)	(0.113)
Urban share					-0.047***	-0.023
					(0.013)	(0.014)
Share of non-natives					-0.014	-0.012
					(0.009)	(0.009)
Agricultural emp. share						0.116***
						(0.025)
Constant	-0.241***	-0.247***	-0.234***	-0.111***	-0.108***	-0.096***
	(0.004)	(0.004)	(0.004)	(0.029)	(0.029)	(0.029)
Demographic controls	No	No	No	Yes	Yes	Yes
Migration / urban controls	No	No	No	No	Yes	Yes
Sectoral controls	No	No	No	No	No	Yes
Observations	558	558	558	558	558	558
$R^2 Adj$	0.096	0.137	0.190	0.236	0.251	0.279

Note: The unit of observation is the Brazilian microregions. All variables are expressed in first differences. Demographic controls include population, high education share, and the share of young individuals. Migration and urban controls include the urban share and the share of non-natives. Sectoral controls include the agricultural employment share. Robust standard errors are reported in parentheses. *p<0.1; **p<0.05; ***p<0.01.

1.4 Causal analysis

As shown in previous sections, there is a strong correlation between income and informality. In the second part of this chapter, I attempt to identify a causal link between income and labor market informality. To do so, I exploit the implementation of Auxílio Emergencial, a nationwide cash transfer program introduced in response to the COVID-19 pandemic, as a source of income variation. Although the program was uniform at the national level, its effective intensity varied across states depending on the size of their eligible populations. By separating the national shock from the state-specific exposure, I isolate plausibly exogenous variation in income across states.

1.4.1 Auxílio Emergencial

Auxílio Emergencial is an emergency cash transfer program implemented by the Brazilian federal government in 2020 to address the economic and social disruptions caused by the COVID-19 pandemic. The program initially provided a monthly benefit of 600 Brazilian reals (approximately 120 US dollars) per individual, with a doubled amount of 1,200 reals for single mothers responsible for supporting their households.[1.10] The program managed to reach nearly 68 million people, covering approximately one-third of the Brazilian population at its peak.[1.11] Brazil spent around 4% of its GDP on the program, injecting over 300 billion reals into the economy in 2020.

Table 1.3 illustrates the impacts on income and income inequality observed in each Brazilian state during the period in which the aid was implemented. The program has a proportionally greater impact on GDP in poorer states. Additionally, a more significant reduction in the Gini index (indicating decreased income inequality) is observed, with this effect being particularly concentrated in poorer states, especially in the northern regions of Brazil.

[1.10] To qualify, applicants needed to meet specific criteria, including being over 18 years old (except for adolescent mothers), not having formal employment, and having low income, defined as a per capita family income below 522.50 reals, a total family income under 3,135 reals per month, and no declared taxable income exceeding 28,559.70 reals in the year prior to the program's start (the maximum annual income a worker could earn without being required to pay income tax).

[1.11] The cash transfers were primarily managed by the Caixa Econômica Federal, with payments distributed through physical bank branches, lottery retailers, and a digital platform. This digital infrastructure, although innovative, faced significant challenges, such as technical instabilities and difficulties in accessing funds, which underscored Brazil's ongoing digital divide.

Table 1.3: Auxílio Emergencial information

State	Beneficiaries (K)	Total Spent (M)	GDP	Δ Gini
Maranhão	2,555	R$ 11,283	10.6%	-0.041
Piauí	1,261	R$ 5,494	9.7%	-0.025
Paraíba	1,447	R$ 6,330	9.0%	0.028
Ceará	3,320	R$ 14,685	8.8%	-0.037
Alagoas	1,159	R$ 5,245	8.3%	-0.028
Sergipe	819	R$ 3,716	8.2%	-0.012
Pernambuco	3,492	R$ 15,701	8.1%	-0.014
Bahia	5,539	R$ 24,479	8.0%	-0.033
Acre	308	R$ 1,318	8.0%	-0.026
Amapá	304	R$ 1,413	7.7%	-0.023
Rio G. do Norte	1,208	R$ 5,363	7.5%	-0.054
Pará	3,149	R$ 14,075	6.5%	-0.032
Roraima	219	R$ 968	6.0%	-0.002
Amazonas	1,482	R$ 6,594	5.7%	-0.009
Tocantins	496	R$ 2,169	5.0%	0.001
Rondônia	564	R$ 2,497	4.8%	-0.036
Goiás	2,134	R$ 9,438	4.2%	-0.017
Espírito Santo	1,228	R$ 5,306	3.8%	-0.023
Minas Gerais	5,950	R$ 25,533	3.7%	-0.017
Rio de Janeiro	5,331	R$ 23,837	3.2%	0.008
Mato G. do Sul	793	R$ 3,503	2.9%	-0.032
Paraná	3,022	R$ 12,962	2.7%	-0.009
Mato Grosso	1,045	R$ 4,642	2.6%	0.006
Rio G. do Sul	2,655	R$ 11,601	2.5%	-0.032
São Paulo	12,055	R$ 52,570	2.2%	-0.005
Santa Catarina	1,591	R$ 6,790	1.9%	0.007
Distrito Federal	736	R$ 3,282	1.2%	-0.010
Brazil	63,877	R$ 280,807	3,7%	-0.011

Note: Data for the year 2020. Available at: https://portaldatransparencia.gov.br/beneficio. The GDP column represents the amount of spending in relation to state GDP. Δ Gini shows the difference in the Gini index across states; for the comparative graph between states, see Appendix 1.6.

1.4.2 Empirical strategy

To estimate the effects of Auxílio Emergencial on formal employment, I use the following empirical specification:

$$\frac{\mathrm{f}_{s,t} - \mathrm{f}_{s,t-1}}{\mathrm{f}_{s,t-1}} = \beta_0 \frac{AE_s^y}{y_s} + X'_{s,t}\delta + e_{s,t}. \tag{1.1}$$

where $\mathrm{f}_{s,t}$ is the share of formal labor contracts in state s at time t; y_s is the output in state s; $X'_{s,t}$ is a vector of controls. I estimate this specification using

two periods: $t-1$, indicating the program's start, and t, indicating its end. The coefficient β_0 is the relative formalization effect: when state s receives an additional one percent of its GDP in Auxílio Emergencial transfers relative to other states, formal jobs in that state grow β_0 percentage points faster than in other states.

Since the cash transfer program targets low-income and informal workers, states with higher pre-existing informality rates naturally have a greater proportion of beneficiaries. This creates an endogeneity problem, as the observed correlation between aid distribution and formalization may not reflect a true causal effect but rather a preexisting structural condition. Consequently, failing to account for reverse causality could lead to misleading conclusions regarding the actual impact of Emergency Aid on formal employment dynamics. To address this, I employ a Bartik-style instrumental variable to capture exogenous variation in the amount of money received by each state. The instrument is constructed as the product of the proportion of individuals registered in Cadastro Único, measured before the pandemic, and the total national disbursement of Emergency Aid. Cadastro Único is a unified registry for identifying low-income households, used to determine eligibility for a variety of federal social programs. This approach leverages cross-state heterogeneity in exposure to the national policy shock while holding the shock itself constant across states. As Cadastro Único shares are predetermined, and the total amount of Auxílio Emergencial is determined at the federal level independently of state-specific labor market dynamics, this instrument is plausibly exogenous to changes in informality at the state level.

The approach is based on the heterogeneous exposure of states to Auxílio Emergencial transfers, similar to Mendes et al. (2024).[1.12] I decompose state-level spending into an exposure term, γ_s to national spending AE_N^y , and a state-level idiosyncratic component $\Delta\tilde{y}_s$:

$$\frac{AE_s^y}{y_s} = \gamma_s \frac{AE_N^y}{y_N} + \Delta\tilde{y}_s. \tag{1.2}$$

The variable γ_s represents state-level exposure to Emergency Aid, calculated as the proportion of individuals registered in the Cadastro Único in each state before the pandemic. The idea is that the idiosyncratic component $\Delta\tilde{y}_s$ addresses potential threats to identification, allowing me to isolate the national exposure component $\gamma_s \frac{AE_N^y}{y_N}$ as the instrument. Since the analysis compares the period before and after the program, identification hinges on the assumption that the observed variation in transfers is not a response to state-level economic

[1.12] The authors measure the effects of Bolsa Família on macroeconomic variables, especially on state-level output.

conditions but is instead exogenously determined.

Although states with larger Cadastro Único coverage tend to be poorer and may exhibit higher baseline informality, the identification strategy relies on the interaction between this predetermined exposure and the nationally determined size of the program. Because the aggregate amount of Auxílio Emergencial is defined at the federal level and does not respond to state-specific labor market conditions, cross-state variation in transfers reflects differential exposure to a common policy shock. The empirical specification focuses on changes in formal employment shares rather than levels and includes controls for pre-existing economic and demographic characteristics, which further mitigates concerns that structural differences across states drive the results.

1.5 Results

Figure 1.7 illustrates the relationship between the change in formal labor contracts and the share of state GDP received through the Emergency Aid program. The figure also indicates each state's region, making it evident that states in the North and Northeast regions received a larger share of aid, consistent with their lower income levels. It is worth noting that Mendes et al. (2024), who conduct a similar analysis for the Bolsa Família program, also identify Amapá as an outlier.[1.13]

Poorer states tend to have a higher share of their population registered in Cadastro Único. In fact, all states in the Northeast (NE), the poorest region in the country, have over 49% of their population listed in the registry. In contrast, some states in other regions, such as Santa Catarina (SC) and the Distrito Federal (DF), have registration rates of around 15%.[1.14]

The first-stage results are presented in Table 1.A.3. The estimates confirm the significance of the instrumental variable in relation to the endogenous regressor of interest, providing initial evidence that the instrument is relevant, with an F-statistic of 74.4, above the conventional threshold of 10. The model also accounts for a substantial proportion of the variation in the endogenous regressor, with an R^2 of 0.86. The high explanatory power and strong statistical significance of the instrument justify its use in the second stage to identify the causal effect of Auxílio Emergencial on changes in informality.

[1.13] In November 2020, Amapá faced a severe energy crisis caused by a fire at a substation that resulted in widespread blackouts lasting over 20 days. The event disrupted local businesses, services, and household consumption, producing a significant economic shock that may help explain deviations observed for the state during the pandemic period.

[1.14] The figure illustrating this pattern is reported in Appendix 1.A.3.

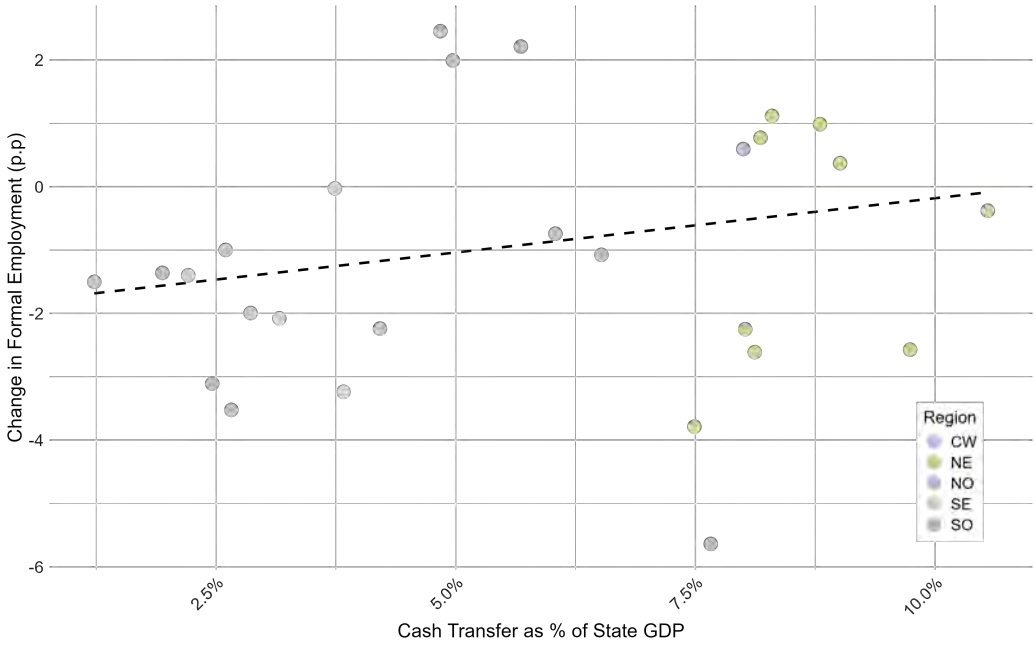

Figure 1.7: Change in formal labor contracts and cash transfers received

Note: This figure shows the relationship between the percentage point change in formal labor contracts across Brazilian states from the fourth quarter of 2019 to the fourth quarter of 2020, and the share of state GDP received in the form of cash transfers in 2020.

Table 1.4 presents the results from the second-stage regression, where the change in formal employment across states, $\frac{f_{s,t}-f_{s,t-1}}{f_{s,t-1}}$, is regressed on the predicted values of Emergency Aid as a share of state GDP, obtained from the first stage. The findings suggest that states receiving a larger injection of resources relative to their GDP performed better in preserving or increasing formal jobs during the crisis. The estimated coefficient implies that a one percentage point increase in Emergency Aid as a share of state GDP leads to an increase of approximately 1.31 percentage points in the share of formal employment contracts. The coefficient is statistically significant at the 1% level. The estimates remain robust after controlling for state-level covariates such as average schooling and the share of agricultural GDP, which help absorb potential confounders related to preexisting structural differences across states. This result supports the hypothesis that the cash transfer program has a causal impact on the labor market by increasing the prevalence of formal labor.

1.6 Conclusion

This chapter investigates the relationship between income, income inequality, and the level of informality in the labor market across different regions of Brazil. Although the literature on this topic is extensive, it primarily relies on cross-country comparisons. By focusing on a single country, we can

Table 1.4: Effect of Emergency Aid on formal employment

	$\frac{f_{s,t} - f_{s,t-1}}{f_{s,t-1}}$			
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
$\Delta \frac{AE_s^y}{y_s}$	0.760**	1.047**	1.074**	1.312***
	(0.355)	(0.387)	(0.404)	(0.437)
Controls	no	no	yes	yes
Observations	27	27	27	27
R^2	0.155	0.133	0.276	0.265
First stage:				
F statistic	—	155.3	—	74.4

Notes: The dependent variable is the percentage change in the share of formal labor contracts in state s between the beginning and the end of the Auxílio Emergencial program. The main explanatory variable is Emergency Aid transfers received by state s as a share of state GDP. Columns (1) and (3) report OLS estimates, while columns (2) and (4) report two-stage least squares (2SLS) estimates. In the IV specifications, Emergency Aid transfers are instrumented using a Bartik-style instrument constructed as the interaction between the pre-pandemic share of individuals registered in Cadastro Único in each state and the total national disbursement of Emergency Aid relative to national GDP. Controls include demographic and socioeconomic characteristics measured prior to the program. Standard errors are reported in parentheses. The first-stage F statistic for the excluded instrument is reported at the bottom of the table. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

control for factors that could influence informal labor, such as culture, legal institutions, and geography. This approach allows for a clearer understanding of how income and inequality are related to informal labor dynamics.

The findings indicate that regions with higher income levels tend to exhibit lower levels of informality. Additionally, regions that have experienced higher economic growth over time also show greater reductions in informal employment. Regarding income distribution, regions with higher levels of income inequality tend to have higher levels of informal employment. Furthermore, regions that have experienced a more significant decline in income inequality are associated with greater reductions in informality.

In a second stage, I establish causality by examining the effects of a large-scale cash transfer program, Auxílio Emergencial, introduced in response to the COVID-19 pandemic. I show that the resources received, measured as a share of state GDP, are positively associated with the change in formal employment across Brazilian states during the pandemic. The instrumental variable estimates indicate that a one percentage point increase in Emergency Aid relative to state GDP leads to an average increase of 1.31 percentage points

in the share of formal employment contracts. Although the analysis relies on a limited number of observations, this is a meaningful and suggestive finding that opens the door for further investigation. Future research using a larger number of observations could provide additional insights into the mechanisms through which income support programs affect labor market outcomes.

In the next chapter, I introduce a theoretical model that explores the mechanism through which rising income affects the level of informal employment in the economy. As income increases, so does the demand for goods and services provided by the formal sector, which in turn induces the expansion of formality.

1.A Appendix

Table 1.A.1: Census variables used

Variable			Description
Census 1991	Census 2000	Census 2010	
V1101	V0102	V0001	State
V7001	V1002	V1002	Mesoregion
V7002	V1003	V1003	Microregions
V1102	V0103	V0002	Municipality
V0322	V1006	V1006	Urban or rural area
V0329	V0432	V0633	Highest degree obtained
V0309	V0408	V0606	Race
V0349	V0447	V6930	Occupational position
V3072	V6036	V6036	Age
V0314	V0416	V0618	Born in this municipality
V3461	V4462	V6462	Economic activity
V0350	-	-	Registered employment
V0353	V0450	V5120	Contributes to social security
V0356	V4514	V6514	Earnings

Notes: This table shows all Census variables used to investigate changes in the informality rate in the first part of the chapter.

Table 1.A.2: PNADc variables used

Variable	Description
UF	State
VD4001	Labor force status
V4029	Formal employment contract status
VD4012	Contributes to social security
VD4009	Occupational position
V1022	Urban or rural area
V1023	Metropolitan area

Notes: This table shows all PNADc variables used to investigate changes in the informality rate in the second part of the chapter.

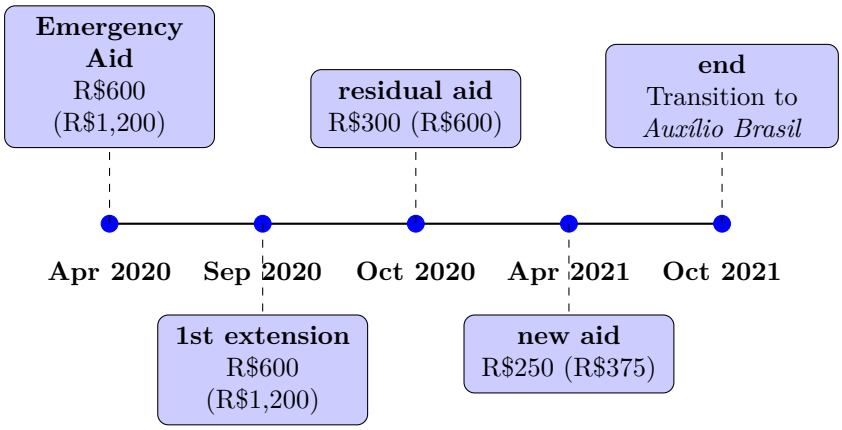

Figure 1.A.1: Timeline of Emergency Aid in Brazil

Note: This figure depicts the timeline of Auxílio Emergencial (Emergency Aid), an income transfer program implemented in response to COVID-19 pandemic. Values in parentheses refer to single mothers who are household heads.

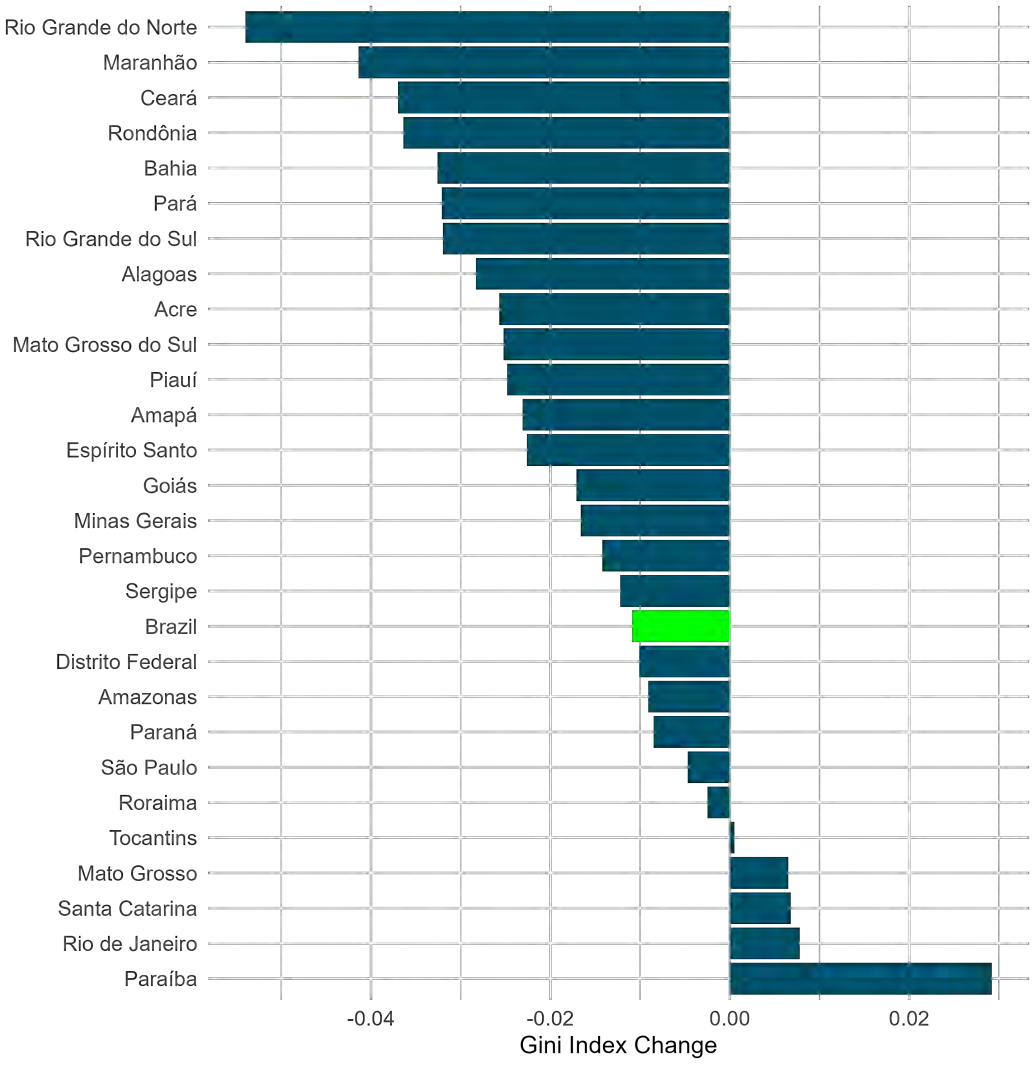

Figure 1.A.2: Gini index change per state

Note: This figure displays the change in the Gini index across Brazilian states between the first quarter of 2020 and the last quarter of 2021. Source: PNAD Contínua.

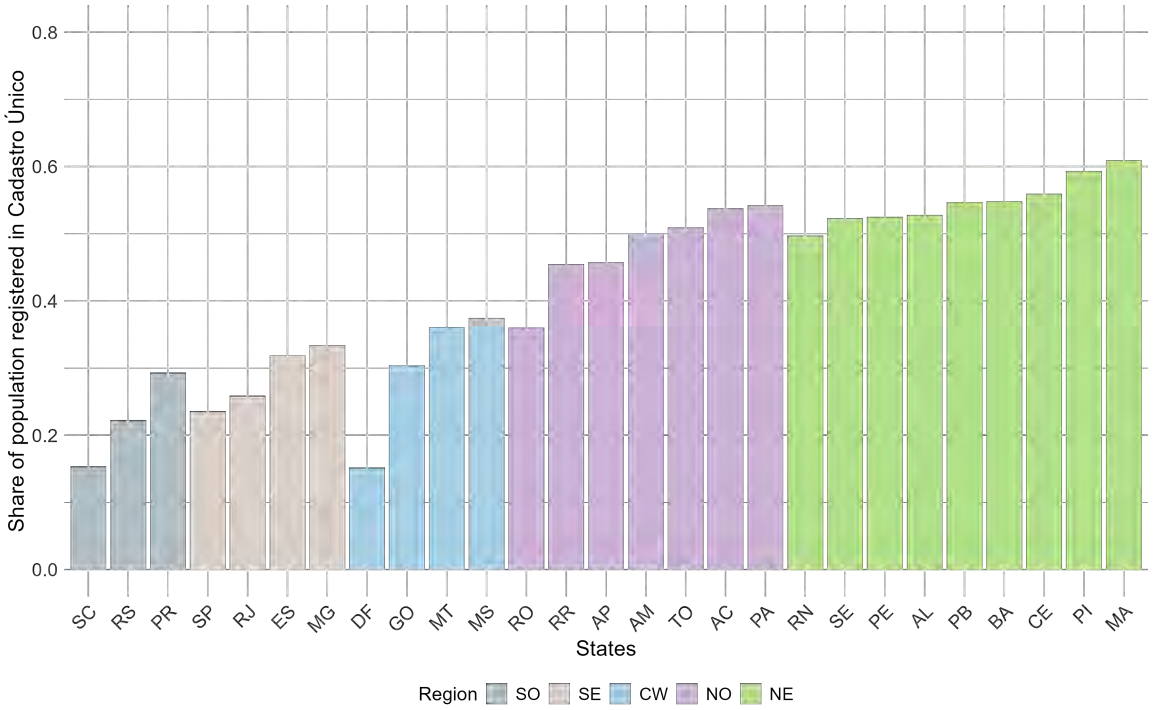

Figure 1.A.3: Share of population registered in Cadastro Único

Note: This figure shows the share of the population in each Brazilian state that is registered in Cadastro Único, the main instrument used by the Brazilian government to identify and include low-income families in federal social programs. Source: IBGE.

Table 1.A.3: First stage regression

	Dependent variable:	
	AE_s^y/y_s	
$\gamma_s \frac{AE_N^y}{y_N}$	5.341***	4.984***
	(0.607)	(0.402)
Controls	no	yes
Observations	27	27
R^2	0.774	0.861
F Statistic	155.3	74.4

Notes: The table reports the first-stage regression in which the dependent variable is Emergency Aid transfers received by state s as a share of state GDP. The instrument is the interaction between the pre-pandemic share of individuals registered in Cadastro Único in each state and national Emergency Aid spending relative to national GDP. Robust standard errors in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

2
Informality and demand: Why does informality fall alongside development?

Abstract: This chapter develops a theoretical and empirical analysis of structural change and labor market informality in Brazil. I first construct a long-run historical series of informality beginning in 1940, showing that informality exceeded 80% at mid-century and declined steadily to around 50% by the 1980s, closely following the contraction of agricultural employment. I then build a neoclassical growth model of structural transformation with two sectors, agriculture and non-agriculture, and with both formal and informal labor markets. Households have non-homothetic preferences, so that the consumption share of agricultural goods falls as income rises. The model replicates the decline in agricultural employment and explains about two-thirds of the observed reduction in informality, showing that formalization arises naturally from shifts in household demand across sectors. Finally, I demonstrate that this demand-driven mechanism operates not only across sectors but also within sectors. Using microdata from Brazilian household expenditure surveys, I find that as income rises, households reallocate consumption toward goods and services that are more intensive in formal labor. Together, these findings provide new evidence that the decline in informality is largely a byproduct of structural transformation.

Keywords: Labor market; informality; budget surveys; consumption

2.1 Introduction

Informality is widespread in developing countries, but as economies grow and develop it systematically declines, giving way to the predominance of the formal economy (La Porta and Shleifer, 2014). No rich country sustains a high degree of informality. Conversely, no poor country displays a predominantly formal labor market. Therefore, the link between formalization and economic growth stands as a strong and robust stylized fact, as shown in Figure 1.1.

If all countries that develop experience a decline in informality, an important question arises: what drives this decline? This chapter argues that the reduction in informality is intrinsically linked to the process of structural change that accompanies the development trajectory of a country.

It is well established that agriculture relies more heavily on informal labor. As this sector gradually contracts and gives way to industry and services, which are more likely to employ formal workers, informality declines. In this sense, this chapter claims that part of the fall in informality is a natural outcome of structural change, driven by the reduction in the share of workers employed in agriculture.

In very poor countries, individuals struggle to secure sufficient food, as meeting basic nutritional needs dominates household expenditure. As income rises, demand shifts toward other goods and services, so that in higher-income economies only a small fraction of household expenditures is allocated to agriculture. Figure 2.1 illustrates the relationship between informality and the share of GDP accounted for by agriculture, highlighting the well-documented fact that a large agricultural share of GDP is associated with higher informality.

Since structural change is a slow, long-run process, analyzing it requires a measure of informality over an extended horizon. I construct such a measure for Brazil beginning in 1940 using data from Brazilian Censuses and the Brazilian household sample survey (PNAD). The choice of 1940 reflects the fact that it was the first Census conducted under the responsibility of the Brazilian Institute of Geography and Statistics (IBGE), ensuring greater methodological rigor. It also marks the deepening of a series of structural transformations in Brazil, as the process of import substitution accelerated in the aftermath of World War II (Malan et al., 1977).[2.1]

Throughout this chapter, I define informal workers as employees without a formal labor contract, which in Brazil requires registration in the official employment booklet (*carteira de trabalho*), and self-employed workers who do

[2.1] For a detailed analysis of structural change in Brazil during this period, see Abreu (2000).

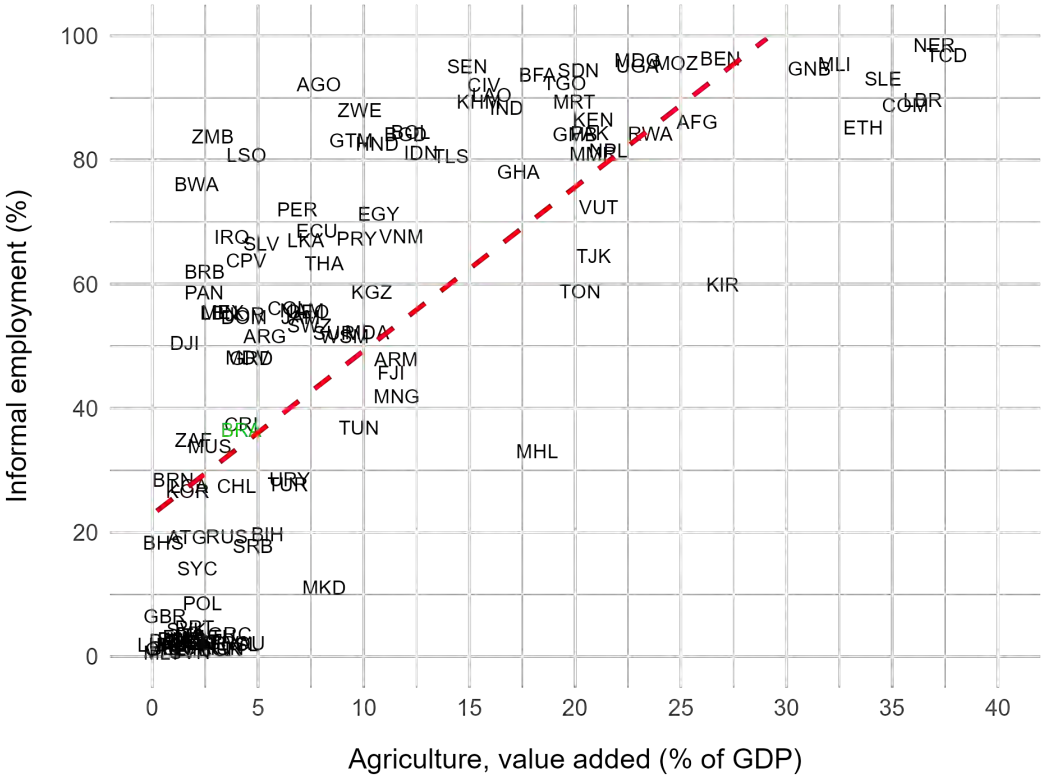

Figure 2.1: Informality and agriculture across countries

Note: The figure plots the share of workers in informal employment against the agricultural share of value added in GDP. Informality follows ILO definitions. Data on informality are obtained from the ILOSTAT database, and sectoral value added is from the World Bank World Development Indicators. The dashed line shows the fitted linear relationship.

not contribute to social security. Because the concept of informality is relatively recent,[2.2] surveys conducted before 1981 do not allow for a precise identification of what is currently considered informal employment.

To estimate values for the period between 1940 and 1980, I rely on the earliest Census that reported informality shares by major worker categories (employees, self-employed, employers, and undeclared) and by sectors (agriculture and non-agriculture). Since these estimates are not precise, I construct three scenarios: a baseline, a lower bound, and an upper bound. The lower bound extrapolates the informality rates of each worker category backward in time. The baseline scenario additionally accounts for the sectoral composition of workers. The upper bound relies on the observed downward trend within each group and extrapolates it backward. I find that informality in 1940 was

[2.2]The term emerged as labor relations gradually became subject to stronger regulation intended to provide workers with greater protection. Its origins can be traced to the British anthropologist Keith Hart, who introduced the expression "informal sector" in 1971. See Hart (1973). Almost simultaneously, the ILO's Employment Mission to Kenya (ILO, 1973) contributed to the dissemination of this category, which was subsequently consolidated in academic and policy debates (Dell'Anno, 2022).

approximately 80%, declining steadily to about 50% by the 1980s. Over the same period, the share of workers in agriculture fell from 65% to 38%.

To link structural change with informality, I develop a neoclassical growth model of structural transformation. The model comprises two sectors, agriculture and non-agriculture, each producing a distinct good. Households exhibit non-homothetic preferences, with the agricultural good treated as a necessity that requires a minimum level of consumption. I extend this framework by introducing a heterogeneous labor market with both formal and informal workers, so that each sector employs both types of labor in the production of goods.

This framework implies that as income rises, households allocate a larger share of their expenditure to non-agricultural goods. Since non-agriculture is more intensive in formal labor, the demand for formal employment increases. Consequently, income growth drives higher levels of formalization in the labor market.

I calibrate the model on Brazilian data for the period from 1940 to 2024. I choose parameters to match selected moments including the initial share of employment in agriculture and the initial share of informality. I then simulate permanent increases in TFP so as to replicate the observed trajectory of per capita output each year. This setup allows me to use the model to generate endogenous series for both employment shares and informality.

I establish two main results. First, it successfully replicates Brazil's structural transformation, capturing the decline in agricultural employment and accounting for 72% of the observed fall in the agricultural employment share. Second, it explains 67% of the decline in informal employment over the period. Therefore, a simple framework with a straightforward mechanism is able to captures a large share of structural transformation and the fall of informality.

So far, the mechanism I propose explains formalization through shifts in demand across sectors. In the second part of the paper, I show that this phenomenon also occurs within sectors. Using evidence from the latest Brazilian household expenditure survey, I classify goods and services into two broad categories: necessities and luxuries. Necessities are more frequently produced in the informal sector, whereas luxury goods and services are predominantly supplied by formal businesses. The analysis shows that as household income rises, the share of expenditures allocated to luxury goods increases. Since luxury goods are more intensive in formal labor, this shift induces a natural reallocation of production and employment toward the formal sector. As a result, richer households consume a larger share of goods and

services associated with formal employment.

The literature on structural change is extensive,[2.3] with early contributions such as Kuznets (1973), Johnston (1970), Syrquin (1988), and Rogerson (1991), as well as more recent work such as Restuccia and Rogerson (2008) and Porzio et al. (2022). A set of stylized facts about this process is remarkably consistent across time and countries. As economies expand, both the employment share and the value-added share of agriculture decline steadily, while the share of services rises continuously. Manufacturing follows a hump-shaped pattern, increasing at intermediate stages of development before declining as services become dominant (Herrendorf et al., 2014). Empirical evidence also shows that improvements in agricultural productivity play an important role in this process by releasing labor from agriculture and accelerating the reallocation of workers toward non-agricultural sectors (Bustos et al., 2016).

There is also a broad literature on growth models of structural change. The first quantitative analysis of structural transformation within the framework of a growth model is provided by Echevarria (1997), followed by the contributions of Greenwood et al. (1997), which build on the two-sector model of Uzawa (1963). Kongsamut et al. (2001) show that structural change can be reconciled with balanced growth if preferences are non-homothetic, leading to sectoral labor reallocation. Ngai and Pissarides (2007) demonstrate that structural change can coexist with balanced growth when sectors differ in TFP growth rates and income elasticities of demand. Foellmi and Zweimüller (2008) innovate by modeling preferences over an unbounded set of individual goods with finite satiation levels, so that structural transformation arises endogenously from the sequential introduction of new goods as income grows, rather than being imposed across three broad sectors. Nevertheless, in general, the structural change literature has paid little attention to the dynamics of informality.

Several studies have examined structural change in Brazil. For instance, Pauli et al. (2012) analyzes shifts in both the level and qualifications of the workforce across sectors, while Santos and Spolador (2018) evaluates the evolution of sectoral productivity after 1980. Ramos (2002) investigates the relationship between changes in informality and the sectoral composition of employment.[2.4]

The economic literature on informality in the Brazilian labor market began to develop more systematically in the late 1980s and early 1990s. Until then, most research focused primarily on conceptual issues, debating the

[2.3] See Matsuyama (2008) for a review of the literature on structural transformation.

[2.4] For a detailed analysis of structural change in Brazil between 1970 and 2010, see Nassif et al. (2015).

boundaries of the informal sector and the appropriate criteria for its definition (Ulyssea, 2006). Because it is a relatively recent concept, systematic estimates of informality prior to the 1980s remain scarce.[2.5]

This chapter contributes to the literature in two main ways. First, it constructs a historical series of informality in Brazil starting in 1940, allowing a clear visualization of how closely informality correlates with the share of employment in agriculture. Second, it connects the literature on informality with that on structural change. While the structural change literature typically studies the reallocation of consumption across sectors (Ngai and Pissarides, 2007; Buera and Kaboski, 2012; Herrendorf et al., 2013), I focus on a reallocation within production arrangements, from informally produced goods to formally produced goods. By employing a structural change model, I demonstrate that a large part of the decline in informality over time can be explained through the demand channel, implying that formalization emerges as an endogenous outcome of development.

The remainder of the chapter is organized as follows. Section 2.2 describes Brazil's structural change and the data used to construct the historical informality series. Section 2.3 outlines the model. Section 2.4 presents the results. Section 2.5 reinforces the idea that rising income increases demand for formal-sector goods by examining patterns within the non-agricultural sector. Section 2.6 concludes.

2.2 Structural change and informality in Brazil

Structural change is a long-term phenomenon. While most advanced economies began this process during the nineteenth century and have already undergone major transformations and are now at a later stage of development, developing countries such as Brazil have been experiencing this transition since the early twentieth century.[2.6] In this section, I present the data used in the analysis to link structural change with the historical evolution of informality in Brazil.

2.2.1 Data and method

I choose 1940 as the starting point for the analysis for several reasons. First, it marks the year of the first Census conducted by the IBGE,[2.7] which ensured greater methodological rigor compared with earlier Censuses. Second,

[2.5] For data covering the last decades of the twentieth century, see Cacciamali (1988, 2000).
[2.6] The urban population in Brazil only surpassed the rural population in the 1970s.
[2.7] IBGE was founded in 1936.

the decennial Census scheduled for 1930 did not take place due to the political instability brought about by the 1930 Revolution. Finally, a historical milestone in this context is 1943, when the Consolidação das Leis do Trabalho (CLT) was enacted under President Getúlio Vargas. This legislation laid the foundation for the formalization of the Brazilian labor market.[2.8] Table 2.1 summarizes the main variables used in the analysis, their definitions, and respective data sources for the period between 1940 and 2024.

Table 2.1: Description of variables

Variable	Description	Source
Population	Total number of inhabitants	Brazilian Census
GDP	GDP at constant 2010 prices	IPEA
Sector share	Share of each economic sector in GDP	IPEA and (Haddad, 1975)
Employment share	Proportion of the labor force employed in each sector	Census and PNAD**
Productivity	Labor productivity, measured as output per hour worked*	IPEA and PWT 10.01
Informality rate	Proportion of workers employed in informal jobs	Census, PNAD and others***

Note: * Labor productivity is calculated as GDP divided by the product of the number of workers and their average annual hours worked.** Employment shares between 1940 and 1950 are estimated based on data from the 1940 Census. *** Informality rate data are described in details in section 2.2.

As a long-run phenomenon, evaluating the relationship between structural change and informality in Brazil requires the construction of long-run data on informality. The concept of informal work is relatively modern, since labor relations in earlier decades were generally not characterized by well-defined contractual arrangements. Consequently, census records and household surveys (PNAD) did not directly ask whether individuals held formal labor contracts or contributed to social security, which makes it particularly challenging to determine informality rates prior to the 1980s.

For the period between 1980 and 2012, I rely on decennial Census data and the PNAD, a household survey conducted in most intercensal years. From

[2.8] Before that, several labor laws had already been approved, such as the 1919 legislation regulating compensation for work-related accidents, the 1932 regulation on working hours, and the 1933 creation of the employment record booklet (carteira profissional), an instrument that marked a turning point in the development of social security provisions (Moraes, 2021).

2012 onwards, I use the PNAD Contínua, a quarterly survey that provides a more detailed measure of labor market status.[2.9]

For the period between 1940 and 1980, informality cannot be directly observed because early Censuses do not report employment relationships in a way that allows a precise classification. I therefore construct three alternative historical series: a baseline estimate, a lower bound, and an upper bound.

I start from the 1991 Census, the earliest dataset containing sufficiently detailed information on employment status to classify workers as formal or informal. Workers are grouped along two dimensions: sector (agriculture and non-agriculture) and employment category (employees, self employed, employers, and undeclared workers). I harmonize occupational categories across earlier Censuses to ensure comparability over time and recover the number of workers in each sector category cell for every Census between 1940 and 1980.

Let $N_{s,c,t}$ denote the number of workers in sector s and employment category c at time t, and let $\theta_{s,c}$ denote the share of informal workers within each cell measured in the 1991 Census.

Baseline scenario

I assume that the informality share within each sector category cell remains constant over time. The aggregate informality rate is then computed as:

$$\text{Informality}_t = \sum_{s,c} \theta_{s,c} \cdot \frac{N_{s,c,t}}{N_t} \tag{2.1}$$

where N_t is total employment in year t. Under this approach, changes in aggregate informality arise from shifts in the composition of employment across sectors and occupational categories.

Lower bound

To obtain a conservative estimate, I collapse the sector dimension and assume constant informality shares only across employment categories:

$$\text{Informality}_t^{LB} = \sum_{c} \theta_{c} \cdot \frac{N_{c,t}}{N_t} \tag{2.2}$$

This specification attributes variation to broad occupational composition.

[2.9] Soares (2004) documents that the share of workers without a registered labor contract increased between the early 1980s and the late 1990s, while the wage gap between formal and informal workers declined during the same period.

Upper bound

To allow for long run improvements in labor market institutions, I extrapolate backwards the trend in cell level informality observed after 1991. Instead of fixing $\theta_{s,c}$, I estimate a time trend $\theta_{s,c,t}$ using post 1991 data and apply it to earlier periods:

$$\text{Informality}_t^{UB} = \sum_{s,c} \theta_{s,c,t} \cdot \frac{N_{s,c,t}}{N_t} \tag{2.3}$$

Finally, I linearly interpolate values between Census years to obtain annual series for all three scenarios.

2.2.2 Results

Figure 2.2 illustrates the evolution of structural change in Brazil since 1940, when the country was still predominantly rural, with more than 65% of the labor force employed in agriculture, even though the sector accounted for only about 25% of GDP. Most of the structural transformation occurred before 1980,[2.10] when manufacturing expanded from 12% of GDP in 1940 to a peak of about 25% in 1981. At present, manufacturing represents around 20% of GDP, agriculture accounts for only a small fraction, and services have expanded to become the dominant sector of the economy.

Figure 2.3 presents the estimates of historical informality in Brazil since 1940. In that year, the informality rate is estimated to have ranged between 70% and 92.2%, with the preferred estimate being 81.4%. A sharp decline in informality is observed from the beginning of the series until 1980, a period during which Brazil experienced rapid economic growth alongside a substantial reduction in the agricultural share of GDP. Notably, the decline in informality is strongly correlated with the contraction of agriculture, as shown in Figure 2.2. Between 1980 and 2000, the economy stagnated and informality remained relatively stable. The 2000s, however, marked a period of renewed economic growth in Brazil, once again accompanied by a significant reduction in informality.

2.3 Model

The model builds on the structural change literature. Its starting point is a neoclassical growth framework with two sectors, agriculture and non-

[2.10] Between 1900 and 1980, Brazil ranked among the world's fastest-growing economies, recording average annual GDP growth of about 5.5% (Spilimbergo and Srinivasan, 2019).

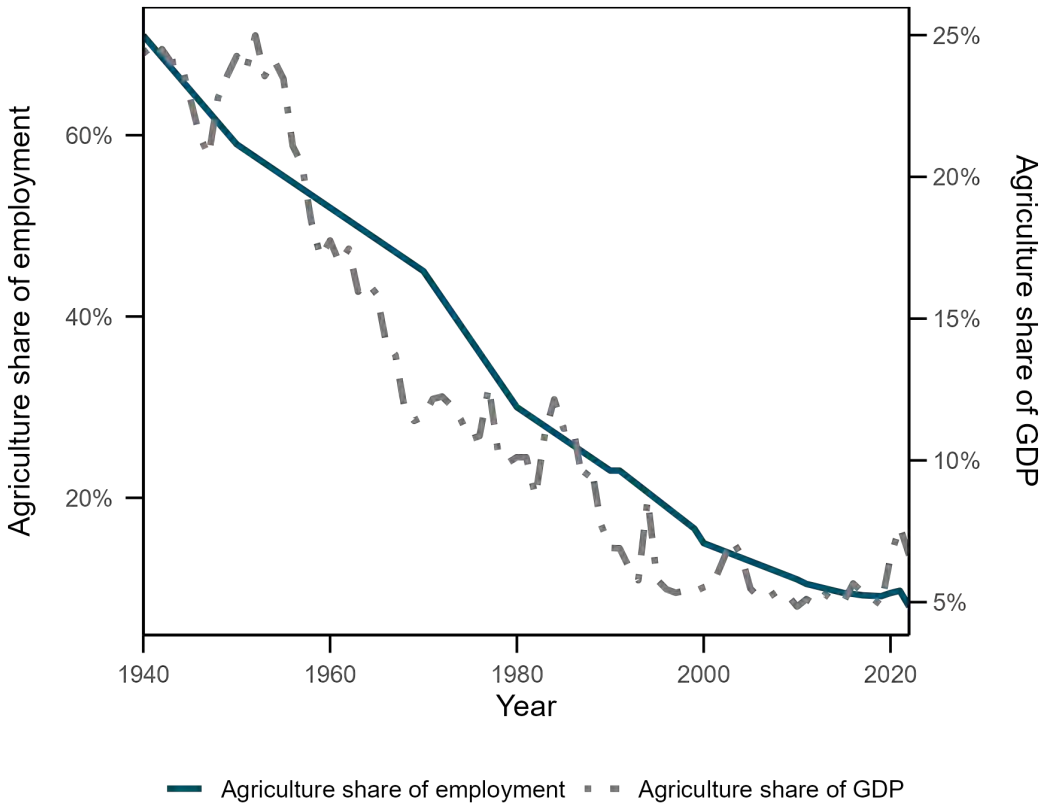

Figure 2.2: Agriculture share of employment and GDP in Brazil

Note: This figure reports the agricultural share of GDP and total employment in Brazil since 1940. GDP shares are obtained from IPEA for the post-1947 period and from the historical estimates compiled by (Haddad, 1975) for earlier years. Employment shares are constructed using data from the Brazilian Census and PNADc. Observations for the years between Census are linearly interpolated.

agriculture. Households are assumed to have non-homothetic preferences. In addition, the model incorporates two labor markets, formal and informal, so that households determine the share of each type of labor they supply. Employment in the formal labor market is subject to payroll taxes, whereas informal employment is not.

2.3.1 Households

The representative household derives utility from consumption in each period

$$\sum_{t=0}^{\infty} \beta^t u\left(C_t\right). \tag{2.4}$$

Consumption goods are either agricultural or non-agricultural

$$C_t = \left[\omega^{\frac{1}{\varepsilon}} \left(C_{at} - \bar{C}_a\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\omega)^{\frac{1}{\varepsilon}} C_{nt}^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}. \tag{2.5}$$

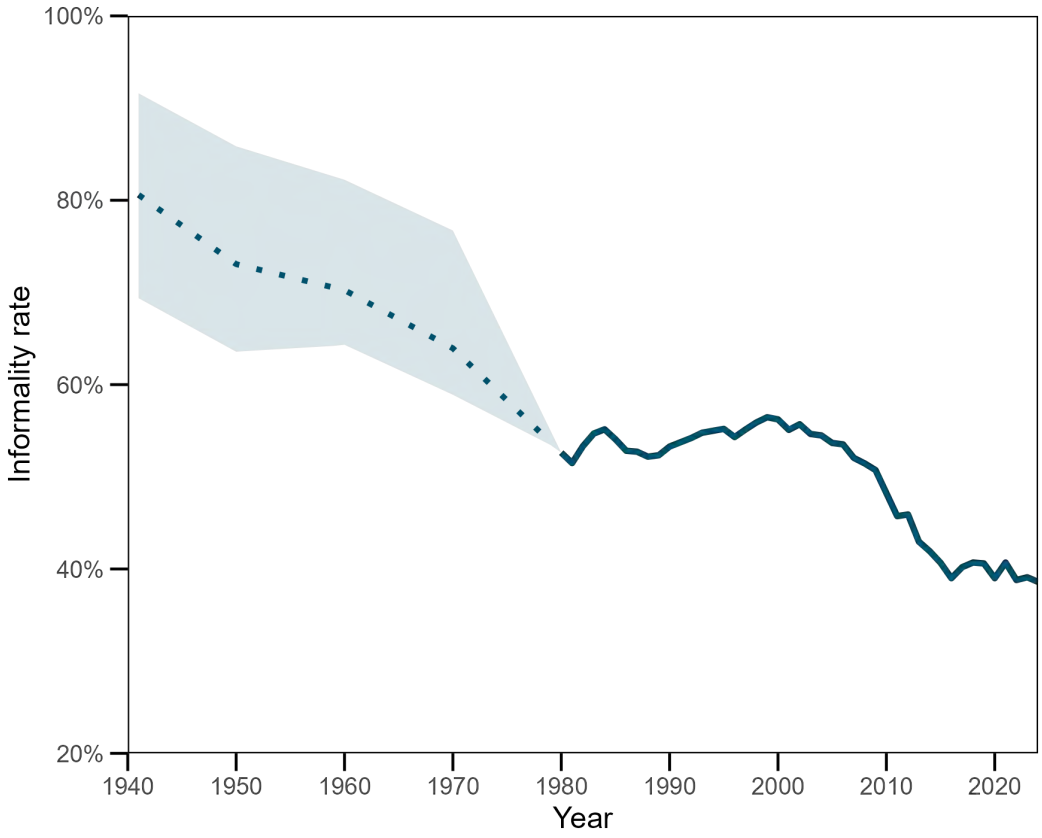

Figure 2.3: Informality rate in Brazil

Note: The solid line shows observed informality rates from 1980 onward using Census, PNAD, and PNAD Contínua data. Earlier values are reconstructed using sectoral and occupational distributions from historical Censuses. The shaded area reports alternative bounds based on different assumptions about the composition of informal employment.

The subsistence term $\bar{C}_a$ implies the flow utility function is non-homothetic. This means changes in income can generate changes in expenditure shares even if relative prices are constant. The parameter $\varepsilon > 0$ governs the elasticity of substitution between the two goods and hence the response of nominal expenditure shares to changes in relative prices. The budget constraint, under the normalization $P_{at} = 1$ and let $P_t \equiv P_{nt}/P_{at} = P_{nt}$ representing the relative price, is

$$C_{at} + P_t C_{nt} = w_t L_t + T_t. \tag{2.6}$$

By solving the household's optimization problem, we obtain

$$\left(\frac{1}{P_t}\right)^{\varepsilon} \frac{C_{at} - \bar{C}_a}{C_{nt}} = \frac{\omega}{1-\omega}. \tag{2.7}$$

The equation establishes a relationship between relative prices, consumption, and preferences, showing that the ratio between agricultural consumption above the subsistence level and non-agricultural consumption adjusts accord-

ing to the relative price of goods and the elasticity of substitution. When the price of the agricultural good increases, this ratio tends to decline, reflecting a shift toward non-agricultural consumption. This response is driven by the structure of preferences, captured by the parameter ω which determines the relative weight assigned to agricultural versus non-agricultural goods in consumption choices.

2.3.2 Firms

There are two types of firms, each representing a distinct sector: agriculture and non-agriculture. Each firm produces goods using both formal and informal labor, where γ_a denotes the share of informal labor in the agricultural sector and γ_n denotes the share of informal labor in the non-agricultural sector.

$$Y_{at} = C_{at} = A_{at} L_{ait}^{\gamma_a} L_{aft}^{1-\gamma_a}. \tag{2.8}$$

$$Y_{nt} = C_{nt} = A_{nt} L_{nit}^{\gamma_n} L_{nft}^{1-\gamma_n}. \tag{2.9}$$

L_{jft} and L_{jit} denote formal and informal labor in sector j. Firms in both sectors are subject to payroll taxes τ_L on formal labor. Firm problem in each sector

$$\max_{L_{ait}, L_{aft}} \left\{ A_{at} L_{ait}^{\gamma_a} L_{aft}^{1-\gamma_a} - w_t \Big(L_{ait} + (1+\tau_L) L_{aft} \Big) \right\}. \tag{2.10}$$

$$\max_{L_{nit}, L_{nft}} \left\{ P_t A_{nt} L_{nit}^{\gamma_n} L_{nft}^{1-\gamma_n} - w_t \Big(L_{nit} + (1+\tau_L) L_{nft} \Big) \right\}. \tag{2.11}$$

By solving the firm's optimization problem, I obtain

$$P_t = (1+\tau_L)^{\gamma_a - \gamma_n} \frac{\gamma_a^{\gamma_a} (1-\gamma_a)^{1-\gamma_a}}{\gamma_n^{\gamma_n} (1-\gamma_n)^{1-\gamma_n}} \frac{A_{at}}{A_{nt}}. \tag{2.12}$$

The equation shows that relative prices are determined by sectoral productivity and structural parameters. An increase in non-agricultural productivity (A_{nt}) causes non-agricultural goods to become cheaper relative to agricultural goods. Preferences and labor-market parameters (γ_a, γ_n), together with taxation through τ_L, determine the extent to which this productivity increase translates into changes in relative prices.

The results above depend on the functional form assumed for production. In both sectors, output is produced using a Cobb-Douglas technology combining formal and informal labor. This assumption imposes a unit elasticity of substitution between the two types of labor.

Consider the agricultural sector, the marginal rate of technical substitution between informal and formal labor is

$$\text{MRTS} = \frac{\dfrac{\partial Y}{\partial L_{ait}}}{\dfrac{\partial Y}{\partial L_{aft}}} = \frac{\gamma_a}{1-\gamma_a}\frac{L_{aft}}{L_{ait}}. \tag{2.13}$$

Because the elasticity of substitution equals one, proportional changes in relative labor costs generate proportional changes in relative factor demand. Payroll taxation therefore affects firms only through relative factor prices, without creating nonlinear adjustment responses in labor composition.

As a consequence, differences in informality across sectors arise from productivity and structural parameters rather than from technological complementarities between formal and informal labor. The Cobb-Douglas case thus serves as a benchmark in which informality responds to policy exclusively through relative prices.

2.3.3 Equilibrium

Total labor is normalized to one, so the allocation across agriculture and non-agriculture must satisfy

$$L_t \equiv 1 = L_{at}+L_{nt} = L_{it}+L_{ft}; \quad L_{at} = L_{ait}+L_{aft}; \quad L_{nt} = L_{nit}+L_{nft}. \tag{2.14}$$

In the goods market, production equals aggregate consumption

$$C_a = Y_a, \quad C_n = Y_n. \tag{2.15}$$

The government collects taxes on formal labor income and rebates them to households as lump-sum transfers. This guarantees that the government budget constraint holds in every period.

Under the model assumptions, for any admissible set of parameters $(A_n/A_a,\ \gamma_a,\ \gamma_n,\ \tau_L,\ \bar{C}_a,\ \varepsilon,\ \Omega)$, there exists a competitive equilibrium. This equilibrium determines labor allocation, sectoral production, relative prices, and consumption levels. Given the structure of preferences and production functions, the equilibrium is unique.

2.3.4 Special case with analytical solution

In this subsection, I focus on a special case that represents the extreme scenario in which $\gamma_a = 1$ and $\gamma_n = 0$, meaning that the agricultural sector

employs only informal labor, while the non-agricultural sector relies exclusively on formal labor.

Suppose productivity grows at a uniform rate in both sectors, $A_{it+1}/A_{it} = A_{ft+1}/A_{ft} > 0$. This implies only the levels differ. Let $A_{it} = \mu A_{ft}$ where $\mu \leq 1$. Notice output and per capita output coincide, $L = 1$. Let the output elasticity of formal employment to output growth is defined as

$$\eta \equiv \frac{\partial L_{ft}/L_{ft}}{\partial Y_t/Y_t} = \frac{\dfrac{\partial L_{ft}/L_{ft}}{\partial A_{it}/A_{it}}}{\dfrac{\partial Y_t/Y_t}{\partial A_{it}/A_{it}}}. \tag{2.16}$$

The output elasticity of formal employment to growth measures the percentage change in formal employment relative to the percentage change in aggregate output. In other words, it captures how responsive the share of formal employment is to the growth of the economy.

Preposition 1. *If $\gamma_a = 1$ and $\gamma_n = 0$, the elasticity of formal employment to output is:*

$$\eta = \frac{\bar{C}_a}{(1+\psi)A_{it}L_{ft}}. \tag{2.17}$$

Proof: see appendix 2.6.

In the case of homothetic preferences, i.e., $\bar{C}_a = 0$, the elasticity is zero, which means that the consumption share of each good remains unchanged as income rises. In contrast, under non-homothetic preferences, when $\bar{C}_a > 0$, the elasticity is positive. This implies that rising income leads households to allocate a larger share of expenditure to non-agricultural goods, which are more intensive in formal labor, thereby increasing the formal labor share in total employment.

2.3.5 Calibration

I calibrate the model using Brazilian data for the period 1940–2024 in order to match a set of key empirical moments, reported in Table 2.2. The shares of informal labor in agriculture and non-agriculture are calibrated using the most reliable Census observations around the midpoint of the sample period. Using mid-sample values allows the calibration to approximate the average level of informality in the economy over the entire horizon.

The relative productivity of the non-agricultural sector is calibrated to match the historical average ratio of non-agricultural to agricultural productiv-

ity. This ratio is computed using sectoral value-added and employment shares, as described in Table 2.1. The labor tax rate is set equal to the current statutory payroll tax rate.[2.11] The elasticity of substitution between agricultural and non-agricultural goods is taken from Comin et al. (2021). Finally, the consumption weight on agricultural goods and the subsistence parameter are jointly calibrated so that the model matches the initial share of agricultural employment.

GDP per capita is normalized to one in 1940. Given this normalization, I recover the sequence of sectoral productivity levels required for the model to replicate the observed path of Brazilian GDP per capita. In each year, productivity adjusts so that the equilibrium level of output in the model coincides with the data. The resulting equilibrium path can therefore be interpreted as a sequence of static equilibria connected by exogenous productivity growth over time.

Table 2.2: Parameters

Parameter		Value	Source/Target
Households			
Consumption weight on agric. goods	Ω	0.1	1940 share of agriculture
EoS agric. and non-agric. goods	ε	0.4	Comin et al. (2021)
Subsistence term	$\bar{C}_a$	0.6	1940 share of agriculture
Firms			
Non-agric. to agric. productivity ratio	$\frac{A_n}{A_a}$	4.73	Period average
Informal labor share in agric.	γ_a	0.91	1991 Census
Informal labor share in non-agric.	γ_n	0.43	1991 Census
Government			
Labor tax rate	τ_L	0.375	Payroll statutory values

Notes: The table reports the calibrated parameters used in the model and the empirical targets used in the calibration. Data sources and construction of the targets are described in the main text.

2.4 Results

Figure 2.4 presents the results. The first panel shows the evolution of GDP per capita, normalized to one in 1940. By construction, the model and the data coincide. The second panel presents the share of agriculture in employment, where I match the 1940 observation and then examine how the model evolves over time. The last panel illustrates how the share of formal

[2.11] Although statutory rates were substantially lower in the mid-twentieth century, they increased markedly after the 1988 Constitution and became consolidated at their current levels during the 2000s.

labor in the model responds to changes in sectoral employment shares, and also reports the difference compared with the data.

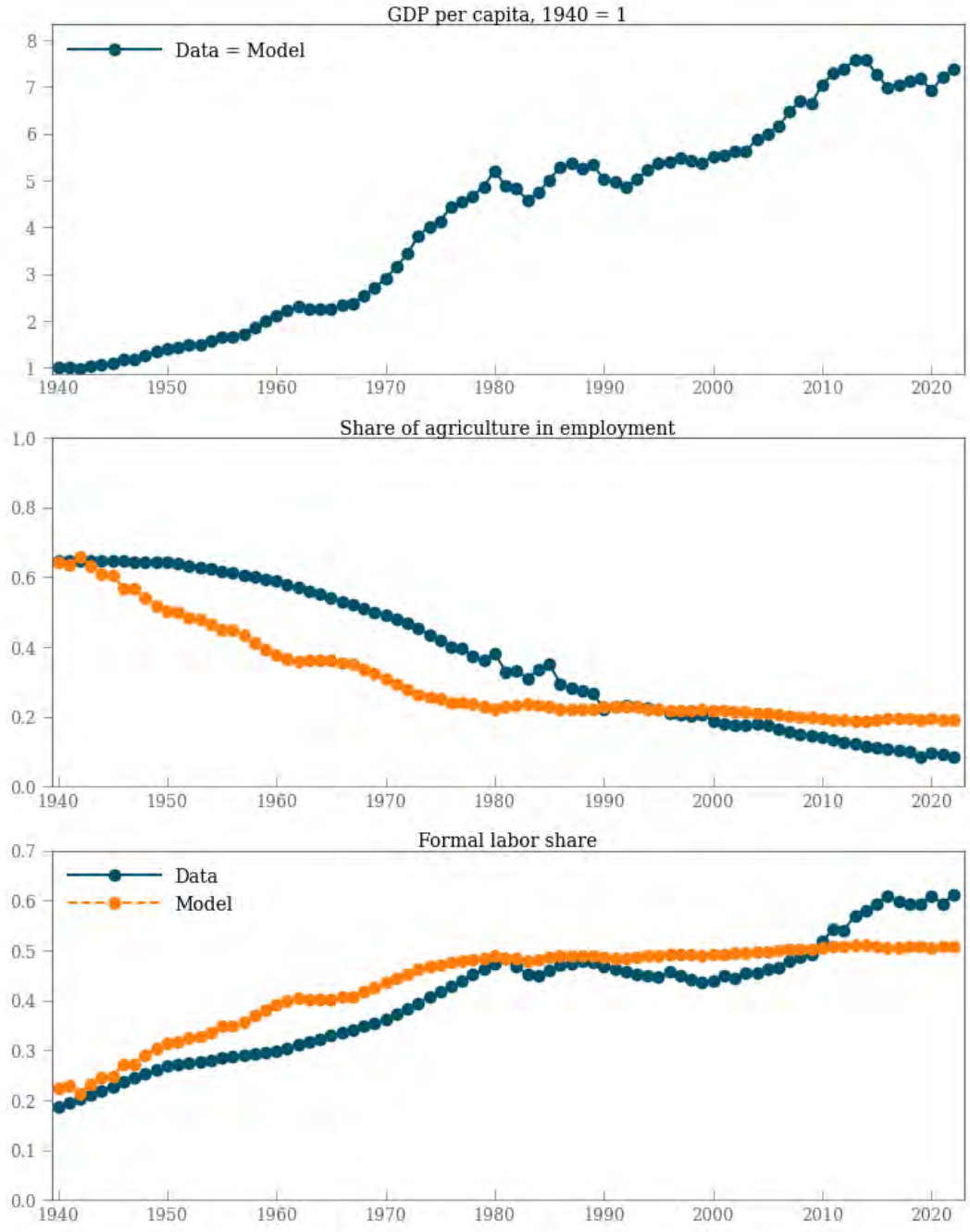

Figure 2.4: Results

Note: The figure compares the model and the data for GDP per capita, the agricultural employment share, and the formal labor share. GDP per capita is normalized to 1940 = 1. In each year, observed GDP is used to construct an exogenous productivity component in the model. As productivity rises, household income increases and, due to non homothetic preferences, demand shifts toward non-agricultural goods. This induces a reallocation of labor out of agriculture and into non-agricultural activities. The formal labor share therefore evolves endogenously.

The share of agriculture in employment declines over time and, despite

an initial overshooting relative to the data, converges to a level close to that observed at the end of the period. The dynamics imposed by the model imply that as the agricultural employment share falls, the level of formal labor in the economy rises, approaching its current level. However, the model is less successful in replicating the more pronounced changes that occurred after 2010.

Two main findings emerge. First, the model replicates the process of structural change, accounting for 72% of the decline in the share of agricultural employment. Second, as the model captures structural change, it also reproduces the substantial increase in formalization, explaining 67% of the observed change over the period. When focusing on the first half of the sample, when the decline was steeper, the model explains 87.0% of the change.

I do not claim that structural change is the only factor behind the decline in informality. The purpose of the model is not to compare mechanisms but to illustrate one parsimonious channel. Even with its simplicity, the model reproduces a large share of the rise in formality over time.

Structural change driven by shifts in household consumption across sectors emerges as an important mechanism in the transition toward a more formal labor market. In the next section, I show that this pattern is present not only across sectors but also within sectors. Using Brazilian household consumption data, I reinforce how income growth and the associated reallocation of the consumption basket can increase the share of formal employment.

2.5 Within-sector evidence

Thus far, I have shown that the shift in demand across sectors, from agricultural to non-agricultural goods, is closely linked to a long-run reduction in informality. Nevertheless, this phenomenon also occurs within sectors. In this section, I show that the same pattern holds when considering only the non-agricultural sector. As households become richer, they allocate a larger share of their consumption to goods that are more intensive in formal labor.

2.5.1 Data and methodology

The analysis relies on two nationally representative data sources. First, I draw on the most recent *Pesquisa de Orçamentos Familiares* (POF), a household expenditure survey conducted by the IBGE. POF provides detailed information on income and consumption patterns across socioeconomic groups. Based on these data, I classify expenditures into two broad categories: necessities and luxuries. Following Bils and Klenow (1998) and Sonnervig (2023),

after categorizing expenditures, I compute a luxury index (ℓ_j for each category j (e.g., agricultural, electronics, education, etc.).

$$S_i^j = \alpha_j + \ell_j \log c_i + \varepsilon_i. \tag{2.18}$$

where S_i^j is the budget share of category j for household i and c_i is the per-capita total consumption expenditures of household i. The luxury index (ℓ_j) measure how the share of each category changes with per-capita consumption. The higher is ℓ_j, he more the item is considered a luxury. The lower is ℓ_j, the more the item is considered a necessity.

Table 2.A.3 reports the ranking of expenditure categories, normalized on a scale from zero to one. For ease of interpretation, goods closer to zero are classified as necessities, whereas goods closer to one are classified as luxuries. As expected, categories such as utilities and transport exhibit lower scores, whereas tourism and vehicles have higher scores. This pattern reflects the tendency for individuals to allocate a greater proportion of their income to these categories as their earnings increase. Conversely, lower-income individuals often do not consume goods and services from these higher-ranked categories.

I employ PNAD data to compute the share of formal workers in each category. I then combine these data to test the hypothesis that categories with a higher luxury index employ a larger share of formal labor.[2.12]

In the recent literature, Bachas et al. (2024) performs a related exercise using household expenditure surveys from 32 countries, classifying consumption as formal or informal according to the type of establishment where purchases occur. In contrast, I do not rely on the place of purchase. Instead, I assign formality status based on the sectoral composition of employment, linking consumption categories to the formal employment shares of the sectors that produce them using PNAD data. A comparable strategy of connecting consumption information from the POF to sectoral production data is employed by Teixeira et al. (2022).

2.5.2 Results

The results are presented in Figure 2.5. There is a clear trend indicating that categories with a low luxury index also tend to exhibit a lower proportion of formally registered workers. This pattern suggests that as goods and services become more luxury-oriented, that is, consumed in a higher proportion as income increases, they are associated with lower levels of informal employment.

[2.12] The mapping between codes is reported in Table 2.A.2.

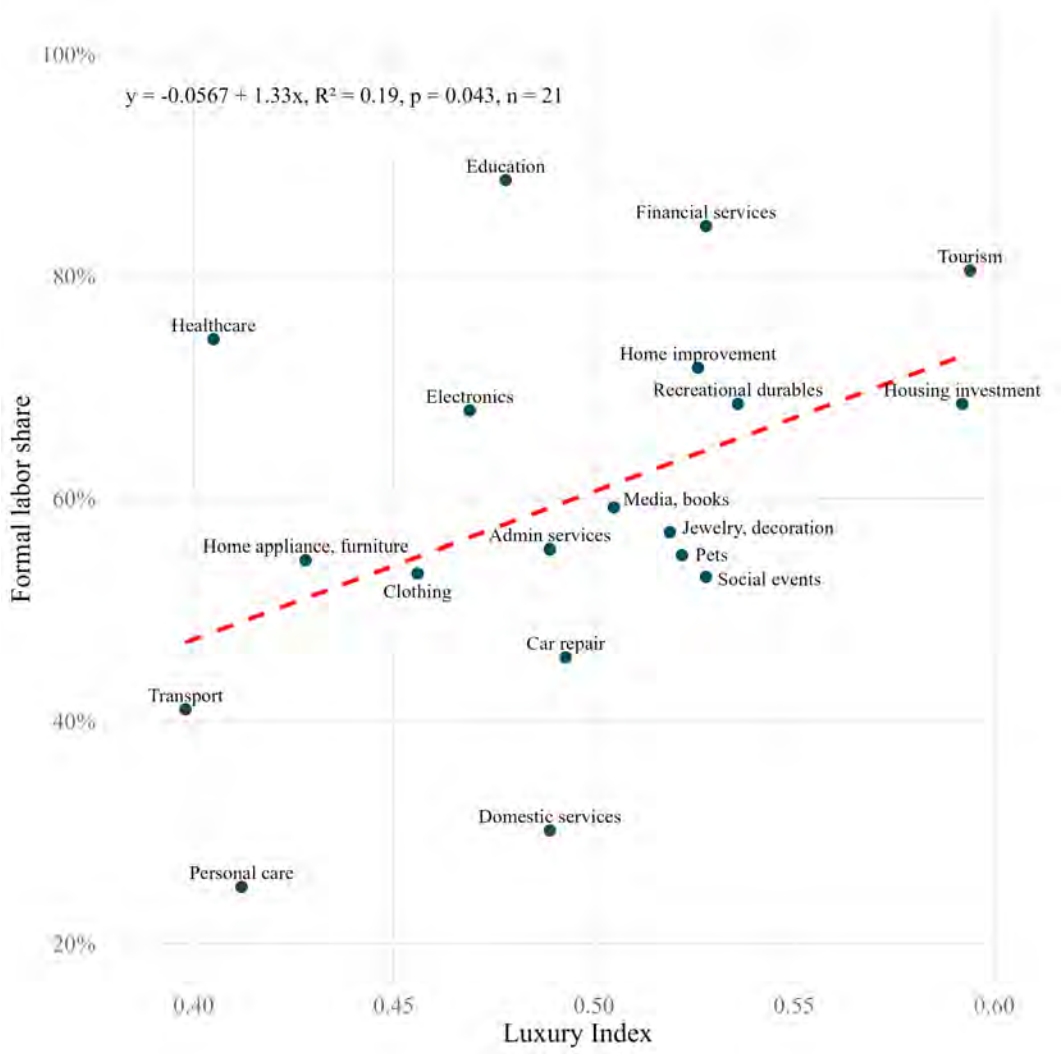

Figure 2.5: Formal labor share and luxury index for each category

Note: Each point represents a consumption category. The horizontal axis reports the luxury index, measuring the income elasticity of demand, while the vertical axis shows the corresponding formal employment share in production. The dashed line displays the OLS relationship across sectors. Utilities and Vehicles are omitted to improve visualization.

Another way to analyze the results is to examine how expenditures on luxury items evolve across different income groups. Based on this classification, I distinguish two groups: the six categories with the lowest luxury index, treated as necessities, and the remaining categories, considered luxuries. Figure 2.6 shows the share of expenditures on luxury items for each income decile. It is clear that this share rises consistently as income increases, with a more pronounced jump for the highest income decile.

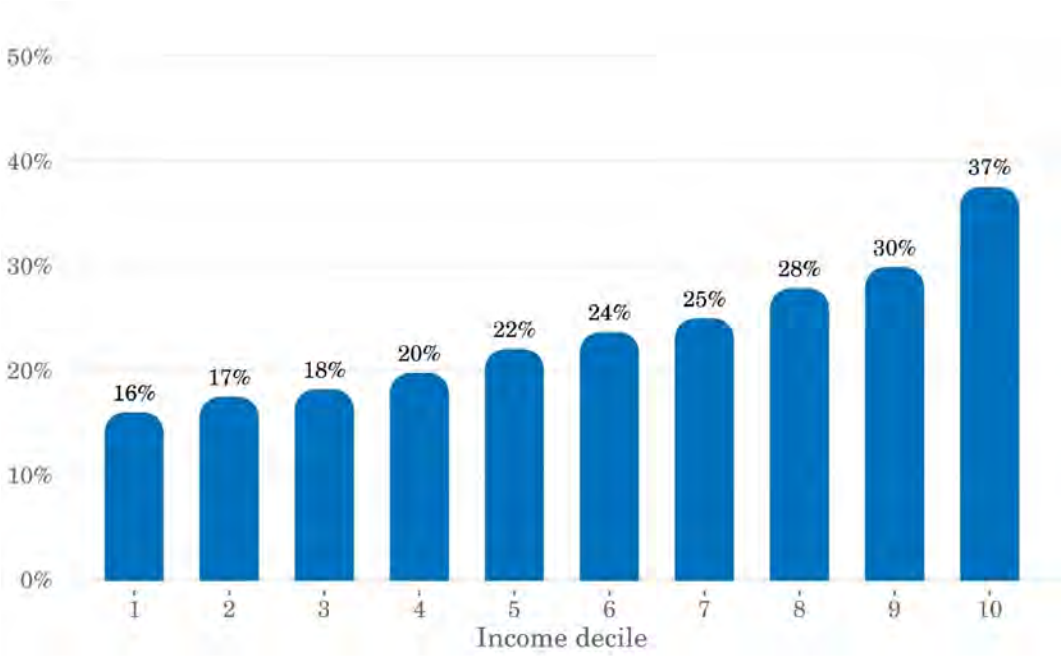

Figure 2.6: Luxury goods expenditure share by income decile

Note: The figure reports the share of total consumption expenditure devoted to luxury goods across income deciles. Luxury goods are defined as all categories other than utilities, transport, healthcare, personal care, home appliances, and clothing.

2.6 Conclusion

This chapter presents a theoretical model designed to explain the decline in informality as a consequence of structural change in the economy. As agriculture, which relies predominantly on informal labor, contracts, industry and services expand, leading to a gradual reduction in informal employment.

Calibrated with Brazilian data, the model accounts for 67% of the observed decline in informality over the period under consideration. Moreover, using household consumption data from Brazil, I show that even when focusing on non-agricultural products, there is a clear tendency for families to increase their consumption of goods that are more intensive in formal labor as income rises. This pattern reinforces the idea of a demand-driven mechanism behind the decline in informality: as economic growth raises household purchasing power, demand progressively shifts toward goods and services produced under formal labor arrangements.

The objective of the chapter is not to argue that structural change is the sole driver of the decline in informality. Rather, I emphasize that it constitutes an important factor that, by itself, explains a substantial share of the observed change.

One limitation of the model is that it tends to overshoot in the early years.

It would be valuable to explore alternative specifications of non homothetic preferences and structural mechanisms (Comin et al., 2021; Matsuyama, 2019; Marto, 2025). Another natural extension would be to incorporate capital, allowing for capital accumulation and sector specific capital to enrich the analysis. Nevertheless, the fact that such a relatively simple framework can account for a substantial share of the decline in informality is, in itself, a significant result.

2.A Appendix

2.A.1 Model derivations

Household first-order conditions:

$$C_{at}: \quad \omega^{\frac{1}{\varepsilon}} u'(C_t) \left(C_{at} - \bar{C}_a\right)^{-\frac{1}{\varepsilon}} C_t^{\frac{1}{\varepsilon}} = \Lambda_t. \tag{2.19}$$

$$C_{nt}: \quad (1-\omega)^{\frac{1}{\varepsilon}} u'(C_t) C_{nt}^{-\frac{1}{\varepsilon}} C_t^{\frac{1}{\varepsilon}} = \Lambda_t P_t. \tag{2.20}$$

Combine the first-order conditions

$$\left(\frac{1}{P_t}\right)^{\varepsilon} \frac{C_{at} - \bar{C}_a}{C_{nt}} = \frac{\omega}{1-\omega}. \tag{2.21}$$

Firms first-order conditions:

$$L_{ait}: \quad w_t = \gamma_n \frac{Y_{at}}{L_{ait}}, \qquad L_{aft}: \quad w_t = (1-\gamma_a)\frac{Y_{at}}{(1+\tau_L)L_{aft}}, \tag{2.22}$$

$$L_{nit}: \quad w_t = \gamma_n P_t \frac{Y_{nt}}{L_{nit}}, \qquad L_{nft}: \quad w_t = (1-\gamma_n) P_t \frac{Y_{nt}}{(1+\tau_L)L_{nft}}. \tag{2.23}$$

Take the ratios of the first-order conditions

$$P_t = \frac{\gamma_a}{\gamma_n}\frac{Y_{at}/L_{ait}}{Y_{nt}/L_{nit}}, \qquad \frac{L_{aft}}{L_{ait}} = \frac{1-\gamma_a}{\gamma_a(1+\tau_L)}, \qquad \frac{L_{nft}}{L_{nit}} = \frac{1-\gamma_n}{\gamma_n(1+\tau_L)}. \tag{2.24}$$

Solve for γ_n and γ_n

$$\gamma_a = \frac{1}{1+(1+\tau_L)\,L_{aft}/L_{ait}} \quad \text{and} \quad \gamma_n = \frac{1}{1+(1+\tau_L)\,L_{nft}/L_{nit}}. \tag{2.25}$$

Plug 2.9 into 2.24 to obtain the relative price

$$P_t = \Psi \frac{A_{at}}{A_{nt}}, \quad \text{where} \quad \Psi \equiv (1+\tau_L)^{\gamma_a - \gamma_n} \frac{\gamma_a^{\gamma_a}(1-\gamma_a)^{1-\gamma_a}}{\gamma_n^{\gamma_n}(1-\gamma_n)^{1-\gamma_n}}. \tag{2.26}$$

Proposition 1 proof

The extreme case $\gamma_a = 1$ and $\gamma_n = 0$ represents a situation in which the agricultural sector relies exclusively on informal labor, while the non-

agricultural sector employs only formal labor. In this case, the production function of each sector can be written as

$$C_{at} = A_{it} L_{it}. \tag{2.27}$$

$$C_{nt} = A_{ft} L_{ft}. \tag{2.28}$$

Solving the firm's problem leads to the following first-order conditions

$$L_{it} : w_t = A_{it}. \tag{2.29}$$

$$L_{ft} : (1+\tau) w_t = P_t A_{ft}. \tag{2.30}$$

Combine the first-order conditions

$$P_t = (1+\tau)\frac{A_{it}}{A_{ft}}. \tag{2.31}$$

The relative price depends on taxes and productivity in each sector. Combine the first-order conditions of households 2.21 and firms 2.31

$$C_{at} - \bar{C}_a = \frac{\omega}{1-\omega}(1+\tau)^{\varepsilon} \left(\frac{A_{it}}{A_{ft}}\right)^{\varepsilon} C_{nt}. \tag{2.32}$$

Use the sectoral production functions and labor market clearing 2.14

$$\begin{aligned} L_{it} &= \frac{1}{1+\psi}\left(\frac{\bar{C}_a}{A_{it}} + \psi\right), \\ L_{ft} &= \frac{1}{1+\psi}\left(1 - \frac{\bar{C}_a}{A_{it}}\right), \end{aligned} \qquad \text{where} \qquad \psi \equiv \frac{\omega}{1-\omega}(1+\tau)^{\varepsilon}\left(\frac{A_{ft}}{A_{it}}\right)^{1-\varepsilon}. \tag{2.33}$$

Take partial derivatives with respect to A_{it}

$$\frac{\partial L_{it}}{\partial A_{it}} = -\frac{1}{1+\psi}\frac{\bar{C}_a}{A_{it}^2} < 0. \tag{2.34}$$

$$\frac{\partial L_{ft}}{\partial A_{it}} = \frac{1}{1+\psi}\frac{\bar{C}_a}{A_{it}^2} > 0. \tag{2.35}$$

An uniform increase in productivity increases output and the share of formal labor L_{ft} in the economy, but decreases the share of informal labor L_{it}. The output elasticity of formal employment is

$$\eta \equiv \frac{\partial L_{ft}/L_{ft}}{\partial Y_t/Y_t} = \frac{\partial L_{ft}/L_{ft}}{\partial A_{it}/A_{it}} \Big/ \frac{\partial Y_t/Y_t}{\partial A_{it}/A_{it}}. \tag{2.36}$$

We then compute the productivity elasticity of output

$$\frac{\partial Y_t/Y_t}{\partial A_{it}/A_{it}} = (1+\tau L_{ft}) \cdot \frac{1}{(1+\tau L_{ft})} = 1. \tag{2.37}$$

Therefore, the output elasticity of formal employment is equal to the productivity elasticity of formal employment

$$\eta = \frac{\partial L_{ft}/L_{ft}}{\partial A_{it}/A_{it}} = \frac{\bar{C}_a}{(1+\psi)A_{it}L_{ft}} = \frac{\bar{C}_a}{(1+\psi)\mu C_{at}}. \tag{2.38}$$

2.A.2 Data

Table 2.A.1: Overview of census data by year

Year	Population (m)	GDP (m)	GDP per capita	Productivity per hour	Informality rate
1940	41,2	118.941	2.889,08	2,77	81,42%
1950	51,9	210.912	4.060,34	4,21	73,07%
1960	70,1	429.992	6.136,57	5,93	70,25%
1970	93,1	782.499	8.401,41	9,39	63,94%
1980	119,0	1.790.020	15.041,84	15,61	52,62%
1991	146,9	2.114.277	14.390,91	13,80	53,75%
2000	169,8	2.706.892	15.941,73	16,02	56,23%
2010	190,8	3.885.847	20.370,79	18,82	48,23%
2022	203,1	4.333.844	21.342,41	19,03	38,80%

Notes: The table presents data for the years corresponding to the Brazilian Population Census. The decennial Census occurred in 1991 (delayed from 1990) and in 2022 (delayed from 2020 due to budget constraints and the COVID-19 pandemic). Population and GDP are measured in millions.

2.A.3
Variable construction for the within non-agriculture analysis

Table 2.A.2: POF - PNAD classification mapping

Category	POF reference	PNAD reference
Admin services	40	69000, 82001
Vehicles	51	45010, 45030
Car repair	33	45020, 45040, 45060
Clothing	34 - 38	48041, 48042
Domestic services	19	97000
Education	49	48072, 85011, 85012, 85013, 85014, 85021, 85029
Electronics	15, 44	48010, 48073, 48074, 61000
Financial services	26, 48, 50	64000, 65000, 66001, 66002
Food	24, 63 - 69	48030, 48080, 48100, 56011, 56012, 56020
Healthcare	29, 42	48071, 86001, 86002, 86003, 86004, 86009, 87000
Home appliance, furniture	9, 16, 17, 39	33001, 48073, 48075, 77010, 95010, 95030
Home improvement	8, 11	41000, 42000, 43000, 48050, 71000, 81011, 81020, 95030, 97000
Housing investment	10, 12, 47	68000, 81012
Jewelry, decoration	18, 46	32001, 48079
Media, books	27, 32	48072
Personal care	30, 31	48071, 96010, 96020
Pets	13	48020, 75000
Recreational durables	28, 43	32003, 48074
Social events	45	48079, 77020, 82003, 91000, 93020, 94010, 94020, 94091
Tourism	41	51000, 55000, 79000
Transport	23	49010, 49030, 49090
Utilities	6, 7, 25	35021, 35022, 36000, 48076, 61000, 62000, 81011, 81012, 81020

Notes: POF categories are defined according to the *id_quadro*, which groups expenditures by categories. The data refer to the most recent available edition (2017–2018). PNAD categories follow the $V4013$ variable, mapped to CNAE economic activities according to the official Brazilian classification. For consistency, PNAD information is restricted to the same period covered by the latest POF.

Table 2.A.3: Luxury index ranking

	Description	Luxury index
1	Utilities	0
2	Transport	0.398
3	Healthcare	0.405
4	Personal care	0.412
5	Home appliance, furniture	0.428
6	Clothing	0.456
7	Electronics	0.469
8	Education	0.478
9	Admin services	0.489
10	Domestic services	0.489
11	Car repair	0.493
12	Media, books	0.505
13	Jewelry, decoration	0.519
14	Pets	0.522
15	Home improvement	0.526
16	Social events	0.528
17	Financial services	0.528
18	Recreational durables	0.536
19	Housing investment	0.592
20	Tourism	0.594
21	Vehicles	1.0

Notes: The table presents the luxury index by consumption category, computed using equation 2.18 and the mapping in Table 2.A.2. The index reflects how expenditure shares vary with per capita consumption.

3
Reductions in working hours and their spillovers into informal employment

Abstract: In this chapter, I study the recent Colombian labor reform that mandated a gradual reduction in the statutory workweek and examine its effects on labor market informality. To estimate its causal impact, I apply the synthetic control method to construct a credible counterfactual trajectory of informality in the absence of the reform. The results show that even before the law was fully implemented, the anticipation of shorter working hours altered labor market dynamics. Informal employment declined significantly, indicating that the reform was associated with a measurable increase in formalization. The findings provide new evidence on how anticipated changes in labor regulations can influence labor market outcomes.

Keywords: Labor market regulation; working hours reduction; informal employment; synthetic control

3.1 Introduction

Labor market regulations are central to shaping employment dynamics, particularly in developing economies where informal employment remains widespread. Among such regulations, limits on working hours have attracted increasing attention due to their dual objectives of improving worker well-being and fostering job creation. However, these policies can also affect employer incentives and often face political resistance, as they typically imply higher labor costs for firms (Lepinteur, 2019). More broadly, the effects of working time regulations depend on the extent to which firms can substitute workers for hours and on how workers are reallocated across firms (Carry, 2024).

On the one hand, reducing formal working hours can generate important benefits for workers, such as improved quality of life and better work-life balance, allowing more time for family and personal activities. Also, there is evidence that shorter working hours may enhance labor productivity by reducing fatigue and improving workers' physical and mental well-being (Messenger, 2018). On the other hand, from the firms' perspective, a reduction in weekly working hours may lead to increased labor costs, especially when not accompanied by proportional wage adjustments, as well as potential challenges in reorganizing production and maintaining competitiveness in highly efficient markets (Crépon and Kramarz, 2002).

In this chapter, I investigate the effects of a legislative reform in Colombia that gradually reduces the statutory maximum workweek. Approved in 2021, the reform aims to lower the legal weekly working hours from 48 in July 2023 to 42 in July 2026. Its primary objective is to improve work-life balance and align the country's labor standards with international recommendations. I seek to answer the following question: How does the reduction in legal working hours affect informality levels in Colombia?

To answer this question, I employ the synthetic control method. Using this approach, I construct a counterfactual version of Colombia by creating a weighted combination of other Latin American countries that did not implement similar policies. The methodology helps account for broader macroeconomic trends and country-specific characteristics that were already influencing Colombia before the reform, allowing for a more credible identification of the reform's effects.

The results indicate that even before the reform was fully implemented, the anticipation of reduced working hours had measurable impacts on labor market outcomes. In particular, the level of informality declined following the approval of the proposal to gradually reduce the statutory workweek for formal

employees. While it is not possible to determine the precise mechanism behind this reduction, both demand and supply side factors may have played a role. On the demand side, employers could have increased their reliance on formal labor to sustain output levels despite shorter individual working hours. On the supply side, workers may have become more inclined to accept formal employment, valuing the improved work life balance and working conditions implied by the reform.

In Colombia, since the approval of the *Código Sustantivo del Trabajo* (CST) in 1950, the legal limit for formal employment has been 48 hours per week. Across Latin America, this number varies: 40 hours in countries such as Ecuador and Venezuela, and 48 hours in countries such as Nicaragua, Panama, and Peru.[3.1] Figure 3.1 presents both the statutory working hours for formal workers and the actual average hours worked across Latin American countries.[3.2] Notably, although Colombia does not have the highest legally mandated workweek, it records one of the highest effective working time, exceeding 44 hours per week.

Since the end of World War I, national legislation has gradually shifted toward working hour limits below 48 hours per week. As noted by Lee et al. (2007), although the 48-hour standard remained prevalent in the postwar period, a 40-hour limit began to emerge in national laws by the mid-1930s and was formally recognized by international standards in 1962. By 1967, most countries had already adopted shorter statutory limits, with the 40-hour workweek gaining influence across industrialized nations and some parts of Africa, in contrast to Latin America and much of Asia, where the 48-hour standard largely persisted. This trend continued, and by 1984, the 40-hour workweek had become nearly as widespread as the traditional 48-hour model (ILO, 1984).

The ILO's most recent global report on working time (2022) shows that long working hours are still common in many parts of the world, especially in developing countries, and remain a challenge for work–life balance. The report also highlights how flexible work arrangements have become increasingly important, particularly during the COVID-19 pandemic, and suggests that improving both the length and the organization of working time should be a priority for public policy (Messenger et al., 2022).

Labor market regulations often affect formal and informal employment

[3.1] In Brazil, since the enactment of the current Constitution in 1988, formal workers have been allowed to work up to 44 hours per week, compared to the 48-hour limit established by the 1934 Constitution.

[3.2] Chile and Colombia are currently undergoing transitions: the legal workweek is set to decrease to 40 hours in Chile by 2028 and to 42 hours in Colombia.

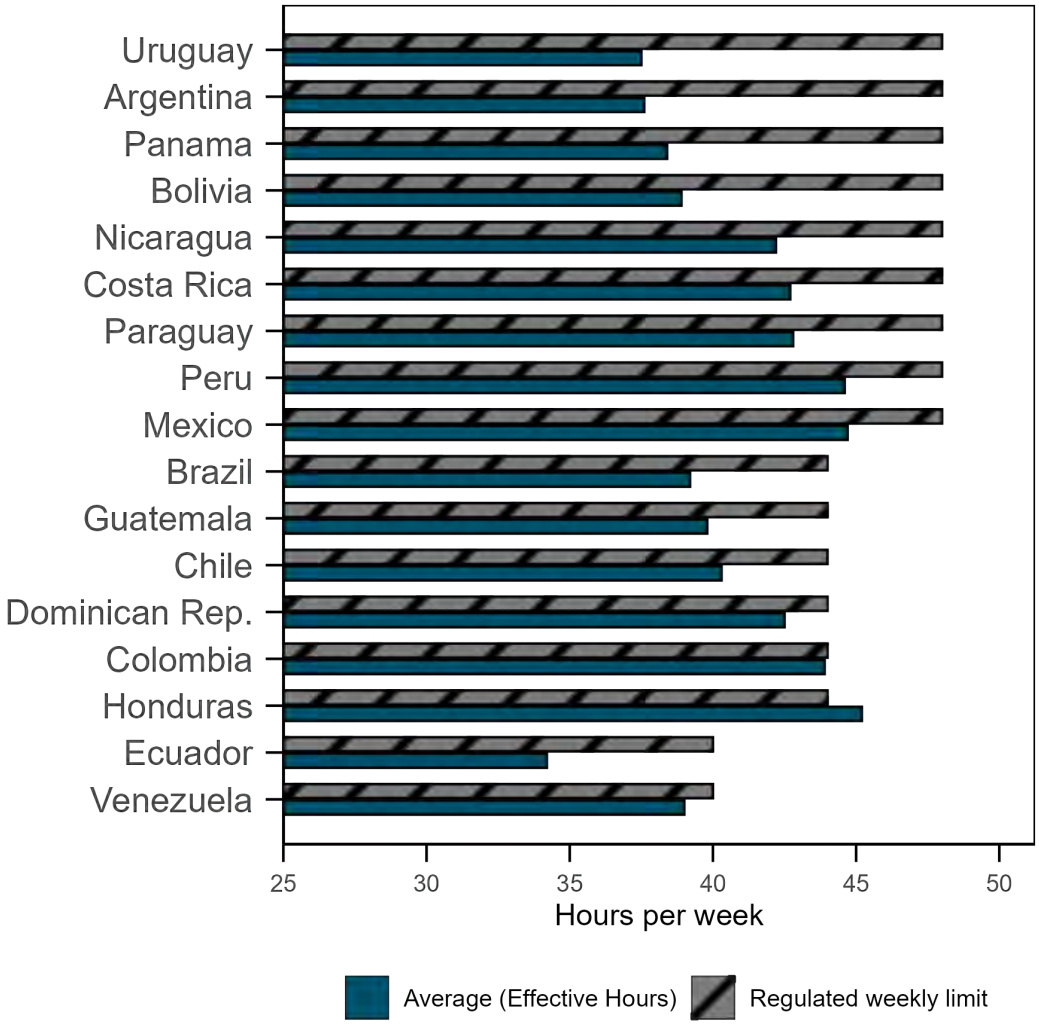

Figure 3.1: Weekly working hours in Latin America

Note: This figure presents the maximum regulated weekly working hours and the average weekly hours usually worked per employed person in each Latin American country. Source: Most recent Wages and Working Time Statistics (COND), ILO. Data for Cuba, El Salvador, and Haiti are not available. Detailed information on maximum regulated weekly working hours and actual hours, disaggregated by sex, is provided in Appendix 3.6.

differently because compliance is largely limited to covered workers. Evidence from Colombia shows that job security regulations primarily influence formal workers, while informal employment remains largely outside the scope of these rules. Using microdata from Colombian household surveys, Kugler (2004) shows that reductions in dismissal costs increased worker turnover in the formal sector relative to the informal sector, highlighting the segmented response of the labor market to regulatory changes. Evidence from the Colombian labor market during the COVID-19 shock shows that the informal sector displays substantially greater flexibility along both extensive and intensive margins. During the 2020 lockdown, average weekly hours among informal workers declined by about 28%, compared to a maximum reduction of only 18% among

formal workers, reflecting the greater rigidity of formal labor contracts (Alvarez et al., 2021). This contrast suggests that working time regulations primarily affect the formal sector, where hours and employment relationships are more tightly regulated.

This chapter contributes to the literature on labor regulations and informal employment in two main ways. First, it investigates a new case of working hours reduction, with a specific focus on its effects on formal employment. Table 3.1 presents several examples from the literature that examine similar reforms around the world. The literature explores a wide range of outcomes, including economic impacts, worker well-being,[3.3] and labor market dynamics. Most of these reforms took place in European countries. Some were motivated by the implementation of the European Working Time Directive (1993),[3.4] while others were adopted earlier as a response to high unemployment rates (Sánchez, 2013).

Table 3.1: Cases of international weekly working time reduction

Country	Years	Change	Reference
Japan	1987–1997	48h to 40h	Kawaguchi et al. (2008)
Brazil	1988	48h to 44h	Gonzaga et al. (2003)
Portugal	1996-1997	44h to 40h	Lepinteur (2019)
Italy	1997-2001	48h to 40h	Fedeli et al. (2008)
France	2000-2002	39h to 35h	Estevão and Sá (2008) Crépon and Kramarz (2002)
Belgium	2002	39h to 38h	Batut (2022)
Slovenia	2003	42h to 40h	Batut (2022)
S. Korea	2004–2011	44h to 40h	Lee et al. (2007)
Chile	2005	48h to 45h	Sánchez (2013)
Iceland	2015–2019	35/36h*	Haraldsson and Kellam (2021)

Note: The table reports documented national reforms that reduced statutory weekly working hours. "Change" indicates the legislated reduction in standard hours, not necessarily effective hours worked. Years correspond to the implementation period of the reform. * The Iceland case refers to a large scale pilot program conducted in the public sector rather than a nationwide legal reform.

Second, unlike most existing studies that emphasize the effects of fully implemented policies, this chapter highlights the anticipatory impact of regulatory announcements. The Colombian reform is still being phased in and will

[3.3] Another issue frequently discussed in the literature concerns the relationship between working hours and occupational accidents. Based on a meta-analysis of over 400 studies on occupational safety, Wagstaff and Lie (2011) found that working more than 8 hours per day substantially increases the likelihood of workplace accidents, with the risk nearly doubling in shifts of approximately 12 hours.

[3.4] A European Union directive (93/104/EC, later consolidated as 2003/88/EC) establishing minimum standards for working time, including limits on weekly working hours (maximum of 48 hours), daily and weekly rest periods, paid annual leave, and protections for night work, aiming to safeguard workers' health and safety.

only be fully implemented in 2026, when the statutory maximum workweek will be reduced to 42 hours.

Among the studies reviewed, those by Gonzaga et al. (2003) and Sánchez (2013) stand out as the most closely related to the focus of this chapter, as they analyze similar events that took place in other Latin American countries. In the Brazilian case, the authors find that, at least in the short run, the reduction in working hours had no negative effects on employment. They also note that the literature frequently documents that the informal sector in Brazil tends to replicate formal sector practices regarding benefits and contractual procedures, suggesting that the absence of effects may plausibly extend beyond formal employment. In the Chilean case, the evidence indicates that firms tended to delay adjustments until close to the policy deadline, suggesting non anticipatory behavior. The study also reports that the reduction in standard working hours had no significant effect on employment transitions.

In the case of Colombia, the reduction in working hours is still being implemented and is expected to be completed in July 2026. To the best of my knowledge, no paper has yet investigated its quantitative effects. A few studies, such as Carrillo (2022) and Castañeda et al. (2022), are limited to a descriptive analysis of the reform and emphasize its positive implications for workers.

The remainder of the chapter is organized as follows. Section 3.2 details the Colombian labor reform. Section 3.3 presents the data and methodology employed in the analysis. Section 3.4 discusses the main findings. Section 3.5 presents some robustness and placebo tests. Finally, Section 3.6 concludes the chapter by summarizing the key insights.

3.2 The Colombian working hours reform

In the years preceding the reform, the discussion on working time in Colombia emerged within a broader debate on labor market performance and job quality. Since the early 2000s, successive policy changes aimed at increasing labor market flexibility were introduced with the objective of stimulating employment creation. Although these measures reduced certain hiring costs and modified employment regulations, their effects on labor market outcomes remained limited, and concerns persisted regarding long working hours, job instability, and the unequal distribution of working time across workers (Acevedo et al., 2022).

The debate gained further relevance after the COVID-19 shock, which led to a sharp contraction in employment and intensified discussions about

alternative mechanisms to promote labor market recovery. Rather than focusing exclusively on cost reductions, policymakers increasingly considered the possibility of redistributing working time as a way to improve job quality and expand employment opportunities. In this context, the reduction of statutory working hours became a central policy proposal, framed as a structural adjustment intended to modernize labor regulation and align working conditions with international standards.

In July 2021, Colombia approved Law 2101, a legislative reform that gradually reduces the statutory maximum workweek from 48 to 42 hours. The reduction is scheduled to occur in four stages:

1. From 48 to 47 hours in July 2023
2. From 47 to 46 hours in July 2024
3. From 46 to 44 hours in July 2025
4. From 44 to 42 hours by July 2026

The reform mandates that workers' salaries and benefits remain unchanged throughout the transition, effectively increasing the hourly cost of labor. The legal structure allows flexibility in the distribution of weekly hours, provided that the total does not exceed the established limit and that at least one weekly rest day is observed.

The policy objective of the reform is to enhance work-life balance and promote worker well-being, aligning Colombia's labor standards with international recommendations. Specifically, the reform reflects the principles of the ILO's Recommendation No. 116, which advocates for the gradual reduction of working time without reductions in compensation. In addition to improving living conditions, the reform aims to encourage labor productivity gains and contribute to the modernization of labor market institutions.

Law 2101 was introduced in the context of broader efforts to update the country's labor framework. The gradual implementation schedule was designed to minimize adjustment costs and provide time for employers to adopt productivity-enhancing measures. The law also includes provisions for technical consultations among the Ministry of Labor, employer associations, and labor unions, with the aim of identifying mechanisms to support firms during the transition.

From an economic standpoint, the reform increases the cost of formal employment by requiring the same monthly wage for fewer hours worked. This change has implications for labor costs, particularly in sectors that rely on extended work schedules or weekend shifts. The potential for productivity gains to offset these higher costs depends on the adoption of organizational

improvements and technological adaptations. The phased nature of the reform is intended to facilitate these adjustments.

The effects on employment and informality are subject to debate. In theory, the reduction in standard working hours could lead to job creation if firms respond by hiring additional workers to maintain output levels. At the same time, higher effective labor costs may induce firms to reorganize production, adjusting hours, workforce composition, or contract structures. Because wages remain unchanged while statutory working hours decrease, the reform implies a higher hourly labor cost, requiring firms to either maintain productivity within fewer hours or rely more intensively on overtime. The overall impact will depend on firm level responses and the effectiveness of complementary policies to promote formalization and improve productivity.[3.5]

3.3 Data and methods

In this section, I describe the empirical strategy and the data employed, as well as the criteria adopted for selecting predictors in the synthetic control analysis.

3.3.1 Empirical strategy

To investigate how the reduction in formal working hours affects the informal labor market, I apply the synthetic control approach[3.6]. This method (Abadie and Gardeazabal, 2003; Abadie et al., 2010), under appropriate conditions, is well suited for comparative case studies in which a single unit (e.g., a country) is exposed to a policy intervention and a suitable counterfactual must be estimated.

In this context, the goal is to construct a "synthetic Colombia", a weighted average of other Latin American countries that were not exposed to the reform, such that this synthetic unit replicates the behavior of Colombia in the pre-reform period as closely as possible. The comparison between the observed trajectory of Colombia and that of its synthetic counterpart after the reform allows for the estimation of the causal effect of the policy.

The identification strategy is based on a synthetic control design in which the approval of the reform defines the treatment date and the counterfactual path is constructed from a weighted combination of comparison countries. The economic relevance of this timing relies on the idea that credible institutional

[3.5] Figure 3.A.2 presents inflation dynamics in Colombia relative to other Latin American economies over the study period.

[3.6] See Abadie (2021) for a detailed description of the method.

changes affect behavior through expectations rather than only through implementation. Evidence from the Brexit referendum shows that economic activity reacted immediately to the anticipated regulatory change instead of its effective enforcement Born et al. (2019). Analogously, the approval of the Colombian working hours reform altered firms' incentives and compliance decisions, allowing the estimated effects to be interpreted as responses to a regulatory shock rather than to gradual enforcement changes.

Let Y_{it} be the informality rate for country i at time t. Suppose there are $J+1$ countries in the sample, where only country $i=1$ (Colombia) is treated, and the remaining J countries form the donor pool. Let T_0 denote the last year before the reform is implemented. For $t \leq T_0$, all countries are untreated, and we observe $Y_{it}^N = Y_{it}$, where Y_{it}^N is the potential outcome in the absence of treatment. After the intervention ($t > T_0$), only the treated unit may be affected, and the treatment effect is defined as:

$$\alpha_{1t} = Y_{1t}^I - Y_{1t}^N, \tag{3.1}$$

where Y_{1t}^I is observed, and Y_{1t}^N must be estimated using the synthetic control.

To construct the synthetic control, I choose a set of non-negative weights $W = (w_2, \ldots, w_{J+1})'$ that sum to one. These weights define a convex combination of the donor countries. The optimal weights are chosen so that a set of pre-intervention characteristics of Colombia, including the informality rate and other predictors (described in detail in Section 3.3.3), closely match the weighted average of the same variables in the control units. Let X_1 be a $(k \times 1)$ vector of pre-treatment characteristics for Colombia, and X_0 a $(k \times J)$ matrix containing the same variables for the control countries. The optimal weights W^* are obtained by minimizing a weighted mean square error:

$$\min_W (X_1 - X_0 W)' V (X_1 - X_0 W), \tag{3.2}$$

subject to $w_j \geq 0$ and $\sum_{j=2}^{J+1} w_j = 1$, where V is a positive semidefinite matrix that reflects the relative importance of each predictor.

Once W^* is determined, the estimated counterfactual outcome for Colombia in the post-reform period is:

$$\hat{Y}_{1t}^N = \sum_{j=2}^{J+1} w_j^* Y_{jt}, \tag{3.3}$$

and the estimated treatment effect is given by:

$$\hat{\alpha}_{1t} = Y_{1t} - \hat{Y}_{1t}^N. \tag{3.4}$$

The validity of this method relies on the assumption that the synthetic control reproduces both observed and unobserved characteristics of the treated unit that affect the outcome, and that any divergence after the reform is attributable to the intervention itself. In practice, the quality of the synthetic control can be assessed by how closely it matches the pre-treatment trajectory of the treated unit.

The causal interpretation of the estimated effect depends on whether the weighted combination of donor countries approximates the trajectory that Colombia would have followed in the absence of the reform. This requires that the pre-intervention period is sufficiently informative about the relationship between the outcome and its underlying determinants. If the synthetic unit closely reproduces the pre-reform dynamics of informality, it becomes more plausible that it also captures the influence of unobserved factors affecting Colombia over time.

A potential concern arises if other structural changes affecting informality occur in Colombia around the time of the reform but are unrelated to the reduction in working hours. In such a case, the divergence between Colombia and its synthetic counterpart would reflect both the policy and these concurrent shocks. For this reason, the analysis focuses on a donor pool composed of countries with similar labor market structures and without major institutional reforms affecting informal employment during the period under study.

Another important consideration is the possibility of anticipation or gradual adjustment. Firms and workers may adjust labor arrangements prior to the formal implementation of the law, especially if the reform was announced in advance or phased in. In this scenario, part of the effect could appear before the official treatment date, potentially biasing the estimated post-reform impact. The empirical analysis therefore evaluates the stability of the estimated gap around the intervention date and verifies whether deviations emerge only after the policy becomes effective.

Several studies in the synthetic control literature highlight that the estimator can be sensitive to specification choices made by the researcher. As discussed by Ferman et al. (2020), the absence of clear guidance on the selection of predictors, the construction of pre-treatment summaries, and the choice of weighting matrices creates scope for specification searching, such that different admissible implementations of the method may yield substantially different estimated effects even when the pre-treatment fit appears satisfactory. Consequently, a good pre-intervention match alone does not guarantee reliable inference, and the credibility of the results depends on the stability of the

estimated effect across alternative specifications.[3.7]

Beyond specification sensitivity, another challenge concerns statistical inference in synthetic control settings. Alternative asymptotic frameworks and extensions, such as Xu (2017) and Gobillon and Magnac (2016), show that conventional placebo-based procedures may exhibit low power or size distortions, particularly in small samples or when the treated unit differs systematically from the donor pool . Related contributions derive confidence intervals or alternative estimators based on factor models or bootstrap approaches, indicating that the statistical properties of the estimator depend on strong assumptions regarding the cross-sectional dimension and the structure of unobserved heterogeneity (Carvalho et al., 2018). Overall, this literature suggests that inference in synthetic control designs is inherently delicate and that credible applications require complementary robustness and sensitivity analyses to support a causal interpretation.

3.3.2 Donor pool selection

As explained in the previous section, it is necessary to define a donor pool of countries from which data can be used to construct a counterfactual for Colombia. For this purpose, I establish a few selection criteria.

First, there must be some similarity between the countries in the donor pool and the treated country in terms of geographical and cultural aspects; therefore, Latin American countries were selected. Second, it is important to assume that there is no interference between units, meaning that the reform in Colombia does not affect the other members of the donor pool. Third, the selected countries must not have experienced a similar legislative change that altered working hours, as in the case of the treated country.

Figure 3.2 presents the countries included in the donor pool. Note that there are 19 Latin American countries besides Colombia. However, only 11 are used as donors. Venezuela and Ecuador were excluded due to their geographic proximity, which could potentially interfere with the results.[3.8] Guatemala, Cuba, Haiti, Honduras and Nicaragua were excluded due to the lack of essential data. Finally, Chile was excluded because it was undergoing a similar legislative reform, which could compromise the validity of the comparison.

[3.7] Several studies, such as Carvalho et al. (2018), Ben-Michael et al. (2021), and Arkhangelsky et al. (2021), propose methodological extensions intended to improve inference and robustness in synthetic control applications.

[3.8] Although Brazil and Panama also share borders with Colombia, they do not have direct overland connections with the country because of natural barriers such as the Amazon rainforest and the Darién Gap.

Figure 3.2: Donor countries

Note: Countries in yellow compose the donor pool used to construct the synthetic control for Colombia. Countries in gray are excluded due to major contemporaneous policy changes, missing data, or lack of comparability in labor market indicators during the pre treatment period. The selection is restricted to Latin American economies to ensure similarity in institutional and labor market conditions prior to the reform.

3.3.3 Data

An important concern in applications of the synthetic control method is the lack of clear guidance on the choice of predictor variables used to estimate the synthetic control weights. This makes it essential to combine theoretical considerations with empirical relevance for the study at hand.[3.9] To select the variables, I begin by reviewing the main determinants of informality highlighted in the literature, including economic development, structural

[3.9] See Ferman et al. (2020) for a discussion on the challenges of selecting predictors in the synthetic control method.

transformation, demographic dynamics, and labor market performance. Based on this review, I identify variables that are consistently available across countries and over time, and that provide a comprehensive characterization of these dimensions.

Macroeconomic and structural indicators, such as GDP per capita, GDP growth, inflation, and the share of industry in GDP, capture levels of development, cyclical fluctuations, and sectoral composition. Demographic variables, including population size, population growth, and urbanization, reflect labor supply and spatial dynamics. Social indicators, such as poverty and education attainment, provide information on living standards and human capital accumulation. Labor market indicators, including unemployment and labor force participation, capture the functioning and dynamics of labor markets. Finally, measures of inequality, such as the Gini index and the income share ratio between the top 10% and bottom 50%, along with the Human Development Index (HDI), are incorporated to capture distributional aspects and multidimensional development. Together, this set of variables balances theoretical relevance with data availability and comparability across countries.[3.10]

Once the candidate predictors are defined, I follow the approach recommended by Abadie (2021), who highlights the Root Mean Squared Prediction Error (RMSPE) as the key diagnostic for pre-treatment fit. A low RMSPE ensures that the synthetic control provides a credible approximation of the treated unit prior to the intervention. Moreover, the ratio of post- to pre-treatment RMSPE, together with placebo tests, makes it possible to assess whether the divergence observed after the reform is large relative to the quality of the pre-treatment fit. By combining these elements, I avoid the pitfalls of specification searches and ensure that the final set of predictors is selected in a consistent way. Table 3.2 provides a description of the variables selected as predictors in the analysis.

Former levels of informality are also included as predictors in the synthetic control fit. I selected two pre-treatment years, 2012 and 2018, based on the criterion of minimizing the RMSPE. Figure 3.3 displays differences in informality levels across Latin American countries in 2021, the year the reform was approved. Colombia ranked ninth, with an informality rate of 63.2%. By 2024, Colombia moved to the eleventh position.

Table 3.3 reports descriptive statistics for the variables used in the donor pool countries considered for the construction of the synthetic Colombia.

[3.10] Table 3.A.2 in Appendix 3.6 details the full set of variables considered in this process.

Table 3.2: Variables used as predictors

Variable	Description	Source
GDP per capita	Ln GDP per capita (US$) PPP	World Bank
GDP growth	Annual GDP growth (%)	World Bank
Labor participation rate	Total population ages 15+ (%)	ILO
Poverty	Population living below poverty line*	World Bank
Urban population growth	Annual growth rate (%)	World Bank
HDI	Human Development Index	World Bank

Note: The table lists the pre treatment predictors used to match Colombia with the donor countries in the synthetic control procedure. These variables capture structural economic conditions, labor market participation, and living standards, which are key determinants of employment dynamics. All predictors are averaged over the pre reform period (2010–2021) to ensure comparability before treatment. * Poverty refers to the international poverty line of US$2.15 per day (2017 PPP).

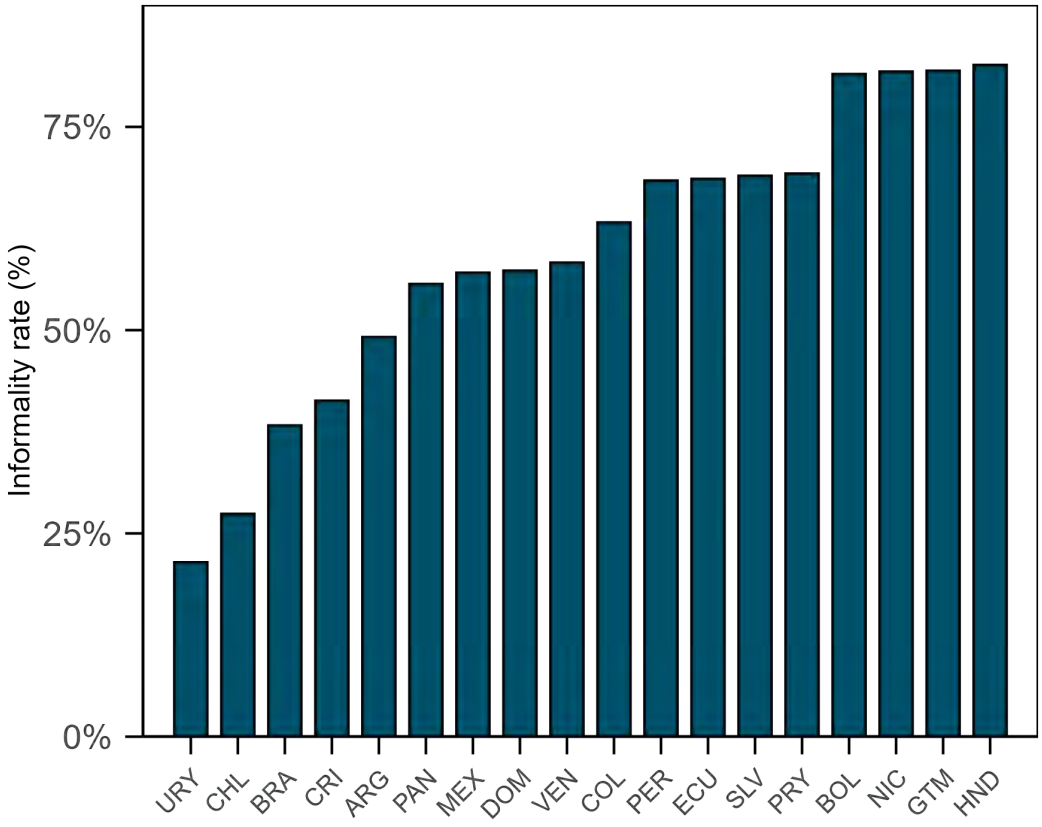

Figure 3.3: Informality across Latin American countries

Note: This figure reports informality rates across Latin American countries based on ILO definitions. Values correspond to 2021 or the closest previous year with available information, which may vary across countries. Informality refers to employment without formal labor registration or social security contributions. Source: ILOSDG database. Data for Cuba and Haiti are unavailable.

3.4 Results

Figure 3.4 shows the evolution of the informality rate in Colombia and in the rest of Latin America during the analysis period. A sharp decline is

Table 3.3: Descriptive statistics

	Mean	Median	SD	Min	Max
Ln GDP per capita	9.61	9.64	0.40	8.54	10.40
GDP growth	3.12	3.54	4.69	-17.80	16.50
Poverty	2.88	2.30	2.05	0.10	9.40
Labor participation rate	64.6	63.7	5.2	56.0	79.2
Urban population growth	1.56	1.64	0.61	0.02	2.94
HDI	0.76	0.76	0.05	0.66	0.85
Informality rate	56.2	56.3	15.1	21.4	85.2

Note: The table reports summary statistics for the outcome and predictor variables. Observations are at the country year level. Informality is available for 2010–2024, while the remaining predictors cover the pre reform period (2010–2021). Statistics are computed using all country year observations in the sample.

observed in Colombia following the approval of Law 2101, bringing the country closer to the regional average. While the average trend across Latin American countries remains largely unchanged, Colombia's informality rate fell from 63.2% in 2021 to 56.1% in 2024.

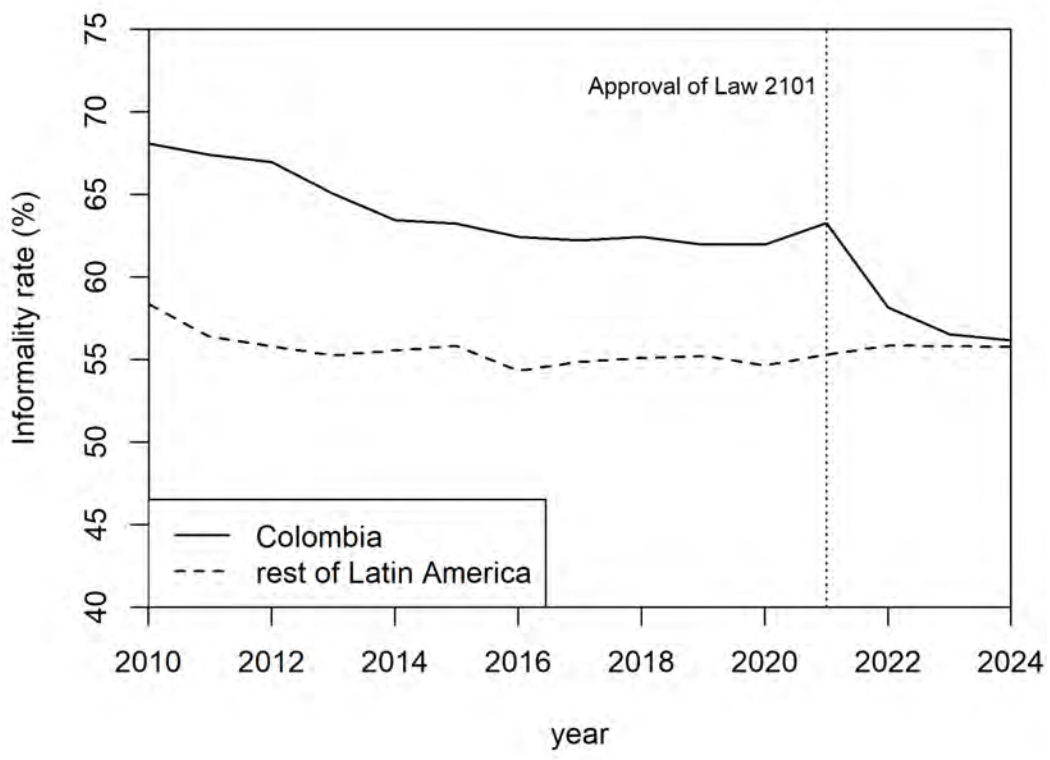

Figure 3.4: Informality rate: Colombia vs. the rest of Latin America

Note: The solid line represents Colombia's informality rate, and the dashed line corresponds to the average informality rate of the Latin American countries included in the donor pool. The vertical line marks the approval of Law 2101. Informality follows ILO definitions. Source: ILOSDG database, ILO.

Table 3.4 shows the weights assigned to each country in the donor pool

used to construct the synthetic Colombia. The synthetic control is composed of a weighted combination of five countries: Peru, Mexico, Bolivia, Brazil, and Dominican Republic. Once the synthetic counterpart is constructed, it is necessary to verify the differences in predictor variables between Colombia and synthetic Colombia, as they should be sufficiently close in order to constitute a credible counterfactual. Table 3.5 summarizes these differences, as well as the average values of all countries in the donor pool used in the analysis.

Table 3.4: Country weights in the synthetic Colombia

Country	Weight
Argentina	0
Bolivia	0.085
Brazil	0.073
Costa Rica	0
Dominican Republic	0.067
El Salvador	0
Mexico	0.352
Panama	0
Paraguay	0
Peru	0.423
Uruguay	0

Note: The table shows the weights used to construct synthetic Colombia. Countries with positive weights form the counterfactual, whereas zero weights indicate exclusion from the synthetic unit.

Table 3.5: Colombia vs. synthetic Colombia

Variables	Colombia		Average of 11 controls
	Real	Synthetic	
Ln GDP per capita	9.510	9.530	9.598
GDP growth	2.723	2.454	2.556
Poverty	6.055	4.118	2.645
Labor part. rate	66.305	68.301	64.500
Urban pop. growth	1.659	1.530	1.593
HDI	0.754	0.752	0.758
Informality rate 2012	66.953	65.187	55.815
Informality rate 2018	62.421	62.725	55.091

Note: The table reports pre reform characteristics for Colombia, synthetic Colombia, and the simple average of the donor pool countries. The similarity between Colombia and the synthetic unit reflects how closely the synthetic control reproduces pre reform characteristics.

Note that the differences between real Colombia and synthetic Colombia are very small, with only the poverty variable showing a noticeable discrepancy. This indicates that the synthetic counterfactual constructed for comparison

with the treated country can be considered credible. Hence, it is possible to compare the trajectory of the informality rate in both cases. Figure 3.5 illustrates them. Colombia and its synthetic counterpart display very similar behavior in the pre-treatment period, but the trend diverges substantially thereafter: while Colombia experiences a significant decline, the synthetic counterpart instead shows a slight increase in the year following the approval of the law.

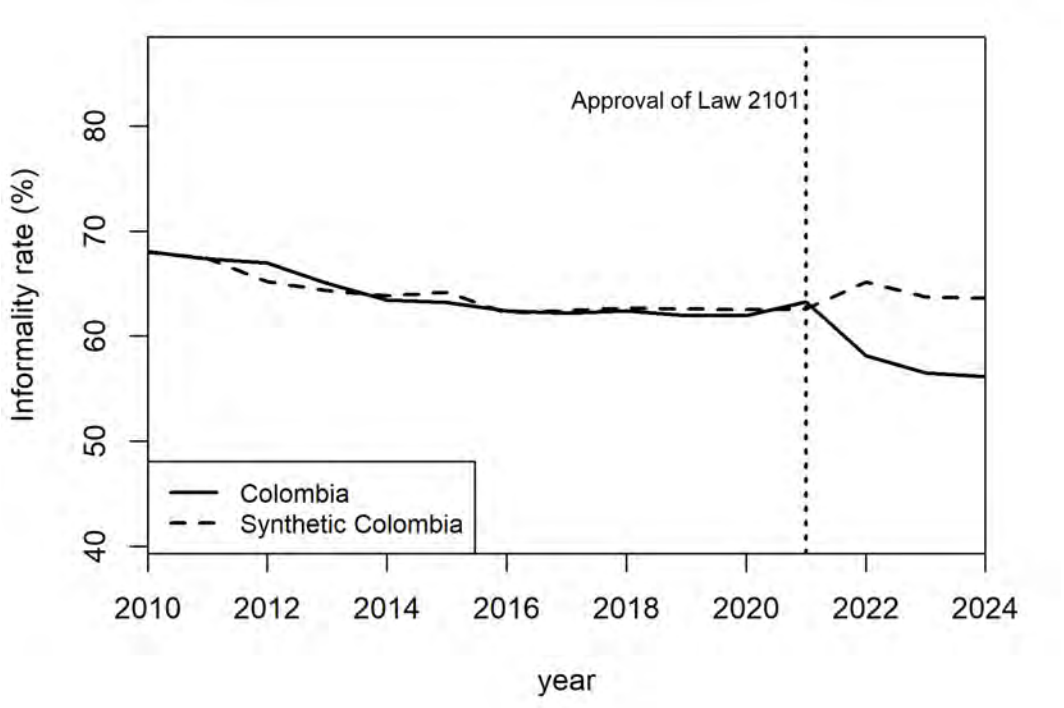

Figure 3.5: Informality: Colombia vs. synthetic Colombia

Note: The figure presents the informality rate in Colombia and its synthetic counterpart over the analysis period. The dashed vertical line marks the approval of Law 2101, which reduced statutory working hours.

Moreover, Figure 3.6 shows the gap between Colombia and its synthetic counterpart. By construction, the gap remains close to zero between 2010 and 2021. However, it decreases sharply to –5.99% in 2022 and reaches –7.44% in 2024.

3.5 Robustness checks

I perform two different placebo tests to assess the robustness of the results. In the first test, I apply the synthetic control method to estimate the impact of Law 2101 in Colombia across all countries in the donor pool. In each placebo iteration, one donor country is artificially considered as treated in 2021, while Colombia is reassigned to the control group. The purpose of

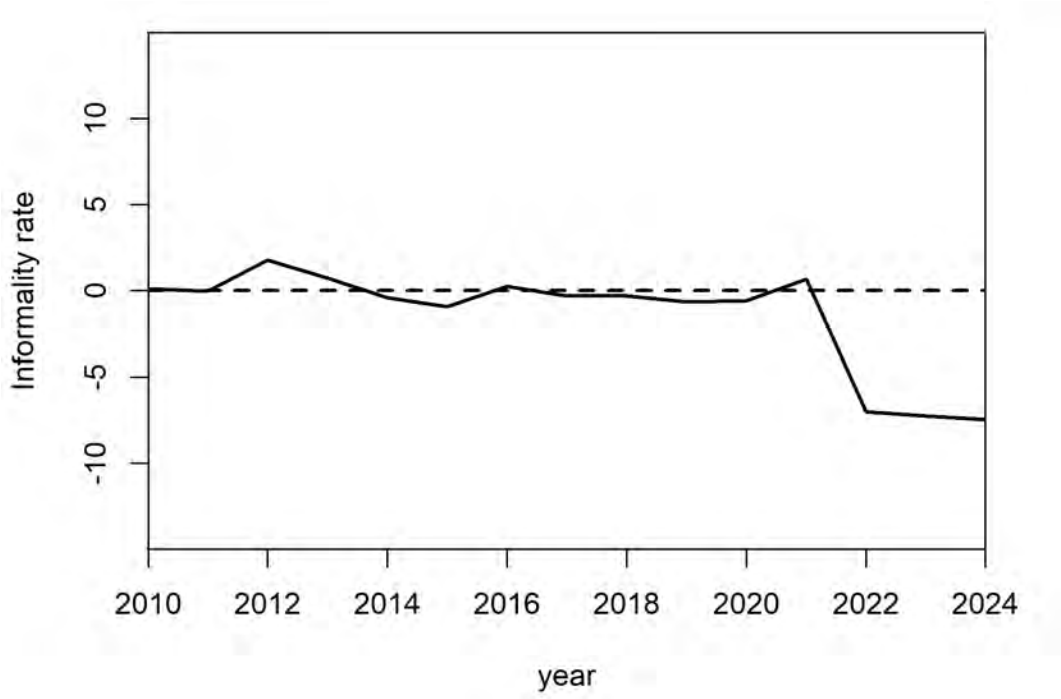

Figure 3.6: Informality gap between Colombia and synthetic Colombia

Note: The figure plots the gap between Colombia's informality rate and that of its synthetic counterpart over the analysis period (Colombia minus synthetic). Negative values indicate lower informality in Colombia relative to the synthetic control.

this exercise is to examine whether the gap observed in Figure 3.6 could be explained by factors other than Law 2101 Abadie et al. (2010).[3.11]

The purpose of the placebo test is to verify whether the trajectory of the treated country differs systematically from those of the non-treated units. If the gap estimated for Colombia is located at the extremes of the distribution of placebo gaps, this indicates that the effect of Law 2101 is statistically significant. Figure 3.7 presents the results of this exercise. The gray lines represent the gaps obtained for each placebo country, while the red line corresponds to Colombia. As shown in the figure, the Colombian trajectory lies at the lower bound of the distribution of placebo gaps, which provides evidence of robustness and supports the interpretation that the observed effect is not driven by random variation.

The second test consists of a temporal placebo. The idea behind this exercise is to verify whether the effect identified in 2021 is not spurious. For this purpose, a new synthetic series was generated by shifting the pre-treatment cutoff back a few years, to 2018. The synthetic trajectory, shown in Figure 3.8, closely resembles the results in Figure 3.5. This indicates that moving the pre-

[3.11] As another robustness check, I conduct an additional simulation including Ecuador in the donor pool. Venezuela, another neighboring country previously excluded, lacks the necessary data. The inclusion of Ecuador did not alter the results.

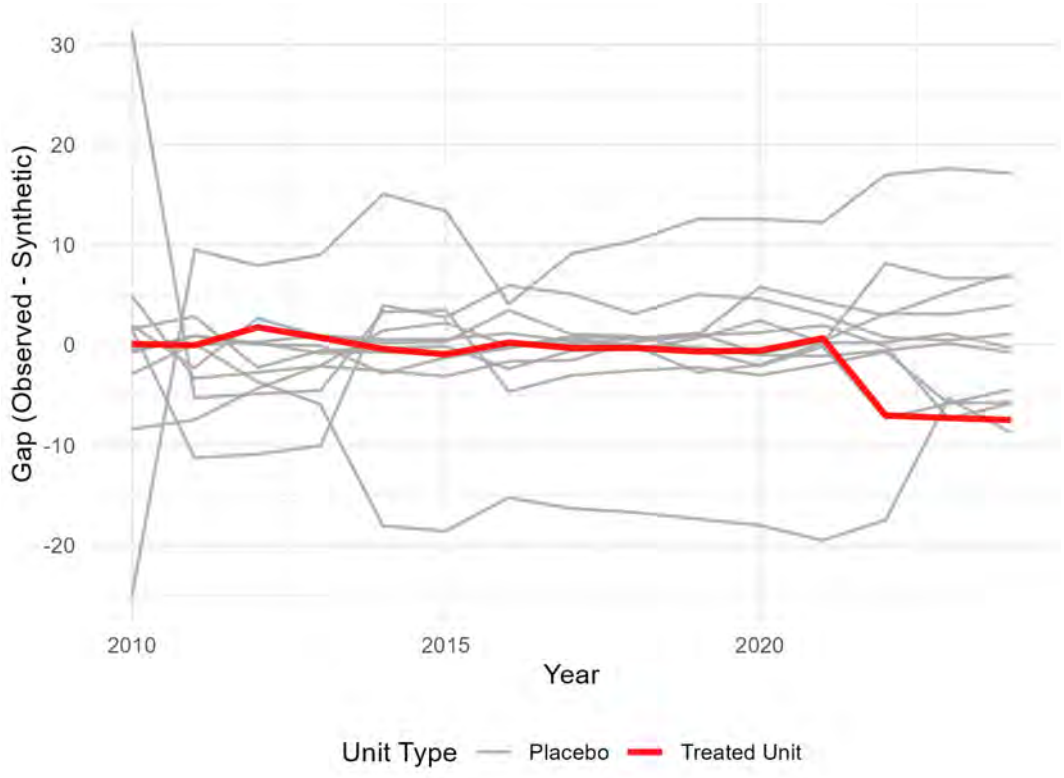

Figure 3.7: Placebo tests

Note: The red line shows the gap for Colombia, and the gray lines represent placebo gaps obtained by assigning the treatment to each donor country. The figure allows comparison between the observed effect and the distribution of placebo effects across untreated units.

shock period back to 2018 does not alter the findings, thereby reinforcing the robustness of the results.

The findings are robust, although some limitations should be acknowledged. The analysis does not capture potential long-term adjustments in labor supply or productivity, which may unfold gradually as the reform takes full effect. While the synthetic control method provides a credible counterfactual, unobserved factors specific to Colombia may still influence the estimates. In addition, the fact that the analysis period overlaps with the COVID-19 pandemic may be problematic, as additional unobserved shocks could have affected labor market outcomes.

A further limitation concerns the interpretation of spillover effects into informal employment. The available data allow us to track employment status but not actual hours worked, effort, or contractual adjustments within jobs. As a result, changes in informal employment may reflect adjustments along unobserved margins, such as work intensity or shifts between occupations, rather than direct displacement from formal jobs. Moreover, the classification of informality relies on survey definitions that may not fully capture heterogeneous arrangements typical of developing labor markets. Therefore, the results

identify the net employment response, but not the mechanisms through which firms and workers accommodated the reduction in standard hours.

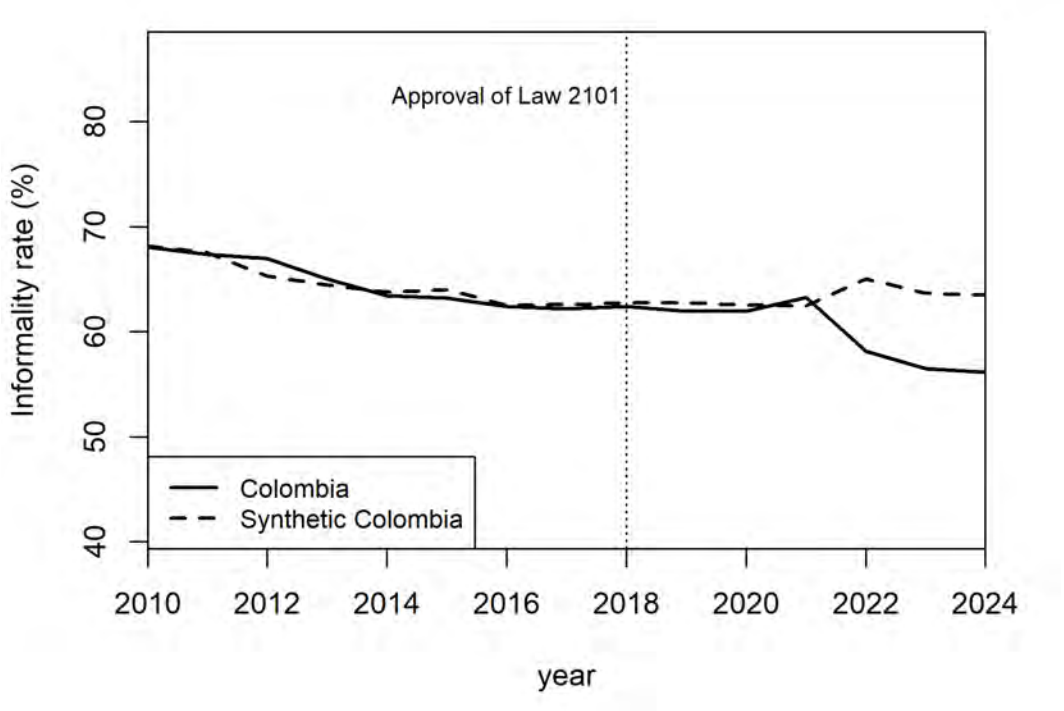

Figure 3.8: Temporal placebo test

Note: The figure presents a temporal placebo test in which the treatment is artificially assigned to 2018. Colombia and its synthetic counterpart are re estimated under this assumption to verify whether a similar divergence would appear before the actual reform.

3.6 Conclusion

In this chapter, I investigate the effect of reducing weekly working hours on the informality rate. For this purpose, I exploit the 2021 labor reform in Colombia, which introduced a gradual reduction in the statutory weekly working hours to be completed by 2026. Using the synthetic control method, I construct a counterfactual to assess how the level of informality in the population responds to this legislative change.

The findings indicate that the approval of the law led to a decrease in the level of informality in the Colombian economy in the year following its enactment. The counterfactual, constructed using Latin American countries that did not experience similar reforms, followed a different trajectory, with no substantial changes observed. Additional tests using alternative combinations of predictor variables, as well as placebo tests, confirm the robustness of the findings.

Some limitations affect the analysis, particularly the relatively small number of predictor countries. This restriction arises both from technical issues, such as data unavailability, and from methodological considerations, including the exclusion of neighboring countries like Ecuador and Venezuela. In addition, the post-intervention period available for evaluation remains short. Since the reform is still being implemented gradually, reducing statutory weekly working hours from 48 to 42 by mid-2026, the results should be interpreted as preliminary. A new assessment after full implementation is therefore warranted, as more substantial effects may emerge over time. At the same time, the ongoing nature of the reform highlights the presence of anticipatory effects, with economic agents apparently adjusting in advance, as reflected in the decline in informality relative to the counterfactual scenario.

Future research should investigate the mechanisms underlying the observed reduction in informality. Informality should be analyzed jointly with unemployment, since recent evidence for Latin American labor markets suggests that both may represent alternative adjustment margins (Aristizabal-Ramirez et al., 2024). Further analysis incorporating labor demand responses and worker reallocation across employment states would help clarify the channels through which working-hours regulation affects labor market outcomes. Extending the post-reform horizon and employing complementary identification strategies would also allow a more definitive evaluation of the policy.

Finally, it is not possible to determine whether the observed reduction stems from demand-side factors, supply-side factors, or a combination of both. The results should therefore be understood as a preliminary assessment of the reform's impact on informality. Further research using complementary methodologies and a broader evaluation after full implementation is strongly recommended.

3.A Appendix

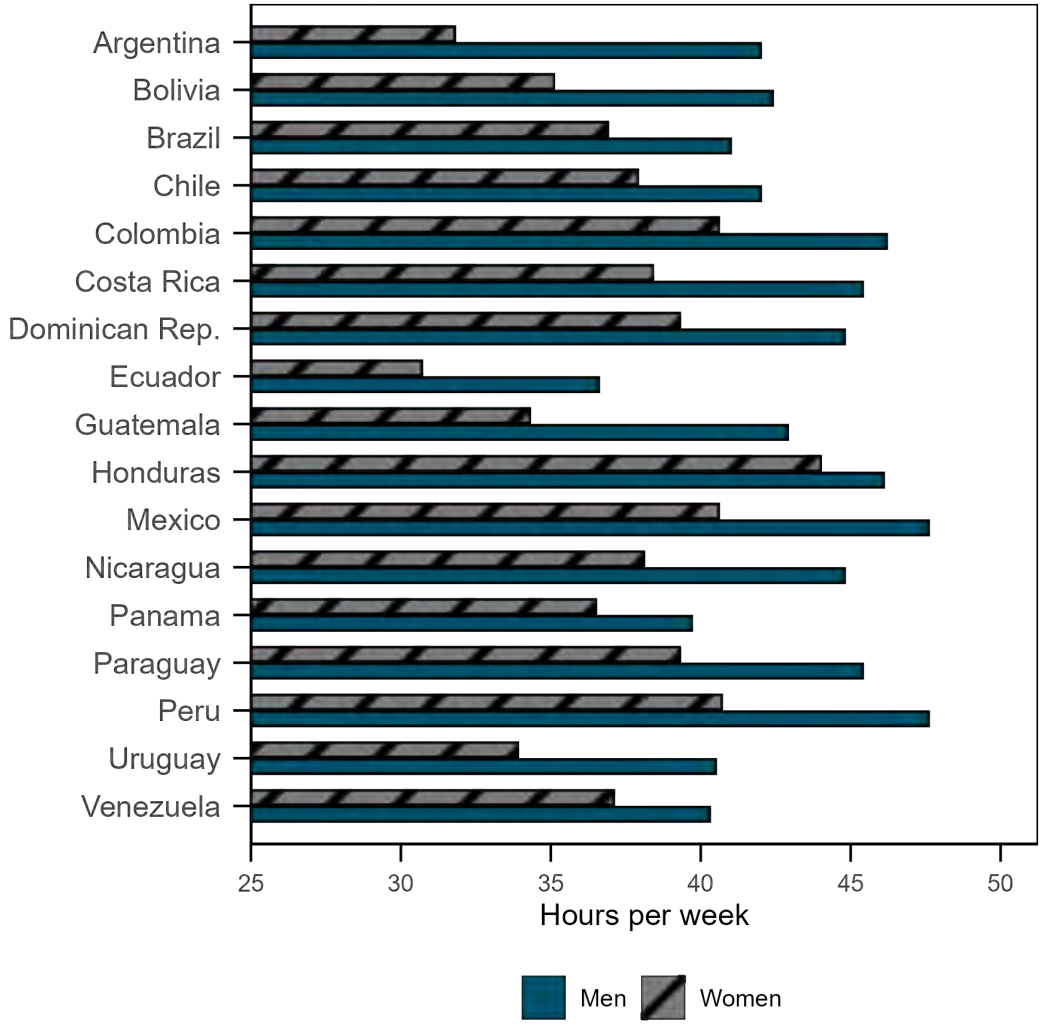

Figure 3.A.1: Weekly hours usually worked per employed person by sex

Note: The figure reports average usual weekly hours worked by employed individuals, separately for men and women, across Latin American countries. Hours refer to actual hours worked rather than statutory limits. Source: ILO Working Time Statistics (COND). Data for Cuba, El Salvador, and Haiti are unavailable.

Table 3.A.1: Maximum regulated weekly working hours in Latin American countries.

Country	Weekly limit	Observations
Argentina	48h	
Bolivia	48h	Night: 42h; mixed: 45h
Brazil	44h	
Chile	44h	To 42h (2026) and 40h (2028)
Colombia	44h	To 42h in July 2026
Costa Rica	48h	Night: 36h
Cuba	44h	Night: 36h
Dominican Rep.	44h	
Ecuador	40h	
El Salvador	44h	Night: 36h; mixed: 42h
Guatemala	44h	Night: 36h
Haiti	48h	
Honduras	44h	Night: 36h; mixed: 42h
Mexico	48h	Night: 42h; mixed: 45h
Nicaragua	48h	Night: 36h; mixed: 42h
Panama	48h	Night: 42h; mixed: 45h
Paraguay	48h	Night: 42h; mixed: 45h
Peru	48h	
Uruguay	48h	Industry: 48h; commerce: 44h
Venezuela	40h	Night: 35h; mixed: 37.5h

Notes: The table reports statutory maximum weekly working hours established by national legislation. "Weekly limit" refers to daytime work, while night and mixed schedules follow specific legal provisions that allow shorter limits. Reported values correspond to legal limits. Source: National constitutions and labor laws of each country and Rivermate.

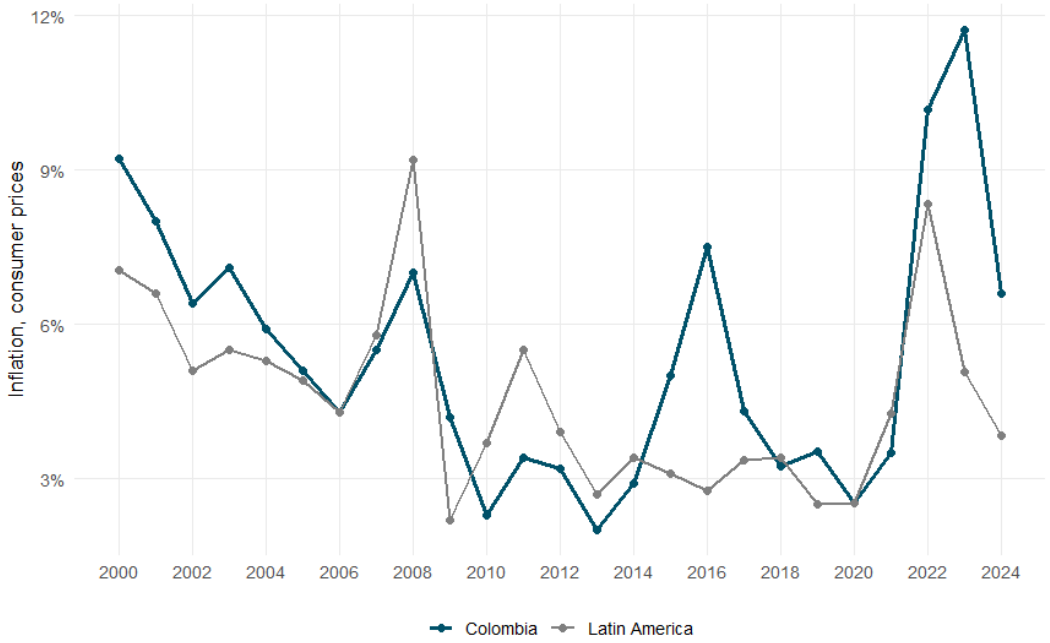

Figure 3.A.2: Inflation: Colombia vs. Latin America

Note: The figure plots consumer price inflation in Colombia and the Latin America and Caribbean (excluding high income) aggregate from the World Bank.

Table 3.A.2: Candidate Predictors for the Synthetic Control

Variable	Description	Source
GDP per capita	GDP per capita (US$) PPP	World Bank
GDP growth	Annual GDP growth	World Bank
Inflation	Annual GDP deflator	World Bank
Industry share of GDP	Industry share of product	Our World in Data
Poverty	Pop. living below poverty line*	World Bank
Gini index	Distribution of income	World Bank
Income inequality	Top 10% / Bottom 50% income	World Ineq. Data
Unemployment	Unemployment rate	ILO
Labor participation rate	Total population ages 15+	ILO
Share of high education	Labor force with post-secondary	ILO
Population	Total population	World Bank
Population growth	Annual growth rate	World Bank
Urban Population	People living in urban areas	World Bank
Urban Pop. growth	Annual growth rate	World Bank
HDI	Human Development Index	World Bank
Doing Business	Ease of doing business index	World Bank
Informality	Informal labor	ILO

Notes: The table lists all variables evaluated as potential predictors in the construction of the synthetic control. From this set, a subset is selected to obtain the pre reform match. Data cover the period 2010–2021. *Poverty refers to the international poverty line of US$2.15 per day (2017 PPP).

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