Essays in Labour Economics: mobility, gender and generational perspectives

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Ai miei genitori e a mio nonno

Certificate of Originality

I hereby declare that except where specific reference is made to the work of others, the contents of this dissertation are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other university.

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Certificate of Authorship and Co-authorship

This section contains an overview on the role of the co-authors in the realization of this thesis.

- **Local labor markets with non-homothetic preferences.** Paper written with my supervisor Gabriele Cardullo (University of Genoa). The discussion paper is available at SSRN: *https://ssrn.com/abstract=4628074* or *http://dx.doi.org/10.2139/ssrn.4628074*. The paper is also accessible on *https://docs.iza.org/dp16533.pdf*.
  My coauthor focused on the theoretical model: the basic framework and the equilibriums, while I handled the data research, calibration, simulation and robustness analysis. For the thesis I add the robustness analysis and the literature review.

- **The mother hen effect and students' mobility: a gravity approach**. This study is a single-authored paper. I want to express my gratitude for the essential help and constant support to Skerdilajda Zanaj (University of Luxembourg). Many thanks also to Gabriele Lombardi (University of Florence).

- **The young side of agriculture**. Paper written with Chiara Baggetta (University of Genoa) and Yari Vecchio (University of Bologna). For the initial idea of this analysis we were inspired by our previous work for the short paper *The young side of agriculture: a focus on the Ligurian case* (currently submitted for the ASA 2023 Conference Short Paper Book). The work has been expanded and modified, partially changing the research question and totally changing the territory analysed (we no longer have a single region, but the en-

tire country) and the methods used. In particular, for the following work, Yari took care of the management of the FADN data, Chiara and I collaborated closely in the drafting of the paper, in the development of the empirical model and in the analysis of the results. For the FADN Data Availability Statement: restrictions apply to the availability of these data. The data were obtained from the Council for Agricultural Research and Economics (CREA) and are accessible at the URL https://bancadatirica.crea.gov.it/Account/Login.aspx with the permission of CREA. Acknowledgments: We gratefully acknowledge the support of CREA for making the RICA data available to the research team (https://www.crea.gov.it/accordi-nazionali).

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Preface

This thesis is the result of my PhD journey. The research is carried out during the course of Economics and Political Economy at the University of Genoa and during my visiting period at the University of Luxembourg.

My works focus on three vulnerable actors in the labor market: the unemployed, the mothers, and the youth. Inequality is a phenomenon that can be studied from various perspectives, and that's what I have attempted to do in my PhD path.

The first chapter theoretically examines local shocks' effects on income inequality, employment, and living costs via a search and matching model calibrated with German data. Results show limited employment gains but significant impacts on housing prices and income inequality, particularly affecting poorer and unemployed individuals due to non-homothetic utility functions.

The second chapter investigates how women's emancipation, measured by regional employment rates and female-headed households, influences aggregated student mobility using a gravity model on Italian data. Results reveal a "mother-hen" effect: the more emancipated women are in terms of salary and employment, the less temporary migration for education.

The third chapter explores the relationship between European policies for young Italian farmers and their business improvement, measured by Return on Equity. The study utilizes individual-level data from 2008 to 2020, showing the positive relationship between dedicated funding and young farmers' economic performance through various regression models.

Introduction

Four out of five people in the OECD believe that income inequalities are excessive in their respective countries (OECD (2021)). Especially in recent decades, various societal shifts have influenced critical aspects of human life, from wealth disparity to gender issue and aging population. This thesis embarks on a multifaceted exploration of these phenomena, aiming to illuminate their complexities and implications across different domains. Through a synthesis of three distinct yet interconnected studies, I delve into the realms of housing affordability, familial (and gender) dynamics, and agricultural sustainability, each contributing valuable insights to the understanding of contemporary socio-economic landscapes. Moreover, through these chapters, I have sought to explore inequality by analyzing it from different perspectives: the poor and unemployed, the women (and working mothers), and the young people starting entrepreneurial activities. These are vulnerable actors in the workplace and social context, but also crucial for its functioning.

Since the aftermath of the 2007-09 financial crisis, the trajectory of house prices and rents has been marked by a steep ascent across many affluent nations, as underscored by the OECD (OECD (2023)). However, this upward trend in housing costs has not been paralleled by a commensurate growth in household incomes, thereby exacerbating the challenge of housing affordability for a majority of households. The first chapter endeavors to address the conundrum of misallocation and inequality within a unified general equilibrium framework. In particular, we examine the effects on income inequality, employment, and the cost of living following local shocks in the real estate market or in the Total Factor Productivity (TFP) of a tradable sector. We construct a search and matching model à la Pissarides with two regions, where housing is considered a necessity good. Worker mobility implies that any changes in one region propagate to the other. We calibrate the model based

on German data (period 2013-2018). The results show that both types of shocks yield limited gains in terms of employment but have a significant impact on housing prices and real income inequality. Poorer and unemployed workers experience a greater increase in their cost of living index. This is due to the assumption of a non-homothetic utility function that generates a specific positive relationship between nominal wages and housing prices, partially shielding employed individuals from rising living costs but significantly affecting the unemployed ones. Hence our analysis illuminates the intricate interplay between housing prices, income differentials, and welfare outcomes, underscoring the disproportionate impact of rising housing costs on vulnerable populations, particularly the unemployed. By unraveling these complexities, we aim to provide policymakers and stakeholders with valuable insights into crafting effective interventions to promote, for example, housing affordability and mitigate inequality.

The role of women in the labor market and, in particular, the working mother is certainly representative of gender inequality. The fabric of parental dynamics undergoes continual evolution, shaped by socio-cultural norms, economic imperatives, and individual aspirations. The second chapter delves into the interplay between maternal emancipation and student mobility, elucidating a nuanced relationship at the regional level. Results unveil the "mother-hen" effect, wherein the bargaining power of women is inversely linked with the propensity of children to migrate for educational pursuits. I measure women's emancipation through the regional female employment rate (in the main analysis) and the percentage of households with female heads (i.e. women who are the main income earners in the family; I use it in the robustness check). I construct these variables at the regional level for Italy for the period 2014-2020. I use a gravity model where the dependent variable is the students' flows between any pair of regions. In each specification, I include fixed effects for region pairs and a comprehensive set of controls. I also consider an Instrumental Variable (IV) approach to mitigate confounding factors and the Oster method to address omitted variable issues. The results suggest a "mother-hen" effect: the more women are emancipated in terms of wages and employment, the less their children temporarily migrate to study in another region. My analysis sheds light on the intricate dynamics of family decision-making, with implications for educational policy and social mobility. By unraveling the mechanisms underpinning

familial dynamics, the study contribute to a deeper understanding of the factors shaping student mobility and educational choices in contemporary societies.

The third chapter investigates the role of young farmers and the efficacy of policy interventions in bolstering economic performance and generational renewal in agriculture. Amidst the backdrop of a burgeoning agricultural crisis in Europe, characterized by declining incomes, dwindling farmer populations, and environmental degradation, the imperative of fostering generational renewal in agriculture assumes paramount importance. Specifically, we aim to determine whether access to European policies for young Italian farmers has a positive relationship with the improvement of their agricultural businesses (measured through Return on Equity). Our study uses a comprehensive database at the individual level, covering the period from 2008 to 2020, considering two different programming periods. The main specifications are linear regression models (simple, with random and with province fixed effects): the economic performance is the dependent variable, and the key variable of interest represents access to dedicated funding for young farmers. The results demonstrate the importance of this type of support for the business performance of young farmers. By elucidating these linkages, we advocate for integrated policy frameworks that prioritize the long-term viability of agricultural systems while addressing pressing social and environmental challenges.

In the end, these three studies converge to offer a panoramic view of contemporary socio-economic challenges and opportunities. From the intricacies of housing affordability to the gender issue and the imperatives of agricultural generational turnover, each study contributes unique perspectives and empirical findings to the broader discourse on societal well-being and progress. By synthesizing these insights, I aspire to inform evidence-based policy interventions and foster dialogue toward a more equitable and sustainable future for all.

Contents

List of Figures

List of Tables

Chapter 1

Local labor markets with non-homothetic preferences

1.1 Abstract

We study the effects on employment, costs of living, and income inequality of local shocks in the housing market or in the productivity of a tradable good. We construct a two-region search and matching model in which housing is considered a necessity good. Mobility of labor implies that any change in one region propagates into the other. The model is analytically tractable and provides some intuitive comparative statics results. We then calibrate the model on the basis of German data. Our simulations indicate that both types of shock produce limited employment gains but have a significant impact on housing prices and real income inequality: poorer, unemployed workers experience a larger increase in their cost of living index. This depends on the assumption of a non-homothetic utility function that generates a specific nominal wage to housing price positive relationship, partially safeguarding employed individuals against the rising cost of living.

Keywords: Local labor markets, income inequality, costs of living, housing expenditures, housing prices.

J.E.L. Classification: R23; R21; R31; J31; J61; J64; D31.

1.2 Introduction

Since the end of the financial crisis in 2007-09, house prices and rents have seen a rapid increase in much of the affluent world, as evidenced by the OECD (2023b). However, for most households, income growth has failed to keep up with these rising housing costs, resulting in obvious consequences for housing affordability.

The primary objective of this paper is to address both the issues of misallocation and inequality within a unified general equilibrium framework. We have developed a standard search and matching model (Pissarides (2000) and Petrongolo and Pissarides (2001)) with two regions in which two goods are produced in the market: a tradable consumption good and a non-tradable one, which represents housing services. A crucial assumption in our model is that all individuals exhibit a non-homothetic constant elasticity of substitution utility function, as seen in Comin, Lashkari, and Mestieri (2021): the share of total expenditures decreases with rising income and this allow us to view housing as a necessity good. The two regions differ only in terms of labor productivity, and the decision to migrate depends on job opportunities, the cost of living, and individual preferences for a specific location. Our model is analytically tractable, and we provide several comparative statics results. We then proceed to a quantitative analysis, calibrating and simulating the model using German data.

We discover that the non-homotheticity assumption plays a pivotal role in amplifying differences in prices, incomes, and cost of living, both across regions and between employed and unemployed workers, following a local shock in productivity or housing supply. As for the increased inequality between employed and job-seeking workers, higher housing prices have a more significant impact on the poorer, unemployed workers who allocate a larger portion of their income to housing. Their cost of living index (i.e., the amount of money they need to achieve a certain level of utility) increases more than that of employed workers. The second reason is a direct result of non-homothetic preferences, where increased housing prices positively influence negotiated nominal wages, creating a specific positive feedback loop. Any rise in housing prices leads to higher nominal wages, which, in turn, further increases the demand for housing, driving prices even higher. Consequently, workers with non-homothetic preferences end up with more expensive housing services but spend a

smaller portion of their income on them. This second factor, which has a moderating effect on the cost of living index for employed workers, is absent in the case of the unemployed, whose income may not increase as significantly, or not at all, to reduce their housing expenditure share. For example, we observe that a 1% rise in Total Factor Productivity (TFP) within the tradable sector in Western Germany leads to a 0.6% increase in the cost of living index for unemployed residents, whereas this indicator remains relatively stable for employed individuals. As a consequence, the gap between the real incomes of employed and unemployed individuals is 50% more pronounced compared to simulating a similar shock with homothetic preferences.

In terms of welfare, these findings produce interesting results. When examining the current (instantaneous) level of utility, employed workers are better off, while unemployed workers are worse off. However, the expected discounted lifetime utility increases for all, as a higher job-finding rate and more generous future earnings outweigh the present loss in real income for the unemployed. More in detail, labor mobility implies that a local shock ripples into other areas of the country, impacting regional inequality. If a shock attracts more workers to one area, a shrinking labor force in other regions of the country depresses the relative housing market. Declining housing prices reduce the cost of living there (and nominal earnings too, as explained previously), affecting unemployed workers more than employed ones. Our simulations suggest that a 1% positive TFP shock in Western Germany reduces the cost of living index by 1% for unemployed workers and by 0.7% for employed workers living in the Eastern states. Real incomes increase by roughly the same amount. Under homothetic preferences, the magnitude of variation is 70% lower. If we consider the entire country, this regional shock on productivity increases the ratio of housing prices between Western and Eastern states by 1.4% and the variance of the (natural) logarithm of real income by 1.4%, against a 1% and 0.9% change (respectively) in the case of homothetic preferences.

We also examine a change in housing supply (possibly stemming from stricter regulations) that raises the equilibrium price in a single region. As dwellings become more expensive there, we expect a larger outflow of migration that could potentially cool the market down, partially offsetting the initial price increase. However, in our model, more expensive housing drives nominal wages up, sustaining the demand. We find that a 5% positive increase in the marginal cost in the property market in

Western Germany raises housing prices by almost 4%, 25% more than what we obtain when eliminating the assumption of non-homotheticity. Less affordable housing will increase migration towards the states not affected by the shock. This, in turn, will also raise the demand for housing in those states. In terms of real income and cost of living, unemployed workers are worst hit, both because they are more dependent on housing and because the surge in prices is not partially offset by a nominal pay increase, as is the case for employed workers.

The reason why we consider housing a necessity good is that it leads to nominal wages being dependent on housing prices. Under a standard Nash bargaining solution, the equilibrium wage must be such that the firm's marginal costs are equal to the workers' marginal utility. When preferences are homothetic, housing prices do not affect this equation. However, if the housing expenditure share decreases with income, higher housing prices raise workers' marginal utility, as becoming employed would have the additional advantage of making them less reliant on a relatively more expensive necessity. A higher marginal utility drives the negotiated wage up, which, in turn, boosts the demand for housing, increasing prices even further.

In our model, while non-homothetic preferences have a significant impact on inequality, their effect on employment is negligible. Changes in the unemployment rate following a shock in the tradable sector or in the housing supply are quite limited and do not differ significantly when we eliminate the assumption of non-homotheticity. This differs from the findings of Hsieh and Moretti (2019) where they highlight the small elasticity of housing supply as a major factor in housing price and nominal wage dispersion, with minimal effects on employment. In this study, we believe that these results stem from the specific characteristics of standard search and matching models, which imply a small elasticity of unemployment concerning productivity or other exogenous shocks.

The rest of this paper is organized as follows: Section 3 presents a literature review, Section 4 introduces the model, Section 5 details the equilibrium properties and comparative statics results, Section 6 displays the quantitative findings, Section 7 aims to test the model's robustness and conclusions by applying it to the Italian market, and finally, Section 8 concludes.

1.3 Related Literature

Our work intersects at the crossroads of several recent branches of literature.

For the theoretical model, we construct a standard searching and matching model (Pissarides (2000) and Petrongolo and Pissarides (2001)).

In terms of preferences, we follow the strand that deals with non-homothetic preferences (Comin, Lashkari, and Mestieri (2021)), which are more realistically able to address issues of inequality and the cost of living for various income brackets.

We therefore rely on very current empirical research that has highlighted how a growing real estate market can exacerbate income inequality. For instance Quigley and Raphael (2004) show that in the U.S. on average, around 25% of a typical family's income is allocated to housing costs, but for low-income, housing expenses typically consume as much as 50% of their income. Again for the United States, Albouy, Ehrlich, and Liu (2016) demonstrate how an ideal cost-of-living index varies non-linearly with income and prices. Indeed, housing rents have not become more affordable over time, and this has had an impact on the poorest. They show how raises in the relative price of housing have increased real income inequality by 25% since 1970. In the same vein, Dustmann, Lindner, et al. (2021) document how the increase in housing expenses has amplified real income inequality in Germany, as poorer families in the lower quintile of the income distribution allocate a larger portion of their income to housing. They are also more likely to pay rent, the relative cost of which has increased over time. Another side of the coin is shown by Belfield, Chandler, and Joyce (2015): in the UK changes in the features of housing also impact individuals' living standards. For the working-age households in England, the floor space per person has remained stagnant or decreased since the mid-1990s. For example, in London, private renters experienced a 25% reduction in space per person between 1996 and 2012.

The fluctuations in housing prices over the last twenty years, especially in the United States, and their impact on the business cycle, have led economists to scrutinize the relationship between housing and labor markets with renewed attention. Most papers have spotlighted demand effects, showing how a decrease in housing prices can depress spending. For example, Mian and Sufi (2014) find that during the Great Recession, U.S. counties where house values depreciated the most also

exhibited a larger decline in employment in non-tradable sectors, which are more vulnerable to local economic conditions. They also show that this is not influenced by shocks specific to particular sectors or by the exposure to the construction sector and neither by stricter credit supply and business uncertainty. Branch, Petrosky-Nadeau, and Rocheteau (2016) focus on liquidity constraints and discovered that an increase in the eligibility of homes as collateral reduces aggregate unemployment, increases house prices, and drives workers away from the construction sector. More in detail, they use a two-sector search-matching model with imperfect mobility of workers.

Supply constraints in the real estate market are not only one of the main factors behind the rise in prices but also hinder the efficient allocation of labor across regions, increasing the cost of migration. Consequently, more productive areas enjoy higher nominal wages and housing prices but modest gains in employment. For example, Hsieh and Moretti (2019) measure the extent of spatial misallocation of labor among U.S. cities and its cumulative costs. According to their perspective, misallocation occurs due to stringent restrictions on housing supply in highly productive cities like San Francisco and New York, thereby restricting access to such high-productivity environments for a significant number of workers. In their research, they employ a spatial equilibrium model and determine that these constraints led to a 36 percent reduction in aggregate U.S. growth from 1964 to 2009. Unlike Hsieh and Moretti (2019), for us, the culprit does not appear to be an excessively inelastic housing supply. Instead, we believe that this is a result of the specific characteristics of standard search and matching models, which imply a small elasticity of unemployment concerning productivity or other exogenous shocks. In our model, the crucial element is the assumption that housing is a necessity good and how this translates into the positive nominal wage-housing price loop explained earlier. Our article points to a labor supply-side channel through which the housing market may affect employment. More expensive dwellings have the same impact as an upward shift in labor supply, which raises nominal wages and reduces employment. In particular, our focus is on tradable employment.

Germany is a very relevant case study. Unlike other Continental European countries, the specific bargaining structure in Germany allows nominal wages to depend more on local labor market conditions, aligning well with the main mechanism of

our model. In fact, Boeri et al. (2021) consider Germany and Italy (the latter is treated as robustness in our analysis), making an intriguing comparison in terms of wages and productivity. The key characteristic of Germany is, therefore, a highly flexible bargaining system, allowing for local negotiations, resulting in wide wage differences and a profound relationship between wages and local productivity. This makes Germany particularly interesting to analyze using our model and approach. Furthermore, in recent years, it has experienced a real estate market boom, with cumulative growth in residential property prices of over 50% from 2015 to 2022 and robust growth in nominal earnings (average annual change of 2-3% from 2008 to 2019). Income inequality increased in the 1990s and 2000s, and recent research has shed light on the role of housing expenditures in that growth. As we already underline, Dustmann, Fitzenberger, and Zimmermann (2021) show that housing expenditure has a significant impact on German income inequality. More in detail, their result tells us that between 1993 and 2013, the 50/10 ratio of net family income increased by 22 percentage points, while it rose by 62 percentage points for income if not considering housing expenses. Moreover, they show that the share of income spent on housing increases disproportionately for the lower-income quintile and decreases for the upper quintile. Among the contributing factors are the mobility to larger cities, the changes in family structure and the decrease in relative costs of homeownership compared to renting. Wealth accumulation is another aspect that they focus on: younger cohorts spend more on housing and save less than their older counterparts at the same age. This could be a very crucial point, especially for those in the lower part of the income distribution. However, data show that this trend halted after the mid-2000s (Biewen, Ungerer, and Löffler (2019)). Nevertheless, Germans have become increasingly concerned about income inequality. Perhaps this discrepancy between data and feelings is not just due to misperception of the increase in inequality in the country in the 1990s and 2000s and how income disparities have been growing more within than between regions (Frieden, Peichl, and Schüle (2023)). Drechsel-Grau et al. (2022) also show that taking total income the level of inequality is much larger than simply considering labor earnings. This disparity between objective indicators and people's sentiments can be explained by the fact that the former is calculated using an identical price index for all categories of individuals, disregarding the impact of income on preferences. Our work focuses

on this point.

1.4 The Basic Framework

1.4.1 Matching Technology

Time is continuous and the model is developed in steady-state. We consider a country composed by two regions, say a and b. Regions differ only in terms of labor productivity, while all the other product and labor market parameters are assumed to be the same. Besides the gain in simplicity, this also allows to isolate more starkly the effects of demand and supply shocks in one region on the entire economy.

In each region, two goods are sold in the market: a consumption good, that can be traded across the regions at a competitive price, and housing services, that are not tradable. To produce the tradable consumption good, firms need to hire workers in the labor market. Conversely, following most of the literature (see Moretti (2011)), we assume that housing services are supplied in the market by landlords that live abroad.

In the entire country there is a measure normalized to L of workers that are infinitely-lived and risk-neutral. Workers can either be employed in the sector that produces the tradabale consumption good or unemployed. In our setting, workers must take two decisions: (i) they have to choose the region to live in, according to a maximization rule it will be presented in the next section; (ii) they must select the optimal amounts of the consumption good and housing services.

Before focusing on these actions, we explain the functioning of the frictional labor markets. Following a standard search and matching approach (Pissarides (2000), chapter 1), the flow of hires in the tradable sector of region $i \in \{a,\, b\}$, M_i depends the number of vacancies, V_i and the number of unemployed people living in region i, U_i. There is no on-the-job search. The matching function is written $M_i = m\,(\,U_i,\, V_i\,)$. Following most of the literature (see Petrongolo and Pissarides (2001)), we impose it is homogeneous of degree 1 and increasing and concave in both arguments. Labor market tightness in region $i \in \{a,\, b\}$ is denoted by $\theta_i \equiv V_i/U_i$. The rate at which vacant jobs become filled is $q(\theta_i) \equiv m\,(\,U_i,\, V_i\,)\,/V_i$, with $q'(\theta_i) < 0$. A job-seeker moves into employment at a rate $f(\theta_i) \equiv m\,(\,U_i,\, V_i\,)\,/U_i = \theta_i\, q(\theta_i)$ with $f\,'(\theta_i) > 0$.[1] We also define $\eta \equiv -q'(\theta_i)\,(\theta_i/q(\theta_i))$, the opposite of the elasticity of the job-filling

[1] We also assume that $\lim_{\theta_i \to 0} q(\theta_i) = +\infty$, $\lim_{\theta_i \to +\infty} q(\theta_i) = 0$, $\lim_{\theta_n \to 0} f(\theta_i) = 0$ and $\lim_{\theta_n \to +\infty} f(\theta_i) = +\infty$.

rate, and we assume to be constant[2]. At an exogenous rate δ a job is destroyed. Let L_i designate the labor force in region $i \in \{a, b\}$, with $L_a + L_b = L$. Then one can write $E_i + U_i = L_i$, with E_i being the measure of employed workers in region i, $i \in \{a, b\}$. The equality between flows in and out of workers' status in steady-state leads to the standard Beveridge curve:

$$u_i = \frac{\delta}{\delta + f(\theta_i)} \quad \text{with } i \in \{a, b\}, \tag{1.1}$$

in which $u_i \equiv U_i/L_i$ is the unemployment rate in region $i \in \{a, b\}$.

1.4.2 Workers' Preferences

The most crucial assumption of the model is that all individuals have non-homothetic preferences. Under homothetic utility functions, the percentage of consumption expenditures on a given good does not change with income under constant prices[3]. This assumption does not seem empirically grounded if we consider housing services. Several recent empirical works find poor people spend a higher fraction of their income on housing (see references in section 1.3 and data presented in section 1.6.1).

To model non-homotheticity, we follow the approach of Comin, Lashkari, and Mestieri (2021). Their specific formulation (a non-homothetic constant elasticity of substitution (NHCES) function) is analytically tractable. The instantaneous utility function ν_i for all workers living in region $i \in \{a, b\}$ is implicitly defined by the following equation:

$$1 = \left(Q_{nt,i} \cdot \nu_i^{-(1+\epsilon)}\right)^{\frac{\sigma-1}{\sigma}} + \left(Q_{t,i} \cdot \nu_i^{-1}\right)^{\frac{\sigma-1}{\sigma}} \quad \text{with } i \in \{a, b\} \tag{1.2}$$

in which $Q_{t,i}$ and $Q_{nt,i}$ respectively denote the tradable good and the not tradable housing services consumed in region $i \in \{a, b\}$. As we will see precisely in this section, parameter $\epsilon \geq -1$ captures the extent of non-homotheticity for the housing services. Notice indeed that, with $\epsilon = 0$, ν_i can be explicitly derived and it becomes a standard constant elasticity of substitution utility function.

Parameter $\sigma > 0$ stands for the elasticity of substitution between the two goods.

[2]This is the case under the standard assumption of a Cobb-Douglas matching function.

[3]This is equivalent to saying that the Engel curves, that illustrate how consumption expenditure on a given good varies with income under constant prices, are straight lines to the origin. See for instance Deaton and Muellbauer (1980), chapter 5.

It tells us how the relative expenditure on the goods changes in response to a variation in relative prices[4].

Let r be the discount factor in this economy. We consider $Q_{t,i}$ as the *numeraire* for the economy of region i. So its price is normalized to 1 and it is equal across the regions. Conversely, we denote with $p_{nt,i}$ the price for housing services in region i.

Unemployed Workers

The expected discounted utility of the unemployed worker j searching for a job in region $i \in \{a, b\}$, $W^U_{j,i}$ verifies the following Bellman equation:

$$\begin{aligned} rW^U_{j,i} &= \max_{Q^U_{t,i}, Q^U_{nt,i}} z_{j,i} + \nu_{U,i} + f(\theta_i) \left[W^E_{j,i} - W^U_{j,i} \right] \\ \text{s.t.} \quad & p_{nt,i} \cdot Q^U_{nt,i} + Q^U_{t,i} = b \end{aligned} \tag{1.3}$$

The instantaneous utility function $\nu_{U,i}$ is implicitly defined in equation (1.2). Here we simply add the subscript U to recall we are considering the case of unemployed workers in region i. The random term $z_{j,i}$ stands for the idiosyncratic preference for region i and it is the only difference in preferences across workers. A higher $z_{j,i}$ means a stronger attachment to region i for worker j. The term $W^E_{j,i}$ is the discounted present value of being employed in region i.

This and the following Bellman equations have a standard interpretation. Being unemployed is like holding an asset that gives you a dividend $z_{j,i} + \nu_{U,i}$ and a capital gain, occurring at the rate $f(\theta_{n,i})$, equal to the term inside the square brackets.

The second line in (1.3) presents the budget constraint for the unemployed workers, in which b stands for the exogenous amount of home production of the consumption good and it is assumed to be identical across regions.

Computing the F.O.C.s for this problem, we get the NHCES Hicksian demand function for each good:

$$\begin{aligned} Q^U_{nt,i} &= \left(\frac{p_{nt,i}}{b}\right)^{-\sigma} \cdot \nu_{U,i}^{(1+\epsilon)(1-\sigma)} \\ Q^U_{t,i} &= b^{\,\sigma} \cdot \nu_{U,i}^{1-\sigma}, \end{aligned} \tag{1.4}$$

[4]With $\sigma > 1$ (respectively, $0 < \sigma < 1$), an increase in the relative price of housing leads to a decrease (resp. increase) in its relative expenditure. The goods are gross substitutes (resp. complements). With $\sigma = 1$, we are in a Cobb Douglas case and relative expenditures are not affected by relative prices.

for $i \in \{a, b\}$.

Moreover, the expenditure function is equal to:

$$b \;=\; \left[\nu_{U,\,i}^{(1+\epsilon)(1-\sigma)} \cdot p_{nt,i}^{1-\sigma} \;+\; \nu_{U,\,i}^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{1.5}$$

Let $s_{U,i} \equiv p_{nt,i} Q_{nt,i}^{U} / b$, the share in total expenditures for the non-tradable housing services for the unemployed workers in region $i \in \{a, b\}$. Then, using the two equations in (1.4) to get rid of the $\nu_{U,\,i}$ term, we get:

$$s_{U,i} \;=\; p_{nt,i}^{1-\sigma} \cdot b^{\,\epsilon(1-\sigma)} \cdot (1 - s_{U,i})^{\,1+\epsilon} \tag{1.6}$$

for $i \in \{a, b\}$. Totally differentiating this equation, we find the elasticity of the housing share with respect to unemployed workers' home production b:

$$\frac{d\, s_{U,i}}{d\, b} \cdot \frac{b}{s_{U,i}} \;=\; \frac{\epsilon(1-\sigma)(1-s_{U,i})}{1 + \epsilon s_{U,i}} \tag{1.7}$$

for $i \in \{a, b\}$. Since $\epsilon \geq -1$, the denominator is always positive and we have that the sign of this elasticity depends on the sign of $\epsilon \cdot (1 - \sigma)$. The effect of b on the housing share depends on the non-homotheticity parameter ϵ and the elasticity of substitution σ. If $-1 \leq \epsilon < 0$ and $0 < \sigma < 1$ (the two goods are gross complements), an increase in b leads to a reduction in $s_{U,i}$. This means that housing belongs to that specific subset of normal goods called necessity goods, whose relative expenditure decreases when income increases[5]. In the present paper we will study the equilibrium properties of the model imposing such parameter restrictions, since they match the data in section 1.6.1. As expected, under homothetic preferences ($\epsilon = 0$), workers do not change their expenditures shares as income changes.

The elasticity of the housing share with respect to its (relative) price is equal to:

$$\frac{d\, s_{U,i}}{d\, p_{nt,i}} \cdot \frac{p_{nt,i}}{s_{U,i}} \;=\; \frac{(1-\sigma)(1-s_{U,i})}{1 + \epsilon s_{U,i}} \tag{1.8}$$

for $i \in \{a, b\}$. The sign of the price effect is uniquely determined by the elasticity of substitution σ.

[5]Conversely, with $-1 \leq \epsilon < 0$ and $\sigma > 1$ housing would be a luxury good whose relative expenditure increases with income.

Employed Workers

The utility maximization problem for an employed worker in region $i \in \{a, b\}$ is:

$$\begin{aligned} rW^E_{j,i} &= \max_{Q^E_{t,i}, Q^E_{nt,i}} z_{j,i} + \nu_{E,i} + \delta \left[W^U_{j,i} - W^E_{j,i} \right] \\ \text{s.t.} \quad & p_{nt,i} \cdot Q^E_{nt,i} + Q^E_{t,i} = w_i \end{aligned} \tag{1.9}$$

With w_i we denote the endogenous nominal wage. The problem is identical to the one presented for the unemployed worker in (1.3). Following the same steps, we get the Hicksian demand and the expenditure functions:

$$\begin{aligned} Q^E_{nt,i} &= \left(\frac{p_{nt,i}}{w_i} \right)^{-\sigma} \cdot \nu_{E,i}^{(1+\epsilon)(1-\sigma)} \\ Q^E_{t,i} &= b^{\,\sigma} \cdot \nu_{E,i}^{1-\sigma}, \\ w_i &= \left[\nu_{E,i}^{(1+\epsilon)(1-\sigma)} \cdot p_{nt,i}^{1-\sigma} + \nu_{E,i}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \end{aligned} \tag{1.10}$$

for $i \in \{a, b\}$. Similarly, if $s_{E,i} \equiv p_{nt,i} Q^E_{nt,i} / w_i$ is the share in total expenditures for the non-tradable housing services for the employed workers in region $i \in \{a, b\}$, we have:

$$s_{E,i} = p_{nt,i}^{1-\sigma} \cdot w_i^{\epsilon(1-\sigma)} \cdot (1 - s_{E,i})^{1+\epsilon} \tag{1.11}$$

It is easy to see that with $\epsilon = 0$, then equations (1.6) and (1.11) are the same: under homothetic preferences, the share of housing services out of total consumption is the same for unemployed and employed workers. The sign of the elasticities of the housing expenditure share with respect to the wage and the relative price depends on the parameters ϵ and σ, as in the unemployed workers' case:

$$\begin{aligned} \frac{d\, s_{E,i}}{d\, w_i} \cdot \frac{w_i}{s_{E,i}} &= \frac{\epsilon(1-\sigma)(1-s_{E,i})}{1+\epsilon s_{E,i}} \\ \frac{d\, s_{E,i}}{d\, p_{nt,i}} \cdot \frac{p_{nt,i}}{s_{E,i}} &= \frac{(1-\sigma)(1-s_{E,i})}{1+\epsilon s_{E,i}} \end{aligned} \tag{1.12}$$

for $i \in \{a, b\}$.

Price Indexes and Utility Elasticity

Using the Hicksian demand for the consumption good (the second equations in (1.4) and (1.10)) and the definition for the housing share of total expenditures, we get:

$$\begin{aligned} \nu_{U,i} &= b\,(1 - s_{U,i})^{\frac{1}{1-\sigma}} \\ \nu_{E,i} &= w_i\,(1 - s_{E,i})^{\frac{1}{1-\sigma}} \end{aligned} \tag{1.13}$$

for $i \in \{a, b\}$. Following the discussion in Comin, Lashkari, and Mestieri (2021), we denote with $P_{U,i} \equiv (1 - s_{U,i})^{\frac{-1}{1-\sigma}}$ and $P_{E,i} \equiv (1 - s_{e,i})^{\frac{-1}{1-\sigma}}$ the average price indexes for unemployed and employed workers of region i, respectively. $P_{U,i}$ (resp. $P_{E,i}$) is indeed the amount of income a unemployed (resp. employed) worker needs to reach a level of utility $\nu_{U,i}$ (resp $\nu_{E,i}$) equal to 1. This also implies that $\nu_{U,i}$ and $\nu_{E,i}$ coincide with the real wage and the real income for (respectively) employed and unemployed workers in region $i \in \{a, b\}$.[6].

Notice that in the case $0 < \sigma < 1$ and $-1 < \epsilon < 0$, equations (1.6) and (1.11) tell us that $s_{U,i} > s_{E,i}$, as long as the nominal wage w_i is higher than the unemployed workers' income, b (this turns out to be always verified in equilibrium).

We have therefore that $P_{U,i} > P_{E,i}$, for $i \in \{a, b\}$. In an economy in which housing services are a necessity, the larger their share out of total expenditures the more expensive the cost of living. Poorer, unemployed workers need to spend more money to reach the same level of utility of an employed worker.

It is also useful to compute the elasticity of employees' instantaneous utility with respect to the wage. Using the second equation in (1.13) and (1.11), we have:

$$\begin{aligned} &\mu_i \equiv \frac{d\,\nu_{E,i}}{d\,w_i} \cdot \frac{w_i}{\nu_{E,i}} = \frac{1}{1 + \epsilon \cdot s_{E,i}}, \quad \text{with} \\ &\mu'(p_{nt,i}) > 0 \quad \text{if and only if} \quad -1 < \epsilon < 0 \;\text{ and }\; 0 < \sigma < 1 \end{aligned} \tag{1.14}$$

for $i \in \{a, b\}$. As expected, for $\epsilon = 0$, the elasticity μ_i is unitary and the instantaneous utility is linear in income. It is greater than one if $-1 < \epsilon < 0$. This is because, $\nu_{E,i}$ is positively influenced by w_i not just directly, as in the homothetic case, but also via the change in $s_{E,i}$. In our scenario where housing is a necessity

[6]The ratio $P_{U,i}/P_{E,i}$ is the true Konüs index that compares differences in the cost of living between unemployed and employed workers. See Diewert (2009).

good, higher nominal earnings reduce the expenditure share $s_{E,i}$ and the cost of living index $P_{E,i}$, thereby increasing employees' instantaneous utility.

The sign of the derivative in the second line of (1.14) is easily obtained looking at the second equation in (1.12). As long as as $-1 < \epsilon < 0$ and $0 < \sigma < 1$, a given percentage increase in the nominal wage has a positive impact on employees' utility that is smaller in an economy with a cheap housing market. The rationale is quite intuitive. An increase in workers' wage lowers the fraction of their income spent on housing, if it is necessity good. If the (relative) price of housing services $p_{nt,i}$ is low, this means they shift towards a consumption bundle in which they will buy a larger share of the relatively more expensive tradable good. The pay rise has therefore a more modest effect on workers' utility.

1.4.3 Firms in the consumption good sector

Following a textbook search and matching model (Pissarides (2000), chapter 1), we impose the one firm - one job assumption. Each firm-worker pair in region i produces an amount y_i of the tradable consumption good, with $i \in \{a, b\}$. We also assume that $y_a > y_b$. This is the only exogenous difference between the two regions.

The expected discounted returns for a firm operating in region $i \in \{a, b\}$, J_i^E verifies the following Bellman equation:

$$rJ_i^E = y_i - w_i + \delta \left(J_i^V - J_i^E\right), \qquad \text{with } i \in \{a, b\} \tag{1.15}$$

At the RHS of (1.15) we have the firm's revenues, namely the amount of the units of the consumption good produced y_i net of the wage bill, and the capital loss occurring at rate δ, with J_i^V being the expected value of a vacancy. It is determined as follows:

$$rJ_i^V = -k + q(\theta_i)\left(J_i^E - J_i^V\right), \quad \text{with } i \in \{a, b\} \tag{1.16}$$

The expected value of vacancy is given by the vacancy costs k, expressed in terms of the consumption good, and the capital gain that accrues from the match, multiplied by the job filling rate.

As common in search and matching models, a free-entry zero profit condition determines the equilibrium values of tightness θ_i, conditional on the nominal wage.

Free-entry of vacancies and zero profits imply that $J_i^V = 0$. Substituting this into (1.15) and (1.16), one gets:

$$\frac{y_i - w_i}{r + \delta} = \frac{k}{q(\theta_i)} \quad \text{with } i \in \{a, b\} \tag{1.17}$$

Firms' expected discounted revenues (the LHS of (1.17)) are equal to the expected cost of posting a vacancy (the RHS of (1.17)).

1.4.4 Wage bargaining

The nominal wage is negotiated between each firm and worker at individual level. We assume an axiomatic Nash solution to split the surplus $W_{j,i}^E - W_{j,i}^U + J_i^E - J_i^V$ originated from the match. The nominal wage w_i solves the following problem:

$$w_i = \text{argmax} \left[W_{j,i}^E - W_{j,i}^U \right]^{\beta} \left[J_i^E - J_i^V \right]^{1-\beta}, \tag{1.18}$$

with $i \in \{a, b\}$. Parameter β denotes the exogenous bargaining power of a worker ($0 < \beta < 1$). By ordinality, we can consider the $log(.)$ of the function in (1.18) to find w_i. Knowing that $J_i^V = 0$ and taking $W_{j,i}^U$ as given, the F.O.C. is:

$$\beta \frac{\frac{d W_{j,i}^E}{d w_i}}{W_{j,i}^E - W_{j,i}^U} + (1-\beta) \frac{\frac{d J_i^E}{d w_i}}{J_i^E} = 0 \quad \text{with } i \in \{a, b\} \tag{1.19}$$

Using (1.9) and (1.15) yields

$$\frac{d W_{j,i}^E}{d w_i} = \frac{\frac{d \nu_{E,i}}{d w_i}}{r + \delta}; \quad \text{and} \quad \frac{d J_i^E}{d w_i} = \frac{-1}{r + \delta} \quad \text{with } i \in \{a, b\}$$

So the F.O.C. in (1.19) becomes:

$$\frac{1 - \beta}{J_i^E} = \beta \frac{\frac{d \nu_{E,i}}{d w_i}}{W_{j,i}^E - W_{j,i}^U} \quad \text{with } i \in \{a, b\} \tag{1.20}$$

At the LHS we have the cost of a marginal increase in the nominal wage, as a higher pay reduces firms' expected revenues. At the RHS there is the marginal gain. It is given by the marginal change in employees' instantaneous utility (the numerator at the RHS) over workers' quasi-rents from the match (the denominator).

Using equations (1.9), (1.13), (1.14), and (1.15), the F.O.C (1.20) can be written as follows[7]:

$$\frac{1-\beta}{y_i \,-\, w_i} \;=\; \frac{\beta\,\mu_i \cdot (1-s_{E,i})^{\frac{1}{1-\sigma}}}{w_i \cdot (1-s_{E,i})^{\frac{1}{1-\sigma}} \,+\, z_{j,\,i} \,-\, rW^{U}_{j,\,i}}, \tag{1.21}$$

with $i \in \{a,\, b\}$ and for a generic worker j. Using equations (1.3), (1.16), (1.20), the zero profit condition $J_i^V = 0$, the expression for the elasticity μ_i from equation (1.14) and rearranging, we have:

$$\begin{aligned} w_i \;&=\; \frac{\beta\;(\,y_i \,+ k\cdot\theta_i\,)\;+\;(1-\beta)\,b\,(1+\epsilon\cdot s_{E,i})\;\left(\frac{1-s_{U,i}}{1-s_{E,i}}\right)^{\frac{1}{1-\sigma}}}{1+(1-\beta)\epsilon\cdot s_{E,i}} \\ w_i' \;&\equiv\; \frac{d\,w_i}{d\,p_{nt,i}}\Big|_{\bar{\theta}_i} \;>\; 0 \quad \text{if} \quad -1 \,<\, \epsilon \,<\, 0 \;\; \text{and} \;\; 0 \,<\, \sigma \,<\, 1 \end{aligned} \tag{1.22}$$

with $i \in \{a,\, b\}$. This complex expression boils down to the standard search and matching wage schedule (see Pissarides (2000), chapter 1), in case of homothetic preferences (that is $\epsilon = 0$ and $s_{U,i} = s_{E,i}$): the nominal pay is a weighted average of labor productivity y_i and the amount of home production b, the weights being represented by workers' bargaining power β, with in addition a fraction of the vacancy costs[8].

Non-homothetic preferences introduce a new, crucial element in the wage equation (1.22). From eqs. (1.6) and (1.11), we know that $s_{U,i}$ and $s_{E,i}$ do depend on the price of the housing services $p_{nt,i}$. So, unlike the homothetic scenario, in which $\epsilon = 0$, $s_{U,i} = s_{E,i}$, and w_i is unaffected by the housing shares, under non-homothetic preferences the nominal wage is influenced by $p_{nt,i}$. More precisely, the derivative in the second line of (1.22) tells us that, for any given level of θ_i, w_i is increasing in $p_{nt,i}$, if $0 < \sigma < 1$ and $-1 < \epsilon < 0$, for $i \in \{a,\, b\}$. Therefore, if under homothetic preferences more expensive housing costs lower the real wage but leave the nominal wage intact, under non-homothetic preferences the rise in the price level is partially offset by a higher nominal pay.

To understand this point, it is more convenient to inspect equation (1.21). First, it is easy to see that employers' marginal costs (the term at the LHS of (1.21)) are

[7] Computations are in Appendix A.

[8] This can be explained by noting that, at $\epsilon = 0$, workers' instantaneous utility is linear in wage (see the second equation in (1.13)), exactly as it is assumed in a textbook matching model, in which $u(w) = w$.

increasing in w_i and not affected by $p_{nt,i}$. Conversely, at the RHS, workers' marginal gains are decreasing in w_i and do depend on the housing market. Moreover, when $0 < \sigma < 1$ and $-1 < \epsilon < 0$, an increase in $p_{nt,i}$ raises the expression at the RHS of (1.21). At the equilibrium a higher $p_{nt,i}$ raises the nominal wage.

Why so? The result crucially hinges on the variable μ_i. We have seen that, if $-1 < \epsilon < 0$ and $0 < \sigma < 1$, such elasticity is larger the higher $p_{nt,i}$ is. Every additional unit of income has a greater value for the employed workers when the housing market is more expensive. This means that, in the wage negotiation, the gain for employees of receiving one unit more of the surplus of the match is larger when housing is less affordable. *Ceteris paribus*, the outcome of the surplus division tilts more in favour of the workers, resulting in higher nominal pays.

1.4.5 Workers' Location Decision

To determine the measure of workers choosing to live in either region, we introduce a condition, borrowed from Moretti (2011), that states that a generic worker j's relative preference for region a over region b is:

$$z_{j,\,a} \;-\; z_{j,\,b} \;\sim\; g\,[-\lambda,\,\lambda]\,, \tag{1.23}$$

with $g(.)$ being a probability density function. Parameter λ captures the importance of the preference for location and therefore the degree of labor mobility. If λ is large, people's willingness to move in order to reap the benefits of higher real wages or shorter unemployment spells is limited. Conversely, if λ is small, workers are more willing to migrate in search of better economic conditions. With $\lambda = 0$, nobody is attached to a region compared to the other, and there is perfect worker mobility. One can define the value λ^* that belongs to the marginal worker j^*, the one indifferent between searching for a job in region a or in b:

$$rW^{U}_{j^*,\,b} \;-\; rW^{U}_{j^*,\,a} \;=\; 0$$

If $\lambda^* \equiv z_{j^*,\,a} - z_{j^*,\,b}$, from equation (1.3) we get:

$$\lambda^* \;=\; \nu_{U,\,b} + f(\theta_b)\,\left[\,W^E_{j^*,\,b} \;-\; W^U_{j^*,\,b}\,\right] \;-\nu_{U,\,a} \;-\; f(\theta_a)\,\left[\,W^E_{j^*,\,a} \;-\; W^U_{j^*,\,a}\,\right] \quad (1.24)$$

This equation can be re-written to make more visible the effect of housing and labor markets on the marginal worker's migration decision. Notice first that the F.O.C. in the Nash bargaining problem (1.19) implies that

$$W^E_{j,\,i} \;-\; W^U_{j,\,i} \;=\; \frac{\beta}{1-\beta}\cdot\frac{(1-s_{E,i})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,i}}\cdot J^E_i \quad = \quad \frac{\beta}{1-\beta}\cdot\frac{(1-s_{E,i})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,i}}\cdot\frac{k}{q(\theta_i)}$$

The last equality is obtained by imposing $J^V_i = 0$ in equation (1.16). Using this and the first equation in (1.13), we have:

$$\lambda^* = b\left[(1-s_{U,b})^{\frac{1}{1-\sigma}} - (1-s_{U,a})^{\frac{1}{1-\sigma}}\right] + \frac{\beta\cdot k}{1-\beta}\left[\frac{\theta_b(1-s_{E,b})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,b}} - \frac{\theta_a(1-s_{E,a})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,a}}\right] \quad (1.25)$$

The labor forces in both regions can be written as:

$$\begin{aligned} L_b \;&=\; H(\lambda^*)\,L \\ L_a \;&=\; (1-H(\lambda^*))\;L\,, \end{aligned} \quad (1.26)$$

with $H(.)$ being the cumulative density function. It is easy to show that the RHS of (1.25) is increasing (resp. decreasing) in θ_b (θ_a) and decreasing (increasing) in $s_{U,b}$ and $s_{E,b}$ ($s_{U,a}$ and $s_{E,a}$). A tighter labor market in region b implies a higher job finding rate. This raises λ^*, augmenting the labor force L_b, as more workers are willing to migrate from a to b. Of course the opposite occurs in case of a higher θ_a. As we will see in the Equilibrium section, if housing and the tradable consumption good are gross complements, $s_{U,i}$ and $s_{E,i}$ are increasing in $p_{nt,i}$ (for $i \in \{a,\,b\}$)[9]. This means that L_b increases also because $p_{nt,a}$ goes up. If housing gets less affordable in the richer region a, workers find more convenient to re-locate in the poorer, less expensive one.

[9]The elasticity in (1.12) shows that, if $0 < \sigma < 1$, then $s_{E,i}$ is increasing in $p_{nt,i}$, *for any given* w_i. In the Equilibrium section, we will see that the sign of the derivative remains the same even when taking into account the wage schedule (1.22).

1.4.6 The housing market

As common in models studying local labor markets (see Moretti (2011)), we assume that the housing supply is in the hands of landowners that live abroad. While this assumption is clearly not realistic, separating workers from landowners in the model allows to distinguish the welfare effects of different shocks across different type of agents. In detail, we follow Hsieh and Moretti (2019) and consider the following housing supply schedule:

$$Q_{nt,i} \;=\; \alpha_i \, p_{nt,i}^{\frac{1}{\gamma}} \tag{1.27}$$

with $\alpha_i > 0$ a region-specific parameter and $i \in \{a, b\}$. Parameter γ stands for the inverse elasticity of the housing supply. At the equilibrium, the demand must be equal to the supply. This implies:

$$\begin{aligned} \alpha_i \, p_{nt,i}^{\frac{1}{\gamma}} \;&=\; U_i \cdot Q_{nt,i}^{U} \;+\; E_i \cdot Q_{nt,i}^{E} \qquad \Longleftrightarrow \\ \alpha_i \, p_{nt,i}^{\frac{1}{\gamma}} \;&=\; L_i \, \frac{u_i \cdot b \cdot s_{U,i} \;+\; (1 - u_i) \cdot w_i \cdot s_{E,i}}{p_{nt,i}} \end{aligned} \tag{1.28}$$

with $i \in \{a, b\}$. The second equation is obtained using the definitions for the housing shares out of total expenditures.

1.5 Equilibrium

1.5.1 Partial Equilibrium

For the sake of clarity, we find it convenient to present first a partial equilibrium version of the model. For partial equilibrium we mean with $p_{nt,i}$ and λ^* fixed. This is tantamount to saying that housing labor supply is perfectly elastic ($\gamma = 0$) and no migration takes place across regions ($\lambda \to +\infty$ for any generic worker j). Of course, these are extreme assumptions. We consider this scenario just to single out more starkly some characteristics of the model that hold even in the general equilibrium case.

Once we take $p_{nt,i}$ and λ^* as given, the only endogenous variables of the model remain the housing share for the employed workers $s_{E,i}$, the nominal w_i, and labor market tightness θ_i, in each region $i \in \{a, b\}$ (from equation (1.6) the housing share for the unemployed workers $s_{U,i}$ is uniquely determined for any given $p_{nt,i}$ and b). To determine these three unknowns we have to consider the system composed by the demand equation (1.11), the free entry zero profit condition (1.17) and the wage equation (1.22). The following Lemma presents the results.

Lemma 1 *A steady-state partial (i.e. for any given $p_{nt,i}$ and λ^*) equilibrium of the model exists and it is unique. Moreover, in the case $0 < \sigma < 1$ and $-1 < \epsilon < 0$, we have that $\frac{d w_i}{d p_{nt,i}} > 0$, $\frac{d \theta_i}{d p_{nt,i}} < 0$, $\frac{d s_{U,i}}{d p_{nt,i}} > 0$, and $\frac{d s_{E,i}}{d p_{nt,i}} > 0$.*

The proof is in Appendix B and it simply consists on the application of the implicit function theorem. Here we want to give an interpretation for the signs of these derivatives. The first one states that an increase in the housing prices leads to higher nominal pays. As we have anticipated in section (1.4.4) (but under the hypothesis of constant θ_i), this results stems from the assumption of non-homothetic preferences that raises workers marginal gains in the bargaining process and drives nominal earnings up.

Less affordable housing also reduces labor market tightness, via its effect on nominal wages. For the free-entry zero profit condition, higher labor costs will dampen firms' vacancy creation. This explains why $\frac{d \theta_i}{d p_{nt,i}} < 0$.

Finally, consider equations (1.6) and (1.11). More expensive housing costs raise the share of total expenditures devoted to buying this service for all employed and unemployed workers. As we have seen by examining the elasticities (1.8) and (1.12), if the consumption good and housing are gross complements, $s_{U,i}$ and $s_{E,i}$ are increasing in $p_{nt,i}$. Notice that there is a second, indirect effect of $p_{nt,i}$ on $s_{E,i}$, that goes in the opposite direction. This stems from the positive impact of the housing price on the nominal pay. More expensive housing costs exert an upward pressure on the nominal wage. Under non-homothetic preferences, a more generous nominal retribution reduces the housing share $s_{E,i}$. At the equilibrium, however, this negative effect is less strong and $p_{nt,i}$ always raises $s_{E,i}$ when $0 < \sigma < 1$.

1.5.2 General Equilibrium

Definition *A steady-state general equilibrium is defined as a vector* $[\, s_{U,i},\, s_{E,i},\, w_i,\, \theta_i,\, p_{nt,i}\,]$ *for* $i \in \{a, b\}$*, and a value for* λ^* *satisfying: (i) the demand equations expressed in terms of the housing shares for unemployed and employed workers, respectively* (1.6) *and* (1.11)*; (ii) the free entry zero profit conditions for firms producing the tradable consumption good,* (1.17)*; (iii) the wage equation,* (1.22)*; (iv) the market clearing condition in the housing sector,* (1.28)*; (v) the migration decision rule,* (1.25)*.*

Compared to the partial equilibrium case, we consider a system with two additional endogenous variables, $p_{nt,i}$ and λ^*, and two additional equations, (1.28) and (1.25). Once all these variables are determined, all the remaining unknowns of the model (workers' utilities, the unemployment rates, and the labor forces in each region) can be easily found via their corresponding equations.

Proposition 1 *In the case* $0 < \sigma < 1$ *and* $-1 < \epsilon \leq 0$*, a steady-state general equilibrium exists and it is unique if* $\frac{1}{\gamma} > (1+\epsilon)(1-\sigma)$*. At the equilibrium, we have the following properties:* $w_a > w_b$*,* $p_{nt,a} > p_{nt,b}$*, and* $P_{U,a} > P_{U,b}$*.*

The formal proof is presented in Appendix C. The sufficient condition for the existence of an a equilibrium is not particularly demanding. It just requires the elasticity of the housing supply $1/\gamma$ to be sufficiently large[10].

[10]Note that in our setting $(1-\epsilon)(1-\sigma)$ is the product of two positive terms lower than 1. If the

Let us focus on the properties of the model. Note first that all the inequalities present in Proposition 1 hold both if preferences are homothetic ($\epsilon = 0$) and if they are not ($-1 < \epsilon < 0$).

In region a nominal wages are higher. This is intuitive, as productivity y_a is greater than y_b, so workers get a share of a larger surplus from the match (from equation (1.22), nominal pays positively depend on y_a). The second inequality in Proposition 1 states that the region with a higher productivity in the tradable sector also exhibits a higher price level in the non-tradable good (housing): $p_{nt,a} > p_{nt,b}$. This result is known in the literature as the Harrod-Balassa-Samuelson effect[11] and refers to the well-known fact that more developed countries present higher consumer prices compared to less developed ones. A common theoretical explanation for that lies on free labor mobility across sectors that, by equalizing wages, drives up the price of the non-tradable good in the country with a higher productivity in the tradable industry. The mechanism in our model is different: we have just seen that a higher productivity y_a positively affects nominal wage. In turn, this implies a stronger demand for housing and a higher price, as housing is a normal good.

Notice that this second inequality also reinforces the first one: nominal pays in region a are higher than in region b not just because $y_a > y_b$ but also because $p_{nt,a} > p_{nt,b}$. Housing prices exert an upward pressure on nominal wages for the mechanism explained in section 1.4.4.

Since $p_{nt,a} > p_{nt,b}$, unemployed workers located there will spend a larger share of their income on housing: $s_{U,a} > s_{U,b}$. This is a direct consequence of the sign of the elasticity (1.8) when goods are gross complements. From the definition of the price index for the unemployed workers in section 1.4.2, we have that $P_{U,a} > P_{U,b}$. Unemployed workers in the more productive region has a higher cost of living index.

We cannot state the same for the housing expenditures shares and the price indices of the employed workers. Those living in region a face a more expensive housing market (that raises $s_{E,a}$ and in turn $P_{E,a}$ when $0 < \sigma < 1$). However, they also receive more generous nominal pays, as both y_a and $p_{nt,a}$ are higher. Under non-homothetic preferences, this tends to reduce $s_{E,a}$ and $P_{E,a}$. The final effect

sufficient condition is fulfilled, the equilibrium in the housing market exists even with an upward sloping demand function (i.e. the RHS of equation 1.28 increasing in $p_{nt,i}$). Clearly, this is more likely if the housing supply is more elastic (the schedule is flatter in the $(Q_{nt,i}, p_{nt,i})$ space).

[11] See Obstfeld and Rogoff (1996), 1996, chapter 4, for a detailed exposition.

cannot be ascertained at the analytical level.

Finally, we are also not able to determine whether the region with higher productivity in the tradable sector also exhibits a lower unemployment rate. This is because we do not know if θ_a is greater than θ_b. The ambiguity lies on two conflicting effects. On the one hand, from the zero profit condition (1.17), a higher productivity in region a tends to raise vacancy creation and labor market tightness. On the other hand, region a also exhibits larger labor costs, as nominal pays are more generous for the combined effect of higher y_a and $p_{nt,a}$. We have seen in section 1.4.4 that under homothetic preferences nominal wages are not affected by housing prices. The second effect is therefore weaker and we always obtain that a higher productivity in the tradable sector implies a tighter labor market and a lower unemployment rate. With $\epsilon < 0$ however we cannot ascertain which effect is stronger.

In the rest of the section, we will consider the implications for the entire economy of two different shocks that hit just one region: one that that changes the housing supply and the other affecting productivity in the tradable sector.

1.5.3 A housing supply shock in one region

The following Proposition summarizes the result:

Proposition 2 *Consider the model with $0 < \sigma < 1$ and $-1 < \epsilon \leq 0$ and a negative housing supply shock in region i (with $i \in \{a, b\}$): α_i is lower. At the new steady-state:*

1. *In region i, the price for housing services increases and the labor force is lower. If $\epsilon = 0$, there are no effects on the nominal wage and the unemployment rate. Conversely, if $\epsilon < 0$, the nominal wage and the unemployment rate in region i is higher.*

2. *In region j (with $j \in \{a, b\}, i \neq j$), the labor force and the price for housing services are higher. If $\epsilon = 0$, there are no effects on the nominal wage and the unemployment rate. Conversely, if $\epsilon < 0$, the nominal wage and the unemployment rate are higher also in region j.*

The proof is in Appendix C. Suppose a negative shock on the housing supply in one region: parameter α_i is now lower. We can interpret such a change as higher costs for

building new houses or more legal restrictions in the supply of new housing services. At the new steady-state, the price $p_{nt,i}$ is obviously higher. Facing a more expensive housing market, more people will decide to migrate towards region j. Recall from the discussion on the migration decision (1.25) that $p_{nt,i}$ positively affects L_j for $i, j \in \{a, b\}, i \neq j$. In turn, this will raise the demand for housing service even there, so that $p_{nt,j}$ will also be higher.

From section 1.4.4, we know that with $\epsilon = 0$ nominal pays do not react to variations in housing prices. In turn, if nominal wages do not change, the zero profit condition (1.17) tells us that labor market tightness and the unemployment rate in both regions are unaffected by the negative shock on the housing supply. Things are different if $\epsilon < 0$. Under non-homothetic preferences workers are able to extract higher rents from the wage negotiation. Earnings in nominal terms go up, dampening vacancy creation. Unemployment soars in both regions. In the quantitative section we will see however that such an increase is quite small in magnitude.

Following a negative housing supply shock in just one region, all the unemployed workers in the entire country will be worse off, not just because their cost of living index has increased ($P_{U,i}$ and $P_{U,j}$ are larger because $p_{nt,i}$ and $p_{nt,j}$ go up) but also for the worse labor market conditions. Conversely, the welfare consequences for the employed workers are not clear-cut, as they experience more expensive housing services but also get more generous nominal pays. The effect on price indexes $P_{E,i}$ and $P_{E,j}$ and real wages are ambiguous.

1.5.4 A productivity shock in one region

Unlike the case of a housing supply shock, a change in the productivity of the tradable sector in one single region does not deliver unambiguous comparative statics results for most of the endogenous variables of the model. So we will devote more attention to the effects of this type of shock in the quantitative session 1.6.2.

As expected, a positive shock on y_i (with $i \in \{a, b\}$) has beneficial effects on the region in which it has occurred. Nominal wages go up, as workers' quasi-rents from the match have increased. Such a wage surge raises the demand for housing and the equilibrium price $p_{nt,i}$. Of course, this also raises the cost of living index for the unemployed workers $P_{U,i}$, whereas the signs of the change on $s_{E,i}$ and $P_{E,i}$ are uncertain. This is because employees pay more for any single unit of housing

but more generous pays change their preferences, reducing their demand for the non-tradable good.

The effects on labor market tightness and unemployment are also ambiguous for the reasons discussed in Proposition 1. Firms have productivity gains but also face larger labor cost and at the analytical level we cannot claim which effect is stronger.

Comparative statics computations does not allow us to have clearcut conclusions on the change in the labor force in both regions. From equation (1.25), we know that the unemployed workers' decision to migrate depends on labor market tightness and the cost of living. After the positive shock on y_i, unemployed workers in region i face a higher cost of living $P_{U,i}$, but the impact on $P_{E,i}$ and θ_i are ambiguous. So, we cannot ascertain the impact of y_i on L_i and, consequently, L_j. Since in this model a local shock propagates into the other region via its effects on the labor force, the ambiguous effect on y_i on L_j means we are not able to have analytical results on the housing and labor market variables in region j.

1.6 Quantitative Results

1.6.1 Calibration

The model is calibrated on the basis of German data in the period 2013-2018. The numerical values of some variables are taken from data (and presented in Table 1.6.1), others are obtained by evaluating the model at the steady-state (see Table 1.6.2).

Calibration I: variables			
Variables	Values	Interpretation	Source
r	0.00083	discount rate	1% on annual basis
β	0.5	workers' bargaining power	arbitrary choice
δ	0.005	separation rate	Hartung, Jung, and Kuhn (2018)
γ	2	inverse elasticity of the housing supply	Cavalleri, Cournède, and Özsöğüt (2019)
σ	0.56	elasticity of substitution between the two good	Finlay and Williams (2022)
η	0.5	the opposite of the elasticity of the job-filling rate	Hosios condition (Hosios (1990))
L_a	33181641	labor force in a	German Federal Statistical Office (https://www.destatis.de)
L_b	7650723	labor force in b	German Federal Statistical Office (https://www.destatis.de)
u_a	0.053	unemployment rate in a	German Federal Statistical Office (https://www.destatis.de)
u_b	0.076	unemployment rate in b	German Federal Statistical Office (https://www.destatis.de)
$s_{E,a}$	0.30	housing expenditure share for employed in a	German Federal Statistical Office
$s_{U,a}$	0.40	housing expenditure share for unemployed in a	German Federal Statistical Office
$s_{E,b}$	0.28	housing expenditure share for employed in b	German Federal Statistical Office
$s_{U,b}$	0.35	housing expenditure share for unemployed in b	German Federal Statistical Office
α_b	1	housing supply parameter $i = b$	normalization
m_a	1	matching function paramter in $i = a$	normalization

Table 1.6.1: Calibration I: variables

Calibration II: results		
Variables	Interpretation	Source
ϵ	non-homotheticity parameter	using the four equations (1.6) and (1.11) to get a real wage gap of 1.2
b	unemployed workers' home production	housing market equilibrium equation (1.28) at $i = b$
α_a	housing supply parameter $i = a$	housing market equilibrium equation (1.28) at $i = a$
$p_{nt,a}$; $p_{nt,b}$	housing prices	equations (1.6)
w_a; w_b	nominal wages	equations (1.6) and (1.11)
θ_a	labor market tightness in region a	steady state equation (1.1)
θ_b	labor market tightness in region b	steady state equation (1.1)
k	cost of keeping a vacancy open	zero profit condition (1.17) at $i = a$ and wage equation (1.22) at $i = a$
y_a	labor productivity in region a	zero profit condition (1.17) at $i = a$ and wage equation (1.22) at $i = a$
m_b	matching function parameter in region b	zero profit condition (1.17) at $i = b$ and wage equation (1.22) at $i = b$
y_b	labor productivity in region b	zero profit condition (1.17) at $i = b$ and wage equation (1.22) at $i = b$
λ	degree of labor mobility parameter	data on L_a and L_b
λ^*	degree of labor mobility for the marginal worker	migration condition (1.25)

Table 1.6.2: Calibration procedure. Unit of time: month.

We identify as region b the six re-established states of the former German Democratic Republic (GDR) and as region a the ten "old" states of the Federal Republic. The month is the unit of time. The discount rate r is fixed at 1% on an annual basis. The elasticity of the housing supply in Germany in the period considered is about 0.5, according to Cavalleri, Cournède, and Özsöğüt (2019)[12]. So parameter γ

[12]Beze (2023) estimates an elasticity of about 0.25, while Lerbs (2012) obtained a value of 0.4

is equal to 2. As concerns the elasticity of substitution parameter σ, we follow Finlay and Williams (2022) and fix it equal to 0.56 (we consider different values for σ in section 1.6.3). For Hartung, Jung, and Kuhn (2018), in the years immediately before those considered for our calibration, in Germany about 0.5% of workers transited from the employment to the unemployment status each month[13]. So parameter δ is equal to 0.005. We consider a standard value for workers' bargaining power β equal to 0.5. As concerns the matching function, we assume a standard Cobb-Douglas functional form: $M_i = m_i V_i^{1-\eta} U_i^{\eta}$ for $i \in \{a, b\}$. We normalize m_a to 1 and, just for simplicity, we also impose the Hosios (1990) condition $\beta = \eta$ that ensures the efficiency of the matching process[14].

Data on the the labor force (L_a, L_b) and the unemployment rate (u_a, u_b) are taken from German Federal Statistical Office, that also provided us the figures on housing[15] expenditure shares for different income groups and for the two different regions of the country[16]. We have therefore to make assumptions on how to relate these data on the expenditure shares for employed and unemployed workers in our model. We attribute to all the employed workers the same income group of the net median wage in Germany in those years (about 2500 euros per month). This corresponds to the class $[2000, 2600]$ for both East and West Germany workers. We get for the period $2013-2018$ an average expenditure shares for housing of 30% and 28% for the employed workers in region a and region b, respectively. As concerns the unemployed workers, in absence of data on their median income, we assume that they belong to the second income group from the bottom: $[900, 1300]$.[17] This implies

for the period 2004-2010. We perform a sensitivity analysis on parameter γ in section 1.6.3.

[13] Carrillo-Tudela, Launov, and Robin (2021) also get similar results.

[14] A sensitivity analysis on β is presented in section 1.6.3.

[15] For the housing expenditure shares we consider the entry "wohnungsmieten" in the data, that includes both effective and the figurative rents. For a detailed discussion on the pros and cons of considering figurative rents, see Dustmann, Fitzenberger, and Zimmermann (2021).

[16] More precisely, we have information on the expenditure shares in East and West Germany for each year in the interval $(2010, 2020)$, for people with a monthly income belonging to the following groups: under 900 euros, $[900, 1300]$, $[1300, 1500]$, $[1500, 2000]$, $[2000, 2600]$, $[2600, 3600]$, and $[3600, 5000]$.

[17] In Germany the primary form of unemployment benefits foresees a payment of 60% of prior average pay (or 67% in case you have children). So 60% of the median wage belong to the upper bound of the $[900, 1300]$ interval. Of course, this is just an approximation, as it means neglecting other sources of income production that are included in our definition of the variable b. It must be also noted that not all registered unemployed workers receive benefits: the duration of the insurance scheme is limited, ranging from 6 to 24 months, on the basis of the recipient's age and time spent on employment, contributing to unemployment insurance. Finally, as documented by Carrillo-Tudela, Launov, and Robin (2021), after the so-called Harz (2005) reform, a not negligible

a value for their housing expenditure shares of 40% and 35% for the unemployed workers in region a and region b, respectively.

As concerns the variables obtained using the equilibrium conditions of the model, we start with the four housing expenditure shares equations. It is easy to see that using equations (1.6) and (1.11) for $i = a$ and $i = b$, one can get rid of $p_{nt,i}$ and b and obtain an expression for the real wage gap $\left[w_a \ (1 - s_{E,a})^{\frac{1}{1-\sigma}}\right] / \left[w_b \ (1 - s_{E,b})^{\frac{1}{1-\sigma}}\right]$ as a function of the housing expenditure share and the two utility function parameters, ϵ and σ. Since σ, $s_{E,i}$, and $s_{U,i}$ for $i \in \{a, b\}$ have been determined, one can use information on the real wage gap to pin down the value of ϵ. Recent estimates on this gap range from 1.35 (Heise and Porzio (2019)) to 1.17 (Boeri et al. (2021))[18]. We set it equal to 1.22, a number inside this interval, obtaining a value for ϵ equal to -0.8.

Once ϵ has been determined, we can use equations (1.6) to write $p_{nt,i}$ (for $i \in \{a, b\}$) as a function of b. We plug this expression for $p_{nt,b}$ in the equilibrium equation in the housing market in region b (1.28). Imposing the housing supply parameter in region b, α_b, equal to 1, this equation has only one unknown, the value of home production b. Once b has been found, the equilibrium values of $p_{nt,a}$, $p_{nt,b}$, w_a, and w_b are easily obtained via the housing expenditure shares equations (1.6) and (1.11). We can then use the equilibrium equation in the housing market in region a, (1.28), to find α_a, the housing supply parameter in region a.

Since $m_a = 1$, using the figure for the unemployment rate in region a in the steady-state equation (1.1) we get the value for θ_a. We then re-arrange the zero profit conditions (1.17) to write y_a as a function of k and y_b as a function of k and m_b. Inserting the expression for y_a in the wage equation (1.22) at $i = a$, we obtain the equilibrium value for k. We then plug the expression for y_b in the wage equation (1.22) at $i = b$ and get the matching parameter m_b.

The only two remaining unknowns are λ, the parameter that captures the degree of mobility in equation (1.23), and λ^*, the threshold value that splits the labor force L into L_a and L_b. We can easily obtain λ^* via equation (1.25), as all the variables at the RHS have been already determined. We finally assume that the function $g(.)$ in

number of unemployed workers ceased to register as such. So they are officially considered as non participants, with no unemployment insurance.

[18]Dickey and Widmaier (2021) obtain a real wage gap of about 1.2 even after having accounted for different human capital endowments, location effects, and human capital depreciation.

equation (1.23) is normally distributed with 0 mean and standard deviation λ. Then λ is computed knowing that the integral of the normal distribution in the interval $[\lambda^*, +\infty)$ must be equal to L_a/L.

We check the empirical validity of our calibration by looking at three figures found in data and not used in our procedure. First, the nominal wage gap w_a/w_b. According to Boeri et al. (2021), it is equal to 1.28. In our quantitative exercise it is equal to 1.286. Recall that in the calibration we used information on the real wage gap. That targeting relative real pays we also get realistic figures for the relative nominal values suggests our costs of living differences between West and East Germany are empirically plausible.

We also look at the productivity ratio y_a/y_b. According to our elaborations on OECD (2023a) data, the gap in gross real value added per employee between West and East Germany was about 1.25 in 2013 and declined in the subsequent years. In 2018 it was 1.2. These are approximately the same figures that can be found in Boeri et al. (2021) and Mertens and Mueller (2022). Our calibrated result for y_a/y_b is 1.28, a value not far from these findings.

Finally, we also look at some validations for the labor market numerical values. In our model $1/f(\theta_i)$ is the expected duration in unemployment, the reciprocal of the job finding rate. For Hartung, Jung, and Kuhn (2018) in the period (2004 - 2014) less than 6% of the unemployed workers found a job each month, with a resulting average expected duration of about 16 months. Data collected by Carrillo-Tudela, Launov, and Robin (2021) for the same period imply similar (if slightly lower) transition rates: about 4%, with an expected duration of about two years. Our calibration, that is based on a subsequent interval of years, delivers an expected duration of 11 months in region a and 16 months in region b. These seem plausible values.

1.6.2 Simulations

Since comparative statics offers more clearcut results if we consider a change in the housing supply than in the tradable sector productivity, we first simulate a shock on the latter. Numerical exercises also allow us to have insights on some variables not considered in the previous section, such as income inequality and expected utilities.

Productivity shocks

We simulate two different scenarios. In the first one, a positive shock in region a (West Germany) of 1% magnitude raises productivity in the tradable sector y_a. In the second exercise, we look at a 1% change in y_a and 1.5% increase in in y_b. This aims to mirror the trend of the economies in West and East Germany, as data show a slow but interrupted convergence[19].

The main results of the first scenario are summarized in Table 1.6.3. To provide a clear picture of the impact of the non-homotheticity assumption on our findings, in the third column we present the values obtained via a sensitivity analysis in which ϵ is equal to 0 (details of the procedure are in Appendix E). In Appendix F some graphics of the simulations results are presented.

Percentage change	$\epsilon < 0$	$\epsilon = 0$
L_a	0.5	0.2
L_b	-2.1	-0.3
u_a	-0.0 pp	-0.0 pp
u_b	-0.0 pp	-0.0 pp
$p_{nt,a}$	1.1	0.9
$p_{nt,b}$	-2.0	-0.3
$P_{E,a}$	0.1	0.6
$P_{E,b}$	-0.7	-0.2
$P_{U,a}$	0.6	0.6
$P_{U,b}$	-0.9	-0.2
w_a (real)	1.0 (0.9)	1.0 (0.4)
w_b (real)	-0.0 (0.7)	-0.0 (0.2)
real b in region a	-0.6	-0.6
real b in region b	1.0	0.2
Variance of log income (real)	2.3 (1.4)	3 (0.9)
W_a^E	0.9	0.4
W_a^U	0.9	0.4
W_b^E	0.7	0.2
W_b^U	0.7	0.2

Table 1.6.3: Productivity shock in region a: $\Delta y_a / y_a = 1\%$ (percentage changes; for the unemployment rates variation in percentage points).

Notice first that housing prices and nominal wages are quite responsive to such productivity increase. In the states directly affected by this change both variables

[19] According to our elaborations based on OECD (OECD (2023a)) estimates, in 2008 the value added per worker West-East ratio was about 1.3. In 2018, it was 1.2. In 2020, it was about 1.17.

change by roughly the same extent of y_a. This is the consequence of the positive co-dependence between nominal pays and housing prices implied by non-homothetic preferences. When a positive productivity shock hits one area of the country, the implied larger match surplus drives the negotiated wage up. This raises the demand for housing services, so prices increase. For the reasons discussed in section 2.4, more expensive dwellings in turn exert an upward pressure on nominal salaries, creating a positive feedback loop.

Migration towards West Germany weakens the demand for housing in the East. Housing prices go down by 2%. As a result, West Germany housing prices become 3% more expensive compared to the East (i.e. the ratio $p_{nt,a}/p_{nt,b}$ is 3% larger). Under homothetic preferences the relative change is three times smaller. For the just exposed wage price positive link, we expect to have lower nominal pays in region b. However, the effects on nominal pays appear to be very modest.

Variations in housing prices and nominal pays have an impact on the cost of living. Recall first from section 1.4.2 that the model implies four different consumer price indexes for the four categories of individuals in the economy: employed and unemployed workers in region a or region b ($P_{E,a}$, $P_{U,a}$, $P_{E,b}$, and $P_{U,b}$ respectively). A positive productivity shock in the tradable good produces two effects on such indexes. In the Western states of Germany, where the relative price of housing goes up, everyone faces a more expensive cost of living[20]. But there is also a second mechanism in motion when preferences are non-homothetic. More generous nominal salaries lower the share of total expenditures devoted to housing, that is a necessity good (in equation 1.11, $s_{E,i}$ decreases with w_i). Employed workers want to spend a lower fraction of their income on the good that has become relatively dearer. This tends to reduce their cost of living. The second effect is not present for the unemployed workers, as their income b does not change with productivity. As Table 1.6.3 illustrates, the price index for the employed workers barely moves. Conversely, unemployed workers experience a not negligible increase in their cost of living. The opposite occurs in the Eastern states of Germany, where housing prices are lower. Unemployed workers benefit more from such a decrease, as housing is a necessity good. Their price index goes down by almost 1%, compared to -0.7% for the

[20]From equations (1.6) and (1.11), we have that if the tradable and the non-tradable goods are gross complements (i.e $0 < \sigma < 1$), a higher $p_{nt,i}$ raises both $s_{U,i}$ and $s_{E,i}$, thereby increasing $P_{E,i}$ and $P_{U,i}$ (see their definition in section 1.4.2).

employed workers. Of course such heterogeneity in the variation of cost of living coefficients disappears once we consider a homothetic utility function. From the third column in Table 1.6.3 we see that both $P_{E,a}$ and $P_{U,a}$ (resp. $P_{E,b}$ and $P_{U,b}$) go up (resp. go down) by the same 0.6% (resp. 0.2%).

If housing is a necessity good, in the states hit by the shock employed workers experience both a pay rise in nominal terms and a (almost nil) change in their cost of living index. Unemployed workers in the West do not get any increase in nominal terms and face a greater surge in their cost of living. Compared to the homothetic scenario, the variation in their real income gap is more than 50% larger. Conversely, since the reduction in $P_{U,b}$ is larger than in $P_{E,b}$, the income divide in the East is narrower. In the end we get that overall inequality in the country (measured by variance of the natural logarithm of real income) goes up.

It is worthwhile to notice that these results do not imply that unemployed workers are negatively affected by a positive productivity shock. True, the instantaneous utility in unemployment $z_{j,i} + \nu_{U,i}$ goes down for $i \in \{a, b\}$ and any worker j. But our simulations suggest that the expected lifetime utility $W^U_{j,i}$ (presented in equation 1.3) does increase in all the country. The positive effect of y_i on both the job finding rate $f(\theta_i)$ and the value of being employed $W^E_{j,i}$ outweighs the current loss in real income.

Finally, we find that increasing productivity has negligible effects in terms of employment. Table 1.6.3 shows that the unemployment rate goes down by 0.1 percentage points at most. In the sensitivity analysis presented in section 1.6.3, we also find that a rigid housing market does not seem to be the culprit. A much larger elasticity $1/\gamma$ produces similar employment effects. In general, standard search and matching models are not able to mimic the observed large fluctuations in unemployment in response to an exogenous productivity shock (see Shimer (2005)). The same occurs in this model.

Our simulations indicate that a 1% increases in y_a raises labor market tightness θ_a by 1.6%. The effect on unemployment however is about half that magnitude[21]. Such a low elasticity translates into a very small change in percentage points.

Table 1.6.4 presents the results of the second scenario. Compared to the previous

[21]From equation (1.1), it is easy to see that the elasticity of the unemployment rate u_i with respect to y_i, μ_{u_i,y_i} is equal to $(1-u_i)(1-\eta)\mu_{\theta_i,y_i}$ with μ_{θ_i,y_i} being the elasticity with respect to tightness. Recall that η is imposed equal to 0.5.

Percentage change	$\epsilon < 0$	$\epsilon = 0$
L_a	-0.1	0.02
L_b	0.4	-0.04
u_a	-0.0 pp	-0.0 pp
u_b	-0.0 pp	-0.1 pp
$p_{nt,a}$	0.5	0.8
$p_{nt,b}$	1.3	1.0
$P_{E,a}$	-0.1	0.5
$P_{E,b}$	0.0	0.7
$P_{U,a}$	0.3	0.5
$P_{U,b}$	0.6	0.7
w_a (real)	1.0 (1.1)	1.0 (0.5)
w_b (real)	1.5 (1.5)	1.5 (0.8)
real b in region a	-0.3	-0.5
real b in region b	-0.6	-0.8
Variance of log income (real)	3.2 (1.4)	3.2 (0.2)
W_a^E	1.1	0.5
W_a^U	1.1	0.5
W_b^E	1.4	0.8
W_b^U	1.4	0.8

Table 1.6.4: Productivity shock in regions a and b: $\Delta y_a/y_a = 1\%$ and $\Delta y_b/y_b = 1.5\%$ (percentage changes; for the unemployment rates variation in percentage points).

exercise the most interesting findings concern housing prices and the cost of living indexes. Since in this scenario a similar positive productivity shock hits both areas, we find a small impact on inter-regional migration (i.e. small changes in L_a and L_b). In turn, this implies that housing prices do not change as much as in the previous scenario where a larger (resp. lower) labor force raises (resp. decreases) the demand for housing in region a (resp. b). The income effect is therefore stronger than the price effect. In this scenario, under non-homothetic preferences, employed workers in West Germany get a small reduction in their price index.

Housing supply shock

We simulate a supply shock that raises of the marginal cost of housing in West Germany (region a). More specifically, we decrease parameter α_a in the supply function (1.27) by 5%. We can interpret it as higher costs for building houses or stricter legal restrictions in the supply of new housing services. Table 1.6.5 summarizes the results. Again, Appendix F presents some graphics of the simulation.

As expected, housing prices increase in both areas (4.0%, +3.4%), as more expensive dwellings in the Western states push more workers to find a job in the East (L_b goes up by 3.7%), raising the demand even there.

The cost of living indexes go up for all workers in the economy. Of course, the increase is larger in for workers in the Western states, where the shock has occurred. Notice also that the change in $P_{U,i}$ is $0.5 - 0.6$ percentage points larger than $P_{E,i}$ for $i \in \{a, b\}$. Unemployed workers suffer more from the shock, as housing is a necessity good that makes up a larger share of their total expenditures. Again this differential impact cannot be captured if $\epsilon = 0$. As the third column illustrates, $P_{U,i}$ and $P_{E,i}$ change by the same amount for $i \in \{a, b\}$. Real income decreases for all the workers in the economy and this has straightforward consequences on their expected lifetime utilities.

Percentage change	$\epsilon < 0$	$\epsilon = 0$
L_a	-0.9	-0.9
L_b	3.7	1.6
u_a	0.0 pp	0.0 pp
u_b	0.0 pp	0.0 pp
$p_{nt,a}$	4.0	3.2
$p_{nt,b}$	3.4	1.2
$P_{E,a}$	1.6	2.2
$P_{E,b}$	1.2	0.9
$P_{U,a}$	2.3	2.2
$P_{U,b}$	1.7	0.9
w_a (real)	0.0 (-1.5)	0.0 (-2.2)
w_b (real)	0.0 (-1.2)	0.05 (-0.9)
real b in region a	-2.3	-2.2
real b in region b	-1.6	-0.9
Variance of log income (real)	0.5 (0.9)	0.1 (-2.7)
W_a^E	-1.6	-2.2
W_a^U	-1.6	-2.2
W_b^E	-1.2	-0.9
W_b^U	-1.2	-0.9

Table 1.6.5: Housing supply shock in regions a : $\Delta\alpha_a/\alpha_a = -5\%$ (percentage changes - for the unemployment rates variation in percentage points).

As concerns income inequality, the variance of the logarithm of real incomes increases by almost 1%. Notice that in the $\epsilon = 0$ case we see a reduction of the same variable. This is because the adoption of a unique price index for employed and unemployed workers alike (implied by the homotheticity assumption) accentu-

ates the real income loss of the richest people (employed workers in the West) and underestimates the loss of the poorest ones (unemployed workers in the East)[22].

1.6.3 Sensitivity analysis

We focus on three main parameters that could in principle alter the main findings of our simulation results: the inverse of the elasticity of the housing supply γ, workers' bargaining power β, and the elasticity of substitution σ.

Let us consider first γ. According to Hsieh and Moretti (2019), the key reason for the employment misallocation across US regions is an excessively rigid housing supply, that, implying large increases in housing prices for any given change in the demand, makes migration towards more productive areas too expensive. Employment changes are limited.

In our model productivity shocks produce small effects on employment. Several empirical works indicate that even Germany has a quite inelastic housing supply too. Cavalleri, Cournède, and Özsöğüt (2019), Beze (2023), and Lerbs (2012) all estimate an elasticity ranging from 0.25 to 0.5. So in our basic setup, γ is fixed equal to 2. Tables 1.8.1 in Appendix E shows the results of a productivity shock and a housing supply shock in case γ is fixed equal to 0.5, implying a counterfactual housing supply elasticity of 2. The central findings of our baseline simulations are unaffected even under an elastic housing supply. Both shocks have a greater impact on the cost of living of unemployed workers. However the welfare effects are not different across individuals: a regional positive productivity shock makes all workers in the economy better off, whereas an increase in the marginal cost of housing reduces the expected lifetime utility of everyone. The sign of the variations in the log income variances are also the same of the baseline simulations. More importantly, employment effects remain very small, despite the larger elasticity $1/\gamma$. In the $\Delta y_a/y_a = 1\%$ scenario, a more elastic housing supply does indeed imply larger migration towards region a: the labor force in a (resp. in b) goes up (resp. down) by almost 1% (resp. 4%). The percentage changes are respectively 0.5 and -2.1% in the baseline simulation. However, such a greater inter-regional workers' relocation does not translate into greater changes in housing prices, precisely because the supply is much more elastic.

[22] From Table 1.6.5, if $\epsilon = 0$, real wages in the West go down by 2.2% (compared to a -1.2% with $\epsilon < 0$) whereas unemployed workers in the East suffer from a 0.9% decrease (-1.6% with $\epsilon < 0$).

More importantly, the employment effects remain very small.
We then change β, from 0.5 to 0.4 and 0.6. As we can see from Table 1.8.2 in Appendix E, in both cases, and for all simulations, the results are remarkably similar (identical to the first decimal place) to the baseline case with $\beta = 0.5$. So workers' bargaining power appears to be quite uninfluential in our setting, at least if we consider values not too close to its upper and lower bound.

Finally, we consider variations in the elasticity of substitution of goods σ. As Table 1.8.3 illustrates, changes are minimal compared to the baseline scenario. We just point out that, with a lower elasticity of substitution ($\sigma = 0.3$) the effects of a housing supply shock on the housing prices get larger in magnitude, as consumers are even less willing to switch from one good to the other. In turn this implies a larger increase in the cost of living index for all workers.

1.7 Robustness Analysis: the Italian Market

For the robustness analysis, we have tailored to the Italian market our model, the calibrations and simulations processes. This market is especially pertinent due to its significant migratory patterns from the South to the North and the pronounced productivity gap between these two macro-zones.

First of all, to have a first empirical and numerical confirmation of non-homothetic preferences, we have focused on the consumption of Italian families. Substantially we want to verify if the share of expenditure destined for housing has a greater impact on the total expenditure[23] for the poorest families than for the richest ones.
In Table 1.7.1 we take into account the structure of consumption expenditure by income quintile (in the first quintile there is the 20% of the poorest family and so on); we have then computed the ratio between the housing expenditure only and the total consumption expenditure. We consider the average relating to the 7 years from 2014 to 2020 and 3 macro-areas: North (Liguria, Lombardia, Piemonte, Valle d'Aosta, Emilia-Romagna, Friuli-Venezia Giulia, Trentino-Alto Adige, Veneto), Center (Lazio, Marche, Toscana, Umbria) and South (Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, Sardegna, Sicilia).
The trend is clear: the richer families are, the less the share of spending they allocate to housing has an impact on total spending. This is totally true for every year for North and South, while for the Center the trend is the same until the fourth quintile, and then there is a very little increase in the share between the fourth and fifth quintile (but it is always a smaller share than that of the poorest families).

2014-2020	**1st**	**2nd**	**3th**	**4th**	**5th**
North	47,91%	42,37%	38,48%	35,63%	31,91%
Center	45,62%	41,64%	39,14%	37,52%	38,54%
South	39,30%	34,36%	32,39%	30,56%	28,96%

Table 1.7.1: Housing expenditure/total expenditure per quintiles. Istat data re-elaboration (http://dati.istat.it/)

Focusing on the macro-areas, it is clear that a Northern family spends on average more on housing than one in the Center and even more than one in the South. If

[23]We consider the total expenditure as an approximation of the household income.

Areas	2014	2015	2016	2017	2018
Italy	35.017	34.743	35.204	36.293	36.416
North	39.081	38.443	38.981	40.139	40.027
Center	36.807	36.431	37.071	38.362	38.227
South	27.552	27.997	28.166	29.097	29.710

Table 1.7.2: Average Yearly Household Income (Euros). Istat Data (http://dati.istat.it/)

Delta	2014	2015	2016	2017	2018
North-Center	2.274	2.012	1.910	1.777	1.800
North-South	11.529	10.446	10.815	11.042	10.317
Center-South	9.255	8.435	8.905	9.265	8.517

Table 1.7.3: Macro-areas Yearly Income Delta (Euros). Istat data re-elaboration (http://dati.istat.it/)

we look at the income in Table 1.7.2, we see that a Northern family earns much above the average in the country, a Central family is just above the average, while a Southern one earns much less. The income deltas shown in Table 1.7.3 demonstrate how big the gap is between areas, especially between North and South. The gap seems to decrease in 2018 with respect to 2014.

1.7.1 Calibration

The model is calibrated based on Italian data in the period 2014-2020. The numerical values of some variables are taken from data (and presented in Table 1.7.4), and others are obtained by evaluating the model at the steady-state (see Table 1.7.5).

Calibration I: variables			
Variables	Values	Interpretation	Source
r	0.00083	discount rate	1% on annual basis
β	0.5	workers' bargaining power	arbitrary choice
δ	0.007	separation rate	ISTAT (Worker Mobility)
γ	4	inverse elasticity of the housing supply	Andrews, Caldera Sánchez, and Johansson (2011), Figure 9 (housing elasticity)
σ	0.56	elasticity of substitution between the two good	Finlay and Williams (2022)
η	0.5	the opposite of the elasticity of the job-filling rate	Hosios condition (Hosios (1990))
L_a	182420	labor force in a	ISTAT (mean 2014-20) (http://dati.istat.it/)
L_b	74500	labor force in b	ISTAT (mean 2014-20) (http://dati.istat.it/)
u_a	0.053	unemployment rate in a	ISTAT (mean 2014-20) (http://dati.istat.it/)
u_b	0.076	unemployment rate in b	ISTAT (mean 2014-20) (http://dati.istat.it/)
$s_{E,a}$	0.38	housing expenditure share for employed in a	ISTAT data re-elaboration (*Indagine sulle spese delle famiglie*)
$s_{U,a}$	0.47	housing expenditure share for unemployed in a	ISTAT data re-elaboration (*Indagine sulle spese delle famiglie*)
$s_{E,b}$	0.32	housing expenditure share for employed in b	ISTAT data re-elaboration (*Indagine sulle spese delle famiglie*)
$s_{U,b}$	0.39	housing expenditure share for unemployed in b	ISTAT data re-elaboration (*Indagine sulle spese delle famiglie*)
α_b	1	housing supply parameter $i = b$	normalization
m_a	1	matching function parameter in $i = a$	normalization

Table 1.7.4: Calibration I: variables

Calibration II: results		
Variables	Interpretation	Source
ϵ	non-homotheticity parameter	using the four equations (1.6) and (1.11) to get a real wage gap of 0.99
b	unemployed workers' home production	housing market equilibrium equation (1.28) at $i = b$
α_a	housing supply parameter $i = a$	housing market equilibrium equation (1.28) at $i = a$
$p_{nt,a}$; $p_{nt,b}$	housing prices	equations (1.6)
w_a; w_b	nominal wages	equations (1.6) and (1.11)
θ_a	labor market tightness in region a	steady state equation (1.1)
θ_b	labor market tightness in region b	steady state equation (1.1)
k	cost of keeping a vacancy open	zero profit condition (1.17) at $i = a$ and wage equation (1.22) at $i = a$
y_a	labor productivity in region a	zero profit condition (1.17) at $i = a$ and wage equation (1.22) at $i = a$
m_b	matching function parameter in region b	zero profit condition (1.17) at $i = b$ and wage equation (1.22) at $i = b$
y_b	labor productivity in region b	zero profit condition (1.17) at $i = b$ and wage equation (1.22) at $i = b$
λ	degree of labor mobility parameter	data on L_a and L_b
λ^*	degree of labor mobility for the marginal worker	migration condition (1.25)

Table 1.7.5: Calibration procedure. Unit of time: month.

We identify as region b the South macro-area and as region a the North and Center ones. The month is the unit of time. The discount rate r is fixed at 1% on an annual basis. The elasticity of the housing supply in Italy in the period considered is about 0.25, according to Andrews, Caldera Sánchez, and Johansson (2011). So parameter γ is equal to 4. As concerns the elasticity of substitution parameter σ, we follow Finlay and Williams (2022) and fix it equal to 0.56. Parameter δ is equal to 0.007, following ISTAT (Worker Mobility). We consider a standard value for workers' bargaining power β equal to 0.5. As concerns the matching function, we assume again a standard Cobb-Douglas functional form: $M_i = m_i V_i^{1-\eta} U_i^{\eta}$ for $i \in \{a, b\}$. We normalize m_a to 1 and, just for simplicity, we also impose the Hosios (1990) condition $\beta = \eta$ that ensures the efficiency of the matching process.

Data on the the labor force (L_a, L_b) and the unemployment rate (u_a, u_b) are taken from ISTAT (http://dati.istat.it/). Also, the housing expenditure shares derive from ISTAT data (*Indagine sulle spese delle famiglie*), but relating to the share in the region a for the unemployed, we compute the mean of the first expenditure share quintile for years, weighted for the number of inhabitants (for the population, we consider the mean of the years 2018-21, due to the lack of the other data). Indeed, for the share in b for the unemployed, we consider the mean of the first expenditure share quintile for the years 2014-2020, while for the employed in the region b, the mean of the 2-5 expenditure share quintiles for the years 2014-2020.

As concerns the variables obtained using the equilibrium conditions of the model, we start (as for Germany) with the four housing expenditure shares equations. It is easy to see that using equations (1.6) and (1.11) for $i = a$ and $i = b$, one can get rid of $p_{nt,i}$ and b and obtain an expression for the real wage gap

$\left[w_a\ (1\ -\ s_{E,a})^{\frac{1}{1-\sigma}}\right] / \left[w_b\ (1\ -\ s_{E,b})^{\frac{1}{1-\sigma}}\right]$ as a function of the housing expenditure share and the two utility function parameters, ϵ and σ. Since σ, $s_{E,i}$, and $s_{U,i}$ for $i \in \{a, b\}$ have been determined, one can use information on the real wage gap to pin down the value of ϵ.

We set the ratio between the real wages equal to 0.99[24], obtaining a value for ϵ equal to -0.3. The procedure is similar to that already presented for the German regions.

Once ϵ is determined, we can employ equations (1.6) to express $p_{nt,i}$ (for $i \in \{a, b\}$) as a function of b. Substituting this expression for $p_{nt,b}$ into the housing market equilibrium equation in region b (1.28), and with the housing supply parameter in region b, α_b, set to 1, we have only one unknown, the value of home production b. After determining b, we can easily calculate the equilibrium values of $p_{nt,a}$, $p_{nt,b}$, w_a, and w_b using the housing expenditure shares equations (1.6) and (1.11). We can then utilize the equilibrium equation in the housing market in region a (1.28) to find α_a, the housing supply parameter in region a.

Given that $m_a = 1$, by utilizing the unemployment rate for region a in the steady-state equation (1.1), we can find the value of θ_a. We can subsequently reorganize the zero profit conditions (1.17) to express y_a as a function of k and y_b as a function of k and m_b. Inserting the expression for ya into the wage equation (1.22) for $i = a$ yields the equilibrium value for k. By plugging the expression for y_b into the wage equation (1.22) for $i = b$, we determine the matching parameter m_b.

The only two remaining unknowns are λ, the parameter representing the degree of mobility in equation (1.23), and λ^*, the threshold value that separates the labor force L into L_a and L_b. We can easily derive λ^* using equation (1.25) since all the variables on the right-hand side have already been determined. We then assume that the function $g(.)$ in equation (1.23), follows a normal distribution with a mean of 0 and a standard deviation of λ. Lambda is subsequently calculated with the constraint that the integral of the normal distribution over the interval $[\lambda^*, +\infty)$ must equal L_a/L.

[24]We base our analysis on what Boeri et al. (2021) show (a real wage gap between the North and South of -0.0921), and the fact that we also consider the Central region as part of the North. This makes the gap smaller. So we have considered the hourly average wage divided by the cost of food per macro-zone (elaboration of ISTAT data on http://dati.istat.it/) from 2014 to 2018 as a proxy of real wages (with a resulting gap of +0.06). Taking into consideration also the difference of the two gaps computed, the ratio between the real wages is set at 0.99.

1.7.2 Simulations

In this scenario again, we proceeded to perform shocks both in productivity and housing, focusing on the expected outcomes of inequality and utility.

Productivity shock

In the Italian case, unlike the German one, it doesn't make sense to introduce two different levels of shocks because the South is not growing in terms of productivity at a faster rate than the North. Therefore, we have only considered the scenario in which there is a positive shock in region a of 1% magnitude raising productivity in the tradable sector y_a.

The main results are summarized in Table 1.7.6. To offer again a clearer illustration of how the non-homotheticity assumption affects our results, we present, in the third column, the values obtained through a sensitivity analysis where ϵ is set to zero.

Percentage change	$\epsilon < 0$	$\epsilon = 0$
L_a	0.3	0.2
L_b	-1.6	-0.6
u_a	-0.0 pp	-0.0 pp
u_b	-0.0 pp	-0.0 pp
$p_{nt,a}$	1.3	1.1
$p_{nt,b}$	-1.7	-0.6
$P_{E,a}$	0.4	0.7
$P_{E,b}$	-0.6	-0.3
$P_{U,a}$	0.8	0.7
$P_{U,b}$	-0.8	-0.3
w_a (real)	1.0 (0.6)	1.0 (0.3)
w_b (real)	-0.0 (0.6)	-0.0 (0.3)
real b in region a	-0.7	-0.7
real b in region b	0.8	0.3
Variance of income (real)	2.1 (0.9)	2.3 (0.5)
W_a^E	0.7	0.4
W_a^U	0.7	0.4
W_b^E	0.6	0.3
W_b^U	0.6	0.3

Table 1.7.6: Productivity shock in region a: $\Delta y_a/y_a = 1\%$ (percentage changes; for the unemployment rates variation in percentage points).

Notice first that also in this case housing prices and nominal wages are quite responsive to such productivity increase. In the region directly affected by this

change both variables change by roughly the same extent of y_a. The result is always the same: the positive and consequential connection between nominal wages and housing prices, driven by non-homothetic preferences. In fact, when a positive productivity shock impacts a specific region of the country, the resulting increased match surplus pushes negotiated wages higher. This, in turn, boosts the demand for housing services, leading to price increases. As elaborated in section 1.4.4, and as already seen for German productivity shocks, the higher cost of housing then applies upward pressure on nominal salaries, establishing a positive feedback loop[25].

The migration toward the northern region reduces housing demand in the South, resulting in a nearly 2% decrease in housing prices. This effect is significantly smaller under homothetic preferences.

These variations in nominal pays and especially in housing prices impact the cost of living. The mechanism is the same as previously explained in section 1.6.2: a positive productivity shock in the tradable goods sector triggers two effects on the consumer price indexes. In the North, where the relative price of housing rises, everyone encounters a higher cost of living. However, a second mechanism comes into play when preferences are non-homothetic. More generous nominal salaries reduce the portion of total expenditures allocated to housing, which is considered a necessity. Employed workers aim to allocate a smaller fraction of their income to this relatively more expensive good, thereby reducing their cost of living. This second effect does not apply to unemployed workers since their income b remains unchanged with productivity. As a result, the price index for employed workers remains more stable. Conversely, unemployed workers undergo a significant increase in their cost of living. The reverse situation takes place in the South, where housing prices are lower. Unemployed workers benefit more from this reduction, given that housing is considered a necessity. Their price index decreases by -0.8%, in contrast to the employed workers whose index decreases by -0.6%. Naturally, this diversity in the changes in cost of living coefficients vanishes when we consider a homothetic utility function.

The mechanism is reiterated in this market, affirming our findings: when hous-

[25]It is important to note that Italy, from a wage perspective, is a unique country. It is characterized by a strong collective bargaining system that tends to level nominal wages from North to South. Therefore, the results of the theoretical model calibrated based on nominal wages may be empirically less valid due to these frictions.

ing is considered a necessity, in regions affected by the shock, employed workers experience both a nominal pay increase and a nearly insignificant change in their cost of living index. Unemployed workers in the North, on the other hand, do not receive any nominal increase and face a more substantial surge in their cost of living. Compared to the homothetic scenario, the variation in their real income gap is 50% larger.

Conversely, due to the greater reduction in $P_{U,b}$ compared to $P_{E,b}$, the income disparity in the South becomes narrower. Ultimately, this results in an increase in overall inequality within the country, as measured by the variance of the natural logarithm of real income.

Finally, it is worth noting that increasing productivity has minimal effects on employment. Table 1.7.6 indicates that the unemployment rate decreases by a maximum of 0.0 percentage points.

Housing supply shock

For this shock as well, we have replicated the same mechanism used for Germany. The results have also been confirmed, thereby validating their robustness.

We conduct a simulation involving a supply shock that increases the marginal cost of housing in Northern Italy (region a). To be more precise, we reduce the parameter α_a in the supply function (1.27) by 5%. This can be interpreted again as an increase in the costs associated with constructing houses or the implementation of stricter legal restrictions on the supply of new housing services. The results of this simulation are summarized in Table 1.7.7.

As anticipated, housing prices rise in both regions, given that the higher cost of housing in region a motivates more workers to seek employment in the South (resulting in a 4.8% increase in L_b). This, in turn, drives up demand in the South and subsequently raises prices there as well.

The cost of living indexes increases for all workers across the economy. Naturally, the increase is more significant for workers in the Northern region, where the shock has taken place.

It's worth noting that in Italy as well, the change in $P_{U,i}$ is 0.7 and 0.5 percentage points larger than in $P_{E,i}$ for $i \in \{a, b\}$, respectively. Unemployed workers are more affected by the shock, as housing constitutes a necessity good, representing a larger

portion of their total expenditures. Once again, this differential impact cannot be captured if $\epsilon = 0$. As the third column demonstrates, $P_{U,i}$ and $P_{E,i}$ change by the same magnitude for $i \in \{a, b\}$.

Real income declines for all workers in the economy, and this has direct implications for their expected lifetime utilities.

Percentage change	$\epsilon < 0$	$\epsilon = 0$
L_a	-0.9	-1.0
L_b	4.8	3.7
u_a	0.0 pp	0.0 pp
u_b	0.0 pp	0.0 pp
$p_{nt,a}$	4.6	3.9
$p_{nt,b}$	5.3	3.5
$P_{E,a}$	2.0	2.4
$P_{E,b}$	1.9	2.1
$P_{U,a}$	2.7	2.4
$P_{U,b}$	2.4	2.1
w_a (real)	0.0 (-2.0)	0.0 (-2.3)
w_b (real)	0.0 (-1.9)	0.00 (-2.0)
real b in region a	-2.6	-2.3
real b in region b	-2.4	-2.0
Variance of income (real)	0.6 (-3.1)	0.5 (-4.1)
W_a^E	-2.0	-2.3
W_a^U	-2.0	-2.3
W_b^E	-1.9	-2.0
W_b^U	-1.9	-2.0

Table 1.7.7: Housing supply shock in regions a : $\Delta\alpha_a/\alpha_a = -5\%$ (percentage changes - for the unemployment rates variation in percentage points).

1.8 Conclusions

Four in five individuals in the OECD believe that income inequalities are excessive in their respective countries (OECD (2021)). This perception seems to be present even where income disparities are low and do not appear to be growing. Germans perceive larger-than-average earnings inequality, even though objective measures of income disparities are below the OECD average and they have remained quite stable in the last decade (Biewen, Ungerer, and Löffler (2019) and Drechsel-Grau et al. (2022)).

One possible explanation for this discrepancy between data and perceptions lies on the fact that most indicators of inequality (computed using either administrative data or household surveys) rely on a unique price or cost-of-living index for all categories of individuals, although it is well known that tastes vary with income[26].

The present paper addresses this point. Positive productivity shocks in the tradable sector or stricter regulations in housing supply at local level have a different impact on employed and unemployed workers, the latter experiencing a larger variation in their cost-of-living index. Inequality is larger than it would be implied using an identical price index for all individuals.

It is important not to infer welfare results from our inequality effects. Our simulations indicate that, if a positive shock in the TFP in the tradable sector lowers unemployed workers' instantaneous utility as living gets more expensive, their expected lifetime utility increases. Better employment opportunities (i.e. a tighter labor market) and the increased value of being employed overcome the present instantaneous loss. So, higher real income dispersion does not entail a welfare loss, at least if we consider a utility function where inequality is not negative *per se*. Of course, our conclusions change with myopic individuals whose current welfare loss matters more than future expected gains.

Employment changes appear to be limited. In our model we focus just on the labor markets in the tradable sectors. Further analysis could also look at the reallocation effects of housing and productivity shocks when both tradable and non-tradable labor markets are considered. Recent papers have pointed out that the negative con-

[26]The importance of non-homotheticity has been recently emphasized by Handbury (2021). Across US locations, the variety of products and prices offered in stores depends on local income levels, with stores in wealthy cities favouring (both in terms of product variety and relative prices) the consumption bundle of high income households.

sequences of the decline in the manufacturing industries have been concealed by the boom in housing sector employment (Kerwin Kofi, Hurst, and Schwartz (2019)).

Our model does not account for different skill levels. By introducing heterogeneity in workers' abilities we could explore how the property market affects the real skill premium. For Moretti (2013), once cross-regional price differences are properly computed, real income disparities between skills groups in US are less pronounced than nominal ones, as highly educated workers migrate towards more productive areas raising housing prices. Dustmann, Fitzenberger, and Zimmermann (2021) do not find evidence for that in Germany, where the share of people at the bottom income quintile located in more expensive regions and cities has increased over the last two decades.

Both the tradable/non-tradable employment inter-linkage and the effects of the property market on the real skill premium are left for future research.

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Appendix A: The Wage Equation

We derive the equation (1.21). From equation (1.15) and the condition $J_i^V = 0$ we easily get that

$$\frac{1-\beta}{J_i^E} = (1-\beta)\,\frac{r+\delta}{y_i - w_i} \tag{1.29}$$

for $i \in \{a, b\}$.

As concerns the RHS of (1.21), using the equations (1.3) and (1.9) to derive an expression for $W_{j,i}^E - W_{j,i}^U$ and the equation (1.13) to compute the derivative $d\,\nu_{E,i}/d\,w_i$ we obtain:

$$\frac{\frac{d\,\nu_{E,i}}{d\,w_i}}{W_{j,i}^E - W_{j,i}^U} = \frac{r+\delta}{z_{j,i} + \nu_{E,i} - rW_{j,i}^U} \cdot \frac{(1 - s_{E,i})^{\frac{1}{1-\sigma}}}{1+\epsilon s_{E,i}} \tag{1.30}$$

for $i \in \{a, b\}$. Rearranging equation (1.16) with $J_i^V = 0$, we get $J_i^E = k/q(\theta_i)$. We use this expression to write the F.O.C (1.19) as follows:

$$W_{j,i}^E - W_{j,i}^U = \frac{\beta}{1-\beta}\,\frac{k}{q(\theta_i)}\,\frac{(1 - s_{E,i})^{\frac{1}{1-\sigma}}}{1+\epsilon s_{E,i}}$$

with $i \in \{a, b\}$. Using this equation and the fact that $\nu_{U,i} = b\,(1 - s_{U,i})^{\frac{1}{1-\sigma}}$ (from equation 1.13), equation (1.3) becomes:

$$rW_{j,i}^U = z_{j,i} + b\,(1 - s_{U,i})^{\frac{1}{1-\sigma}} + \frac{\beta}{1-\beta}\,k\,\theta_i\,\frac{(1 - s_{E,i})^{\frac{1}{1-\sigma}}}{1+\epsilon s_{E,i}}$$

We can insert this expression $W_{j,i}^U$ into equation (1.30). Knowing that $\nu_{E,i} = w_i\,(1 - s_{E,i})^{\frac{1}{1-\sigma}}$ (from equation 1.13) and that $\mu_i = 1/(1+\epsilon s_{E,i})$ (from equation 1.14), we obtain:

$$\frac{\frac{d\,\nu_{E,i}}{d\,w_i}}{W_{j,i}^E - W_{j,i}^U} = \frac{(r+\delta)\,\mu_i}{w_i - b\left(\frac{1-s_{U,i}}{1-s_{E,i}}\right)^{\frac{1}{1-\sigma}} - \frac{\beta}{1-\beta}\,\mu_i\,k\cdot\theta_i}$$

for $i \in \{a, b\}$. Putting together this expression with equation (1.29), we easily obtain equation (1.21).

We also want to show that the RHS of equation (1.21) is increasing in $p_{nt,i}$. Com-

puting the derivative, we get:

$$\beta \left[\frac{\frac{d\mu_i}{dp_{nt,i}} \cdot (1 - s_{E,i})^{\frac{1}{1-\sigma}}}{w_i \cdot (1 - s_{E,i})^{\frac{1}{1-\sigma}} + z_{j,i} - rW_{j,i}^U} - \mu_i \frac{\frac{1}{1-\sigma} (1 - s_{E,i})^{\frac{1}{1-\sigma}-1} \cdot \frac{ds_{E,i}}{dp_{nt,i}} \left[z_{j,i} - rW_{j,i}^U \right]}{\left[w_i \cdot (1 - s_{E,i})^{\frac{1}{1-\sigma}} + z_{j,i} - rW_{j,i}^U \right]^2} \right]$$

From equations (1.10) and (1.14), it is easy to see that both $\frac{d\mu_i}{dp_{nt,i}}$ and $\frac{ds_{E,i}}{dp_{nt,i}}$ are positive in our scenario with $0 < \sigma < 1$ and $-1 < \epsilon < 0$. Moreover, from equation (1.3) we also get that $z_{j,i} - rW_{j,i}^U < 0$. So we conclude that the derivative the RHS of equation (1.21) with respect to $p_{nt,i}$ is unambiguously positive.

Appendix B: Proof of Lemma 1

If $p_{nt,i}$ and λ^* are assumed to be fixed, an equilibrium exists if the system composed by the three equations (1.11), (1.17), and (1.22) admits a solution for the $s_{E,i}$, θ_i, and w_i in the case $0 < \sigma < 1$ and $-1 < \epsilon < 0$, for $i \in \{a, b\}$. If the equilibrium values for these unknowns exist, then all the other endogenous variables of the model (the expected lifetime and the instantaneous utilities) are easily obtained using their corresponding equations[27]. We first apply the implicit function theorem to equation (1.11). It is easy that w_i is a decreasing function of $s_{E,i}$ in the case $0 < \sigma < 1$ and $-1 < \epsilon < 0$. Moreover, $w_i \to +\infty$ as $s_{E,i} \to 0$ and $w_i \to +0$ as $s_{E,i} \to 1$. So for any value of $s_{E,i}$, equation (1.11) allows to identify a corresponding value of w_i. We can write $w_i(s_{E,i})$ with $w_i'(s_{E,i}) < 0$.

We write down the system of equation (1.17) and (1.22) in the following way:

$$\begin{cases} \mathbb{ZP}_i \equiv \frac{y_i - w_i(s_{E,i})}{r + \delta} - \frac{k}{q(\theta_i)} = 0 \\ \mathbb{W}_i \equiv w_i(s_{E,i}) - \frac{\beta\,(\,y_i + k \cdot \theta_i\,) + (1-\beta)\,b\,(1+\epsilon \cdot s_{E,i}) \left(\frac{1 - s_{U,i}}{1 - s_{E,i}} \right)^{\frac{1}{1-\sigma}}}{1 + (1-\beta)\epsilon \cdot s_{E,i}} = 0 \end{cases} \tag{1.31}$$

for $i \in \{a, b\}$. Notice that $\frac{d\,\mathbb{ZP}_i}{d\,s_{E,i}} = \frac{\partial\,\mathbb{ZP}_i}{\partial\,w_i} \cdot w_i'(s_{E,i})$ is positive because the first derivative is negative and we have just seen that w_i is decreasing in $s_{E,i}$. Moreover, since $q(\theta_i)$ is a decreasing function, then $\frac{d\,\mathbb{ZP}_i}{d\,\theta_i} < 0$, for $i \in \{a, b\}$. So the first equation of the system describes an increasing relationship in the $(s_{E,i}, \theta_i)$ space. In addition, with $s_{E,i} \to 0$ we have $w_i \to +\infty$ and, for the conditions in footnote 1,

[27] With $p_{nt,i}$ fixed, $s_{U,i}$ is obtained via equation (1.6).

$\theta_i \to 0$. Conversely, if $s_{E,i} \to 1$ we have $w_i \to 0$ and θ_i is a positive finite number. Under a Cobb-Douglas matching function $\theta_i = \left(\frac{y_i}{(r+\delta)k}\right)^{\frac{1}{\eta}} \equiv \bar{\theta}_i$.
As concerns the second equation of the system, we get:

$$\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} = \frac{\partial\,\mathbb{W}_i}{\partial\,s_{E,i}} + \frac{\partial\,\mathbb{W}_i}{\partial\,w_i} \cdot w_i'(s_{E,i}) \tag{1.32}$$

with

$$\frac{\partial\,\mathbb{W}_i}{\partial\,s_{E,i}} = -\frac{1-\beta}{1+(1-\beta)\epsilon \cdot s_{E,i}} \left[b \left(\frac{1-s_{U,i}}{1-s_{E,i}}\right)^{\frac{1}{1-\sigma}} \left(\frac{1+\epsilon \cdot s_{E,i}}{(1-s_{E,i})\,(1-s)} + \epsilon\right) - \epsilon w_i \right] \tag{1.33}$$

for $i \in \{a, b\}$. Notice that $\frac{1+\epsilon \cdot s_{E,i}}{(1-s_{E,i})(1-s)} + \epsilon > 0$ as long as $-1 < \epsilon < 0$ and $0 < \sigma < 1$. So we have $\frac{\partial\,\mathbb{W}_i}{\partial\,s_{E,i}} < 0$. Since $\frac{\partial\,\mathbb{W}_i}{\partial\,w_i} = 1$, the second term at the RHS of (1.32) is negative, and we obtain that $\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} < 0$. It is also easy to see that $\frac{d\,\mathbb{W}_i}{d\,\theta_i} < 0$. Therefore $\mathbb{W}_i = 0$ describes a decreasing relationship in the $(s_{E,i},\, \theta_i)$ space. In addition, if $s_{E,i} \to 0$ we have $w_i \to +\infty$ and, $\theta_i \to +\infty$. We can also show (details are available on request) that if $\theta_i = \bar{\theta}_i$, $s_{E,i} \in (0,\, 1)$.
This implies that there exists a unique equilibrium in $(s_{E,i},\, \theta_i)$ levels that satisfy system (1.31). The equilibrium value of $s_{E,i}$ allows to uniquely identify w_i. In turn, all the other endogenous variables are determined via their corresponding equations. As concerns the derivatives presented in Lemma 1, they are just obtained applying the implicit function theorem to the system (1.31). More specifically, we get:

$$\frac{d\,s_{E,i}}{d\,p_{nt,i}} = -\left[\frac{d\,\mathbb{W}_i}{d\,p_{nt,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,\theta_i} - \frac{d\,\mathbb{W}_i}{d\,\theta_i} \cdot \frac{d\,\mathbb{ZP}_i}{d\,p_{nt,i}}\right] \left[\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,\theta_i} - \frac{d\,\mathbb{W}_i}{d\,\theta_i} \cdot \frac{d\,\mathbb{ZP}_i}{d\,s_{E,i}}\right]^{-1} > 0$$

since we have:

$$\frac{d\,\mathbb{W}_i}{d\,p_{nt,i}} = -(r+\delta) \cdot \frac{d\,\mathbb{ZP}_i}{d\,p_{nt,i}} > 0\,; \qquad \frac{d\,\mathbb{W}_i}{d\,\theta_i} < 0 \tag{1.34}$$

for $i \in \{a, b\}$. Moreover, using equations (1.32) and (1.33), we have:

$$\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} = \frac{\partial\,\mathbb{W}_i}{\partial\,s_{E,i}} + w_i'(s_{E,i}) < 0; \qquad \frac{d\,\mathbb{ZP}_i}{d\,s_{E,i}} = -\frac{w_i'(s_{E,i})}{r+\delta} > 0; \qquad \frac{d\,\mathbb{ZP}_i}{d\,\theta_i} < 0 \tag{1.35}$$

for $i \in \{a, b\}$. We also get:

$$\frac{d\,\theta_i}{d\,p_{nt,i}} = -\left[\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,p_{nt,i}} - \frac{d\,\mathbb{W}_i}{d\,p_{nt,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,s_{E,i}}\right]\left[\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,\theta_i} - \frac{d\,\mathbb{W}_i}{d\,\theta_i} \cdot \frac{d\,\mathbb{ZP}_i}{d\,s_{E,i}}\right]^{-1}$$

for $i \in \{a, b\}$. The second difference at the RHS is positive for the inequalities in equations (1.34) and (1.35). From equations (1.34) and (1.35) we can also write the first difference as follows:

$$\left[\frac{d\,\mathbb{W}_i}{d\,s_{E,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,p_{nt,i}} - \frac{d\,\mathbb{W}_i}{d\,p_{nt,i}} \cdot \frac{d\,\mathbb{ZP}_i}{d\,s_{E,i}}\right] = -\left(\frac{\partial\,\mathbb{W}_i}{\partial\,s_{E,i}} + w_i'(s_{E,i})\right)\frac{1}{r+\delta}\frac{d\,\mathbb{W}_i}{d\,p_{nt,i}} + \frac{w_i'(s_{E,i})}{r+\delta}\frac{d\,\mathbb{W}_i}{d\,p_{nt,i}}$$

for $i \in \{a, b\}$. This term is positive because the we have proved that $\frac{\partial\,\mathbb{W}_i}{\partial\,s_{E,i}} < 0$. In turn, this means that $\frac{d\,\theta_i}{d\,p_{nt,i}} < 0$

Notice that, for the zero profit condition (1.17), $\frac{d\,\theta_i}{d\,p_{nt,i}} < 0$ implies that $\frac{d\,w_i}{d\,p_{nt,i}} > 0$. The only reason labor market tightness decreases after a positive variation in $p_{nt,i}$ is because w_i has increased, the other variables of the equation (1.17) being exogenously given.

Appendix C: Proof of Proposition 1

We divide the proof in four steps.

STEP 1.

From Lemma 1, we have seen that the system composed by the housing share equation for employed workers (1.11), the free entry zero profit condition (1.17), and the wage equation (1.22) admits a unique equilibrium in $s_{E,i}$, θ_i, and w_i for any given $p_{nt,i}$, and λ^* ($i \in \{a, b\}$). Now, we focus on the market clearing conditions in the housing sector in both regions, (1.28). Notice first that using the Hicksian demand functions (1.4) and (1.10) and equation (1.13), we can write

$$u_i \cdot Q^U_{nt,i} + (1-u_i) \cdot Q^E_{nt,i} = p^{-\sigma}_{nt,i}\left[u_i\, b^{1+\epsilon(1-\sigma)}\,(1-s_{U,i})^{1+\epsilon} + (1-u_i)\, w_i^{1+\epsilon(1-\sigma)}\,(1-s_{E,i})^{1+\epsilon}\right]$$

for $i \in \{a, b\}$. We can insert this expression into the equilibrium condition (1.28).

Using equation (1.26), we get:

$$(1 - H(\lambda^*))\, L \;=\; \frac{\alpha_a\, p_{nt,a}^{\frac{1}{\gamma}+\sigma}}{u_a\, b^{1+\epsilon(1-\sigma)}\, (1 - s_{U,a})^{1+\epsilon} \,+\, (1 - u_a)\, w_a^{1+\epsilon(1-\sigma)}\, (1 - s_{E,a})^{1+\epsilon}} \tag{1.36}$$

$$H(\lambda^*) L \;=\; \frac{\alpha_b\, p_{nt,b}^{\frac{1}{\gamma}+\sigma}}{u_b\, b^{1+\epsilon(1-\sigma)}\, (1 - s_{U,b})^{1+\epsilon} \,+\, (1 - u_b)\, w_b^{1+\epsilon(1-\sigma)}\, (1 - s_{E,b})^{1+\epsilon}} \tag{1.37}$$

We want to show that the RHS of both equations are increasing in $p_{nt,i}$ for $i \in \{a,\, b\}$. The numerator is of course increasing in $p_{nt,i}$. As concerns the denominator, applying the implicit function theorem to the system composed by equations (1.11), (1.17), and (1.22) (details are available on request), we obtain that $\frac{d\, w_i}{d\, p_{nt,i}} > 0$, $\frac{d\, s_{E,i}}{d\, p_{nt,i}} > 0$, $\frac{d\, s_{U,i}}{d\, p_{nt,i}} > 0$ and $\frac{d\, \theta_i}{d\, p_{nt,i}} < 0$. Since the unemployment rate u_i is decreasing in θ_i for equation (1.1), we get that the only positive term[28] of the derivative of the denominator of (1.36) with respect to $p_{nt,i}$ is :

$$(1 + \epsilon(1 - \sigma))\; (1 - u_i)\; (1 - s_{E,i})^{1+\epsilon}\; w_i^{\epsilon(1-\sigma)}\; \frac{d\, w_i}{d\, p_{nt,i}}$$

for $i \in \{a,\, b\}$. Computing the derivative of (1.36) with respect to $p_{nt,i}$, we then obtain that sufficient condition for the term at the RHS of (1.36) to be increasing in $p_{nt,i}$ is that

$$p_{nt,i}^{\frac{1}{\gamma}+\sigma}\; [1 + \epsilon(1 - \sigma)]\; (1 - u_i)\; (1 - s_{E,i})^{1+\epsilon}\; w_i^{\epsilon(1-\sigma)}\; \frac{d\, w_i}{d\, p_{nt,i}} \;<\; \left(\frac{1}{\gamma} + \sigma\right) p_{nt,i}^{\frac{1}{\gamma}+\sigma-1} (1 - u_i)\, (1 - s_{E,i})^{1+\epsilon}\; w_i^{1+\epsilon(1-\sigma)}$$

This is equivalent to prove that

$$\frac{d\, w_i}{d\, p_{nt,i}} \frac{p_{nt,i}}{w_i} \;<\; \frac{\frac{1}{\gamma} + \sigma}{1 + \epsilon(1 - \sigma)}$$

In a supplementary note (available on request) we prove that this is always verified if the term at the RHS is greater than 1. This in turn is equivalent to imposing $\frac{1}{\gamma} > (1 + \epsilon)(1 - \sigma)$.

[28] This is because the denominator at the RHS of (1.36) is decreasing in $s_{E,i}$ and $s_{U,i}$, that are increasing in $p_{nt,i}$. Moreover, the same denominator is decreasing in u_i (that is in turn positively affected by $p_{nt,i}$, because $b^{1+\epsilon(1-\sigma)}\, (1 - s_{U,i})^{1+\epsilon} < w_i^{1+\epsilon(1-\sigma)}\, (1 - s_{E,i})^{1+\epsilon}$ (as $b < w_i$ and $s_{U,i} > s_{U,i}$ if $-1 < \epsilon < 0$).

Therefore, if this condition holds, we have that the term at the RHS of (1.36) is an increasing function of $p_{nt,i}$

STEP 2

We then use both equations in (1.36) to get rid of the terms with λ^*:

$$\begin{aligned}\mathbb{L} \equiv L - \frac{\alpha_a\, p_{nt,a}^{\frac{1}{\gamma}+\sigma}}{u_a\, b^{1+\epsilon(1-\sigma)}\,(1-s_{U,a})^{1+\epsilon} + (1-u_a)\, w_a^{1+\epsilon(1-\sigma)}\,(1-s_{E,a})^{1+\epsilon}} + \\ - \frac{\alpha_b\, p_{nt,b}^{\frac{1}{\gamma}+\sigma}}{u_b\, b^{1+\epsilon(1-\sigma)}\,(1-s_{U,b})^{1+\epsilon} + (1-u_b)\, w_b^{1+\epsilon(1-\sigma)}\,(1-s_{E,b})^{1+\epsilon}} = 0\end{aligned} \tag{1.38}$$

For the result obtained in STEP 1, the implicit function $\mathbb{L} = 0$ describes a decreasing relationship in the $(p_{nt,a},\, p_{nt,b})$ space. Notice also that $\frac{d\,\mathbb{L}}{d\,y_i} > 0$ for $i \in \{a,\, b\}$, as w_i is increasing in y_i (see equation 1.22) and $\frac{d\,u_i}{d\,y_i} = \frac{\partial\,u_i}{\partial\,\theta_i} \cdot \frac{\partial\,\theta_i}{\partial\,y_i} < 0$ and $\frac{d\,s_{E,i}}{d\,y_i} = \frac{\partial\,s_{E,i}}{\partial\,w_i} \cdot \frac{\partial\,w_i}{\partial\,y_i} < 0$.

STEP 3

For convenience we re-write here the migration equation (1.25):

$$\Lambda \equiv \lambda^* - b\left[(1-s_{U,b})^{\frac{1}{1-\sigma}} - (1-s_{U,a})^{\frac{1}{1-\sigma}}\right] - \frac{\beta\cdot k}{1-\beta}\left[\frac{\theta_b(1-s_{E,b})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,b}} - \frac{\theta_a(1-s_{E,a})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,a}}\right] = 0$$

Notice that $\frac{d\,\Lambda}{d\,\lambda^*} > 0$. Moreover we get:

$$\frac{d\,\Lambda}{d\,p_{nt,a}} = \frac{\partial\,\Lambda}{\partial\,p_{nt,a}} + \frac{\partial\,\Lambda}{\partial\,p_{nt,b}} \cdot \frac{\partial\,p_{nt,b}}{\partial\,p_{nt,a}}\Big|_{\mathbb{L}=0}$$

in which $\frac{\partial\,p_{nt,b}}{\partial\,p_{nt,a}}\Big|_{\mathbb{L}=0} < 0$ is obtained by total differentiating the implicit function $\mathbb{L} = 0$ (see STEP 2). Moreover, we have:

$$\begin{aligned}\frac{\partial\,\Lambda}{\partial\,p_{nt,a}} = -b\,(1-s_{U,a})^{\frac{1}{1-\sigma}-1}\cdot\frac{d\,s_{U,a}}{d\,p_{nt,a}} + \frac{\beta\cdot k}{1-\beta}\frac{(1-s_{E,a})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,a}}\cdot\frac{d\,\theta_a}{d\,p_{nt,a}} + \\ - \frac{\beta\cdot k}{1-\beta}\cdot\frac{\theta_a(1-s_{E,a})^{\frac{1}{1-\sigma}}}{1+\epsilon\cdot s_{E,a}}\cdot\frac{(1+\epsilon\cdot s_{E,a})+\epsilon(1-\sigma)(1-s_{E,a})}{(1-\sigma)(1-s_{E,a})(1+\epsilon\cdot s_{E,a})}\cdot\frac{d\,s_{E,a}}{d\,p_{nt,a}}\end{aligned}$$

This derivative is negative, since $\frac{d\,s_{U,a}}{d\,p_{nt,a}} > 0$, $\frac{d\,s_{Ea}}{d\,p_{nt,a}} > 0$, $\frac{d\,\theta_a}{d\,p_{nt,a}} < 0$ and $(1+\epsilon\cdot s_{E,a})+\epsilon(1-\sigma)(1-s_{E,a}) > 0$. Following the same procedure, it is easy to see that $\frac{\partial\,\Lambda}{\partial\,p_{nt,b}} > 0$. So we have that $\frac{d\,\Lambda}{d\,p_{nt,a}} < 0$. The implicit function $\Lambda = 0$ describes a positive relationship in the $(p_{nt,a},\, \lambda^*)$ space.

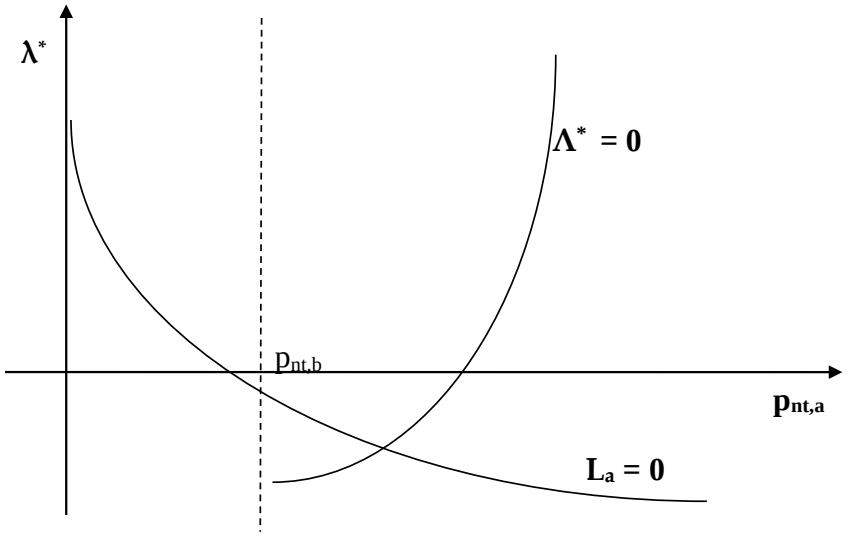

Figure 1.1: Equilibrium of system (1.39)

STEP 4

We consider the system composed by the migration equation (1.25) and the market clearing condition in the housing market in region a, the first equation in (1.36):

$$\begin{cases} \Lambda \;=\; 0 \\ \mathbb{L}_a \;\equiv\; (1 - H(\lambda^*))\, L \;-\; \dfrac{\alpha_a\, p_{nt,a}^{\frac{1}{\gamma}+\sigma}}{u_a\, b^{1+\epsilon(1-\sigma)} \left(1-s_{U,a}\right)^{1+\epsilon} + (1-u_a)\, w_a^{1+\epsilon(1-\sigma)} \left(1-s_{E,a}\right)^{1+\epsilon}} = 0 \end{cases} \tag{1.39}$$

We have proved in STEP 3 that $\Lambda = 0$ a positive relationship in the ($p_{nt,a}$, λ^*) space. From STEP 1 we also know that the term at the LHS of the second equation of system (1.39), is decreasing in $p_{nt,a}$. Moreover, the same term is also decreasing in λ^*, as $H(.)$ is cumulative density function. Therefore, the second equation of system (1.39) describes a positive relationship in the ($p_{nt,a}$, λ^*) space. As concerns the limit of the second equation of the system, as $\lambda^* \to \lambda$, there is no labor force in region a and $p_{nt,a} \to 0$. If $\lambda^* \to -\lambda$, $p_{nt,a}$ takes a positive finite number.

We focus now on the limit cases for the the implicit function $\Lambda = 0$, that is obtained using the migration equation (1.25) and he implicit function $\mathbb{L} = 0$, defined in (1.38). If $\lambda^* < 0$, $L_a > L_b$ and the first negative term at the LHS of equation (1.38) must

be greater in absolute value the the second one. Since $y_a > y_b$ and $\frac{d\mathbb{L}}{dy_i} > 0$ for $i \in \{a, b\}$ (see STEP 3), this is possible only if $p_{nt,a} > p_{nt,b}$. This implies that the implicit function $\Lambda = 0$ is negative for values of $p_{nt,a}$ close but greater than $p_{nt,a}$. Since it is an increasing function in the $(p_{nt,a}, \lambda^*)$ space, an equilibrium for the system (1.39) exists and it is unique. See Figure 1. Once the equilibrium values of $p_{nt,a}$ and λ^* are determined, $p_{nt,b}$ is uniquely obtained via equation (1.38). From Lemma 1, all the other endogenous variables of the model can be found solving system (1.31).

Notice that in Figure 1 we have considered an equilibrium with $\lambda^* < 0$ and $L_a > L_b$. We cannot rule out however the possibility that the two curves intersect in the positive hortant.

As concerns the inequalities presented in Proposition 1, we use the implicit function theorem to system (1.39):

$$\frac{d\,p_{nt,a}}{d\,y_a} = -\left[\frac{d\,\mathbb{L}_a}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,y_a} - \frac{d\,\mathbb{L}_a}{d\,y_a}\cdot\frac{d\,\Lambda}{d\,\lambda^*}\right]\cdot\left[\frac{d\,\mathbb{L}_a}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,p_{nt,a}} - \frac{d\,\mathbb{L}_a}{d\,p_{nt,a}}\cdot\frac{d\,\Lambda}{d\,\lambda^*}\right]^{-1} > 0 \tag{1.40}$$

since we have:

$$\frac{d\,\mathbb{L}_a}{d\,\lambda^*} < 0\,; \qquad \frac{d\,\mathbb{L}_a}{d\,y_a} > 0\,; \qquad \frac{d\,\mathbb{L}_a}{d\,p_{nt,a}} < 0\,; \qquad \frac{d\,\Lambda}{d\,\lambda^*} > 0$$

$$\frac{d\,\Lambda}{d\,y_a} = \underbrace{\frac{\partial\,\Lambda}{\partial\,y_a}}_{+} + \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,b}}}_{+}\cdot\underbrace{\frac{\partial\,p_{nt,b}}{\partial\,y_a}\Big|_{\mathbb{L}=0}}_{+} > 0 \quad \text{and} \quad \frac{d\,\Lambda}{d\,p_{nt,a}} = \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,a}}}_{-} + \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,b}}}_{+}\cdot\underbrace{\frac{\partial\,p_{nt,b}}{\partial\,\partial_{nt,a}}\Big|_{\mathbb{L}=0}}_{-} < 0$$

All the signs of the derivatives in the first line are easily obtained by differentiating the equations in system (1.39). The signs of the derivatives in the second line are computed by differentiating the implicit equation $\mathbb{L} = 0$ in (1.38). The sign of the derivative in equation (1.40) means that $p_{nt,a} > p_{nt,b}$ as long as $y_a > y_b$. In turn, this implies that $w_a > w_b$ because

$$\frac{d\,w_a}{d\,y_a} = \frac{\partial\,w_i}{\partial\,y_i} + \frac{\partial w_i}{\partial p_{nt,i}}\cdot\frac{\partial p_{nt,i}}{\partial y_i} > 0.$$

The first term at the RHS is positive and it is obtained by applying the the implicit function theorem to system (1.31). The second term at the RHS is also positive for the results in Lemma 1 ($\frac{\partial w_i}{\partial p_{nt,i}} > 0$) and for what we have obtained by totally

differentiating system (1.39) ($\frac{\partial p_{nt,i}}{\partial y_i} > 0$). The fact that $p_{nt,a} > p_{nt,b}$ also means that $s_{U,a} > s_{U,b}$ for equation (1.6).

Appendix D: Proof of Proposition 2

The proof consists on applying the implicit function theorem to system (1.39). We consider a marginal change in α_a but the same procedure applies in case of a variation in α_b. More specifically, we get that

$$\frac{d\,p_{nt,a}}{d\,\alpha_a} = -\left[\frac{d\,\mathbb{L}_a}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,\alpha_a} - \frac{d\,\mathbb{L}_a}{d\,\alpha_a}\cdot\frac{d\,\Lambda}{d\,\lambda^*}\right]\cdot\left[\frac{d\,\mathbb{L}_a}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,p_{nt,a}} - \frac{d\,\mathbb{L}_a}{d\,p_{nt,a}}\cdot\frac{d\,\Lambda}{d\,\lambda^*}\right]^{-1} < 0 \tag{1.41}$$

since we have:

$$\frac{d\,\mathbb{L}_a}{d\,\lambda^*} < 0\,; \qquad \frac{d\,\mathbb{L}_a}{d\,\alpha_a} < 0\,; \qquad \frac{d\,\mathbb{L}_a}{d\,p_{nt,a}} < 0\,; \qquad \frac{d\,\Lambda}{d\,\lambda^*} > 0$$

$$\frac{d\,\Lambda}{d\,\alpha_a} = \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,b}}}_{+}\cdot\underbrace{\frac{\partial\,p_{nt,b}}{\partial\,\alpha_a}\Big|_{\mathbb{L}=0}}_{-} < 0 \quad \text{and} \quad \frac{d\,\Lambda}{d\,p_{nt,a}} = \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,a}}}_{-} + \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,b}}}_{+}\cdot\underbrace{\frac{\partial\,p_{nt,b}}{\partial\,\partial_{nt,a}}\Big|_{\mathbb{L}=0}}_{-} < 0$$

All the signs of the derivatives in the first line are easily obtained by differentiating the equations in system (1.39). The signs of the derivatives in the second line are computed by differentiating the implicit equation $\mathbb{L} = 0$ in (1.38).

To evaluate the effects on $p_{nt,b}$ and λ^* of a marginal reduction in α_a we find it easier to focus on an alternative equilibrium system, in which we consider the equilibrium condition in the housing market in region b, the second equation in (1.36):

$$\begin{cases} \Lambda = 0 \\ \mathbb{L}_b \equiv H(\lambda^*)L - \dfrac{\alpha_b\, p_{nt,b}^{\frac{1}{\gamma}+\sigma}}{u_b\, b^{1+\epsilon(1-\sigma)}\left(1-s_{U,b}\right)^{1+\epsilon} + (1-u_b)\, w_a^{1+\epsilon(1-\sigma)}\left(1-s_{E,b}\right)^{1+\epsilon}} = 0 \end{cases} \tag{1.42}$$

The same procedure described in STEP 4 in the previous Appendix allows to find a unique equilibrium in the ($p_{nt,b}$, λ^*) space.

Comparative statics is easier if we consider this system as $\frac{d\mathbb{L}_b}{d\,\alpha_a} = 0$. So we get:

$$\frac{d\,p_{nt,b}}{d\,\alpha_a} = -\left[\frac{d\,\mathbb{L}_b}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,\alpha_a}\right]\cdot\left[\frac{d\,\mathbb{L}_b}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,p_{nt,b}} - \frac{d\,\mathbb{L}_b}{d\,p_{nt,b}}\cdot\frac{d\,\Lambda}{d\,\lambda^*}\right]^{-1} < 0 \tag{1.43}$$

and

$$\frac{d\,\lambda^*}{d\,\alpha_a} \;=\; \left[\frac{d\,\mathbb{L}_b}{d\,p_{nt,b}}\cdot\frac{d\,\Lambda}{d\,\alpha_a}\right]\cdot\left[\frac{d\,\mathbb{L}_b}{d\,\lambda^*}\cdot\frac{d\,\Lambda}{d\,p_{nt,b}}-\frac{d\,\mathbb{L}_b}{d\,p_{nt,b}}\cdot\frac{d\,\Lambda}{d\,\lambda^*}\right]^{-1} \;<\; 0 \qquad (1.44)$$

since we have:

$$\frac{d\,\mathbb{L}_b}{d\,\lambda^*} \;>\; 0\,; \qquad \frac{d\,\mathbb{L}_b}{d\,p_{nt,b}} \;<\; 0\,; \qquad \frac{d\,\Lambda}{d\,\lambda^*} \;>\; 0$$

$$\frac{d\,\Lambda}{d\,\alpha_a} \;=\; \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,a}}}_{-}\cdot\underbrace{\frac{\partial\,p_{nt,a}}{\partial\,\alpha_a}\Big|_{\mathbb{L}=0}}_{-} \;>\; 0 \quad \text{and} \quad \frac{d\,\Lambda}{d\,p_{nt,b}} \;=\; \underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,b}}}_{+}+\underbrace{\frac{\partial\,\Lambda}{\partial\,p_{nt,a}}}_{-}\cdot\underbrace{\frac{\partial\,p_{nt,a}}{\partial\,\partial_{nt,b}}\Big|_{\mathbb{L}=0}}_{-} \;>\; 0$$

Again, all the signs of the derivatives in the first line are easily obtained by differentiating the equations in system (1.42). The signs of the derivatives in the second line are computed by differentiating the implicit equation $\mathbb{L} = 0$ in (1.38).

We get that a marginal reduction in α_a increases $p_{nt,a}$, $p_{nt,b}$, and λ^*. Since the labor force L_a is a decreasing function of λ^*, a lower α_a reduces L_a and raises L_b. For the properties described in Lemma 1, for any $i \in \{a, b\}$ a higher $p_{nt,i}$ raises w_i and $P_{U,i}$, while it reduces θ_i (so u_i goes up for equation 1.1).

Appendix E: Sensitivity Analysis

We follow two alternative procedures to calibrate our model under homothetic preferences (i.e. $\epsilon = 0$). The first one consists on following the same steps presented in section 1.6.1. We make only one notable departure. Since with $\epsilon = 0$, the expenditure shares are equal for all workers belonging to the same region, we consider the average values of the expenditure share for the Western states of Germany and the Eastern states, instead of distinguishing between employed workers and poorer, unemployed ones. The resulting calibrated model is then simulated in response to the same shocks considered in section 1.6.2.

In the second alternative approach, we take the baseline calibrated model and simulate a change on ϵ. Its initial calibrated value is -0.8. We look at the new values for the endogenous variables of the model if $\epsilon = -0.08$, ten times larger in absolute value. We then simulate the same shocks considered in section 1.6.2 using as starting point the model at $\epsilon = -0.08$.

They are both counterfactual exercises. The first one considers the real average

values for the housing expenditures shares, but all the variables that are calibrated conditional on a specific value of ϵ (most of those presented in Table 2) are obtained imposing homotheticity, an assumption that does not match German data, that show housing expenditures shares decrease with income. On the other hand, the second procedure is equivalent to considering a shock on ϵ that changes households' preferences on housing (in the sense it is no longer considered a necessity good) and then look at how the resulting economy would react to the shocks.

Luckily, results are very similar for either option. In Tables 1.6.3, 1.6.4, and 1.6.5 we present the results of the second procedure. The ones obtained via the first approach are available on request.

As concerns the other sensitivity analyses presented in section 1.6.3, we simply change the values of the parameter of interest in the calibration and then proceed with the simulation.

Percentage change	$\Delta y_a/y_a = 1\%$	$\Delta \alpha_a/\alpha_a = -5\%$
L_a	0.9	-0.6
L_b	-4	2.7
u_a	-0.04 pp	0.002 pp
u_b	-0.002 pp	0.001 pp
$p_{nt,a}$	0.6	1.7
$p_{nt,b}$	-1.6	1.0
$P_{E,a}$	-0.07	0.7
$P_{E,b}$	-0.6	0.4
$P_{U,a}$	0.4	1.0
$P_{U,b}$	-0.7	0.5
w_a (real)	1 (1.1)	0.0 (-0.7)
w_b (real)	0.0 (0.6)	0.0 (-0.4)
real b in region a	-0.4	-1.0
real b in region b	0.7	-0.5
Variance of log income (real)	2.0 (1.5)	0.2 (-1.1)
W_a^E	1.1	-0.7
W_a^U	1.1	-0.7
W_b^E	0.6	-0.4
W_b^U	0.6	-0.4

Table 1.8.1: Sensitivity analysis with $\gamma = 0.5$ (percentage changes - for the unemployment rates variation in percentage points)

	$\beta = 0.4$	$\beta = 0.4$	$\beta = 0.6$	$\beta = 0.6$
Percentage change	$\Delta y_a/y_a = 1\%$	$\Delta\alpha_a/\alpha_a = -5\%$	$\Delta y_a/y_a = 1\%$	$\Delta\alpha_a/\alpha_a = -5\%$
L_a	0.5	-0.8	0.5	-0.8
L_b	-2.1	3.7	-2.1	3.7
u_a	-0.04 pp	0.0 pp	-0.04 pp	0.0 pp
u_b	-0.002 pp	0.0 pp	-0.0 pp	0.0 pp
$p_{nt,a}$	1.1	4.0	1.1	4.0
$p_{nt,b}$	-1.9	3.4	-1.9	3.4
$P_{E,a}$	0.1	1.6	0.1	1.6
$P_{E,b}$	-0.7	1.2	-0.7	1.2
$P_{U,a}$	0.6	2.3	0.6	2.3
$P_{U,b}$	-0.9	1.6	-0.9	1.6
w_a (real)	1 (0.9)	0.0 (-1.5)	1 (0.9)	0.0 (-1.5)
w_b (real)	-0.0 (0.7)	0.0 (-1.2)	-0.0 (0.7)	0.0 (-1.2)
real b in region a	-0.6	-2.3	-0.6	-2.3
real b in region b	0.9	-1.6	0.9	-1.6
Var. log income (real)	2.3 (1.4)	0.5 (0.9)	2.3 (1.4)	0.5 (0.9)
W_a^E	0.9	-1.5	0.9	-1.5
W_a^U	0.9	-1.5	0.9	-1.5
W_b^E	0.7	-1.2	0.7	-1.2
W_b^U	0.7	-1.2	0.7	-1.2

Table 1.8.2: Sensitivity analysis with $\beta = 0.4$ and $\beta = 0.6$ (percentage changes - for the unemployment rates variation in percentage points)

	$\sigma = 0.3$	$\sigma = 0.3$	$\sigma = 0.7$	$\sigma = 0.7$
Percentage change	$\Delta y_a/y_a = 1\%$	$\Delta\alpha_a/\alpha_a = -5\%$	$\Delta y_a/y_a = 1\%$	$\Delta\alpha_a/\alpha_a = -5\%$
L_a	0.4	-0.9	0.6	-0.9
L_b	-1.7	3.8	-2.4	3.7
u_a	-0.04 pp	0.0 pp	-0.03 pp	0.0 pp
u_b	-0.002 pp	0.0 pp	-0.0 pp	0.0 pp
$p_{nt,a}$	1.1	4.8	1.1	3.6
$p_{nt,b}$	-1.9	4.3	-2.0	3.1
$P_{E,a}$	0.2	1.8	0.04	1.5
$P_{E,b}$	-0.7	1.5	-0.8	1.2
$P_{U,a}$	0.6	2.6	0.7	2.3
$P_{U,b}$	-0.9	1.9	-1.0	1.6
w_a (real)	1 (0.8)	0.0 (-1.7)	1.0 (1.0)	0.0 (-1.5)
w_b (real)	-0.0 (0.7)	0.0 (-1.5)	-0.0 (0.8)	0.0 (-1.2)
real b in region a	-0.6	-2.5	-0.7	-2.3
real b in region b	0.9	-1.9	1.0	-1.6
Var. log income (real)	2.7 (1.5)	0.5 (1.2)	2.0 (1.3)	0.5 (0.8)
W_a^E	0.8	-1.8	1.0	-1.5
W_a^U	0.8	-1.8	1.0	-1.5
W_b^E	0.7	-1.5	0.8	-1.2
W_b^U	0.7	-1.5	0.8	-1.2

Table 1.8.3: Sensitivity analysis with $\sigma = 0.3$ and $\sigma = 0.7$ (percentage changes - for the unemployment rates variation in percentage points)

Appendix F: Some graphical approaches of the simulations results

A positive productivity shock in a specific region of the country increases match surplus, leading to higher negotiated wages and subsequently driving up demand for housing services, resulting in price increases (Figure 1.2 panel on the left and Figure 1.3 both panel). Migration towards the western region reduces housing demand in region b (Eastern Germany), causing a decline in housing prices (Figure 1.2 panel on the right). This is true only for the case of the productivity shock in region a (Western Germany); while when we consider the scenario of the contemporary shock in a (1%) and b (1.5%), the prices increase in both the two regions. As we have seen, the positive correlation between housing prices and nominal salaries, evidenced by the wage equation (Eq. (1.22)), partially explains the impact on employment, as rising wages limit vacancy creation. Fluctuations in nominal wages, particularly in housing prices, influence the overall cost of living. In the first scenario with the productive shock only in one region, where housing prices rise, individuals experience higher costs of living, but with non-homothetic preferences, employed workers allocate less income to housing, mitigating their cost of living, while unemployed workers face a significant increase (Figure 1.4 panel on the left). Conversely, in the East, where housing prices are lower, unemployed individuals benefit more, resulting in a decrease in their cost of living index compared to employed individuals (Figure 1.4 panel on the right). If we consider the second scenario (Figure 1.5), the income effect outweighs the price effect. Consequently, under non-homothetic preferences, employed workers in West Germany experience a slight decrease in their price index, while the other actors see an increase.

Considering instead the shock to housing supply in region a (Figure 1.6: the shock is negative and therefore the graph is to be read from right to left), as anticipated, the cost of living indexes increase for all workers across the economy. Naturally, the rise is more pronounced for workers in region a, where the shock has originated. Unemployed workers bear a greater impact from the shock, given that housing constitutes a larger proportion of their total expenditures.

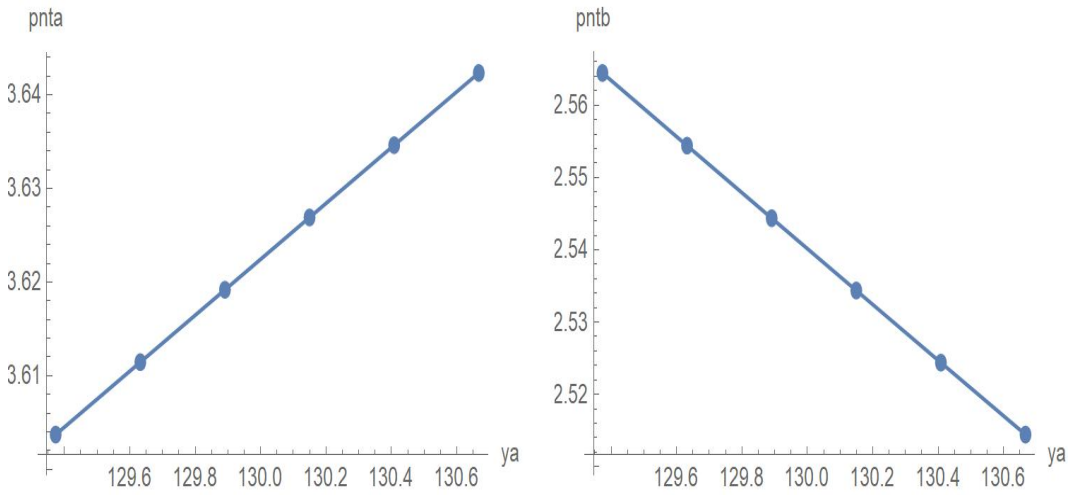

Figure 1.2: Productive shock on regions a (1%): housing prices in regions a and b

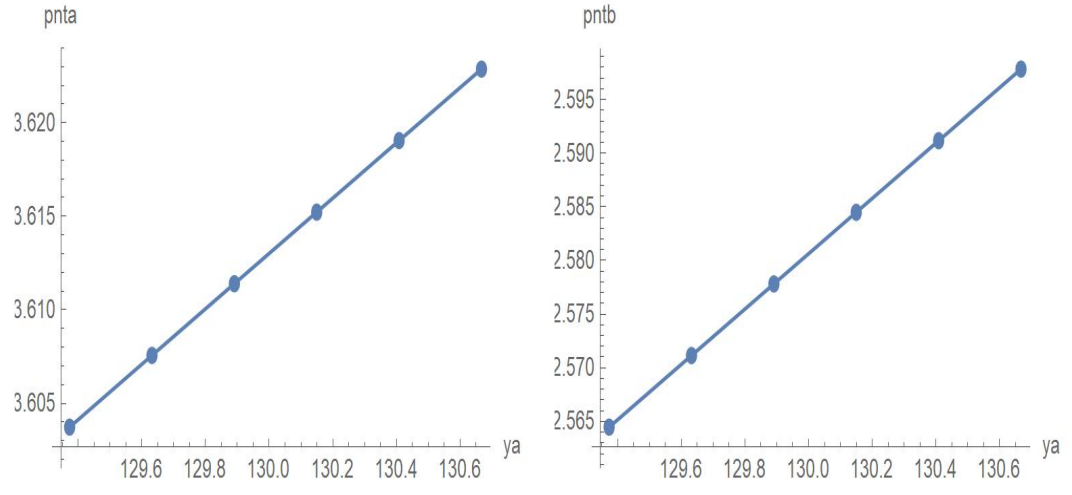

Figure 1.3: Productive shock on regions a (1%) and b (1.5%): housing prices in regions a and b

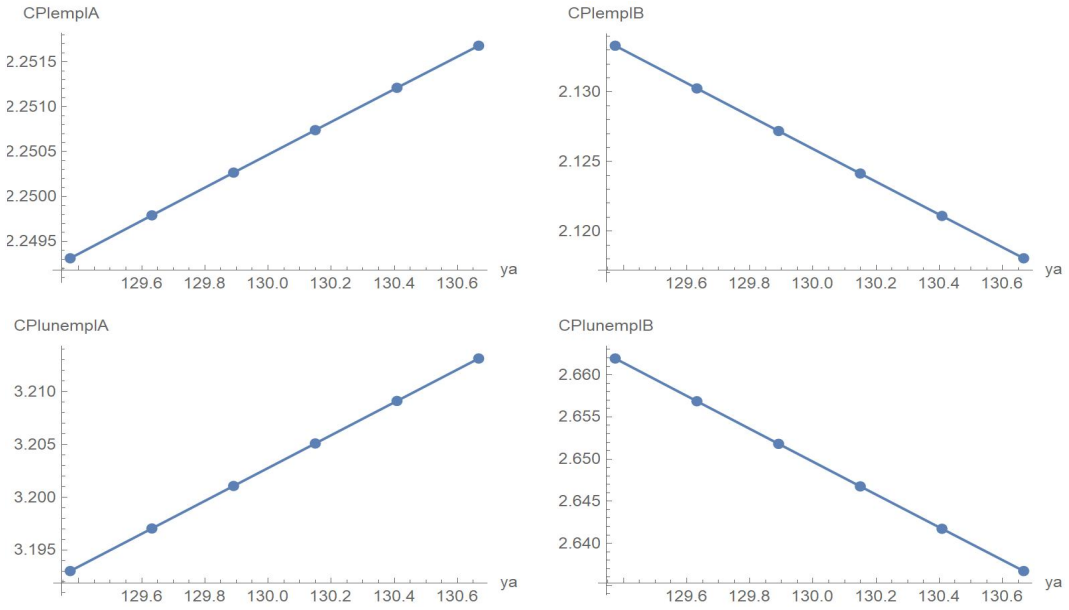

Figure 1.4: Productive shock on regions a (1%): CPI for employed and unemployed in regions a and b

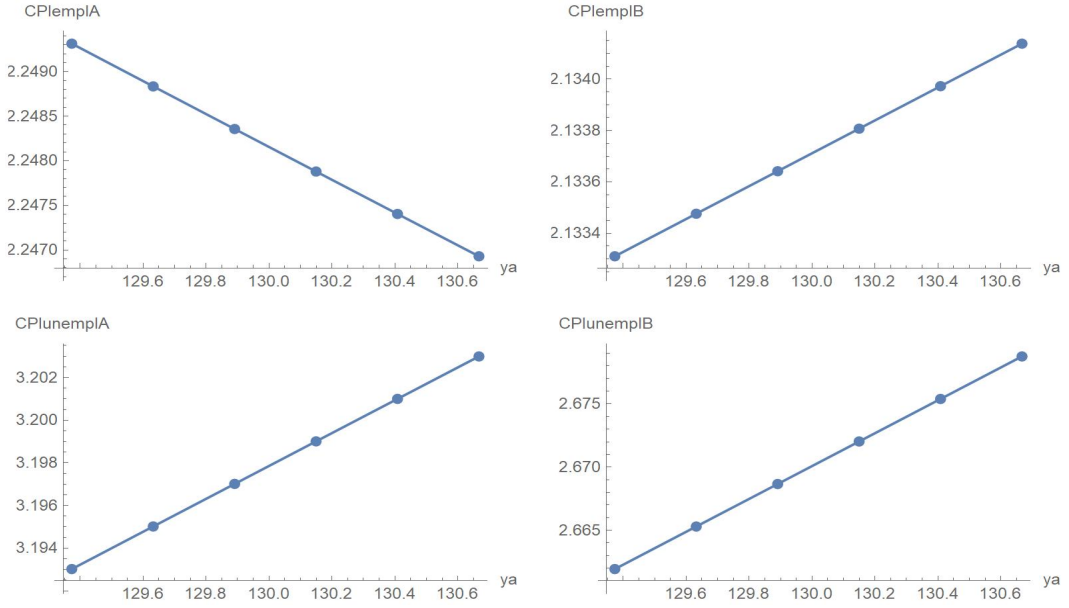

Figure 1.5: Productive shock on regions a (1%) and b (1.5%): CPI for employed and unemployed in regions a and b

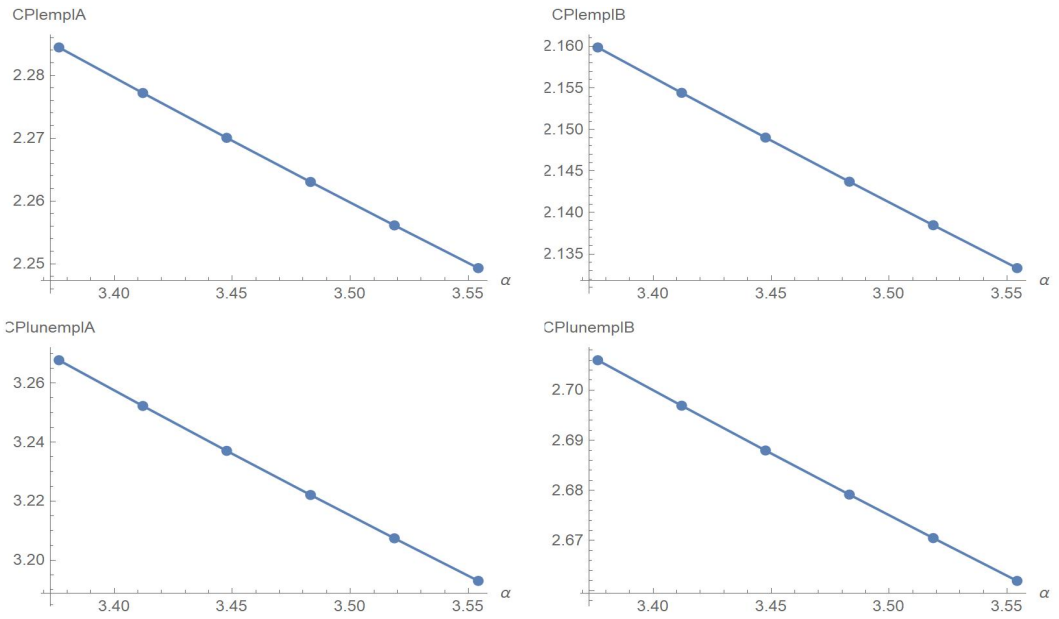

Figure 1.6: Housing supply shock on regions a (-5%): CPI for employed and unemployed in regions a and b

Chapter 2

The mother hen effect and students' mobility: a gravity approach

2.1 Abstract

This study investigates whether the role of mothers in society and in households has an impact on student mobility. The results suggest a *mother-hen* (mamma-chioccia) effect: the more emancipated women are in terms of salary and employment, the less likely their children are to temporarily migrate in another region for study purposes. Previous literature on student mobility has focused on economic or social determinants of student mobility, but to the best of my knowledge, this is the first paper that looks into the role of mothers' emancipation. Women's emancipation is measured using either the regional female employment rate in the main analysis or by the percentage of households where women are heads in the robustness one. These variables are constructed at the regional level for Italy for the period 2014-2020. The flow of students who leave a region in Italy to study at a university in another region is considered. For each pair of regions, I construct dyadic student mobility flows. The model is a gravity model where the dependent variable is the students' flows between any pairs of regions. In each specification, region-pair fixed effects and an extended set of controls are added. I also consider an instrumental variable approach (IV) to mitigate the issue of confounding factors and the Oster method to face the problem of the omitted variables. Overall, the results suggest that the more emancipated women are, the less likely their children are to temporarily migrate to another region to begin their university path.

Keywords: Student's mobility, Female Employment Rate, Female Emancipation, Gender Norms, Temporary Migration.

J.E.L. Classification: J16, I23, R23, I25, O15.

2.2 Introduction

Mobility is an intrinsic part of the history of humanity, from the itinerant life of the first groups of Palaeolithic hunter-gatherers to the migrations of our contemporary society, including students' mobility. This paper advances the hypothesis that mothers' emancipation negatively affects student mobility establishing a link at the regional level between the bargaining power of women and student mobility. My findings suggest a "mother-hen" effect [1]: the more significant the bargaining power of women, the less likely children quit their home city to study in another region. The mechanism driving our results is multifaceted. Firstly, women tend to favor raising their children in societies where they (themselves) possess strong bargaining power and enjoy decision-making autonomy. Additionally, women particularly prioritize creating nurturing environments for their daughters within settings that promote women's emancipation. Consequently, such environments become an ideal setting for child-rearing, motivating mothers to raise both daughters and sons together.

Existing research on student mobility, such as Beine, Delogu, and Ragot (2020) and others, has predominantly concentrated on the economic factors influencing it. Numerous studies have highlighted the significance of university fees, the cost of living, and the quality of the university as pivotal determinants of mobility. Nevertheless, as far as I am aware, this paper is the inaugural exploration into the impact of family dynamics, with a specific focus on the role of mothers.

An expanding body of literature examines the role of mothers and the factors influencing the well-being or choices of their offspring. Earlier studies suggest that when a mother experiences an increase in her income within the labor market, both in absolute terms and in comparison to others, it heightens her relative sway over decisions concerning her children (Guiso and Zaccaria (2023) and Magda, Cukrowska-Torzewska, and Palczyńska (2023)). Italy serves as a pertinent case study in this regard. The concept of the traditional family and the different roles of father and mother within it are deeply rooted in the cultural and historical context of Catholicism[2]. Although it is undeniable that the Italian population is becoming increasingly

[1] In Italy and more broadly in the Mediterranean, this is known as *mamma-chioccia* effect.

[2] A history that was reinforced during the Fascist period, with the central role of the mother as a homemaker for the functioning of the family.

secular (in 2021, according to ISTAT[3], more than 30% of the population has never visited a place of worship during the year), data demonstrate that cultural norms and thus social practices are still very much alive. According to Eurostat[4], Italians have a lower divorce rate compared to the European average by about six percentage points. However, this is not the only difference between them. The SIRC (2012) reports that in 2010, first marriages represented over 80% of all marriages in Italy. The average duration of an Italian marriage is over 15 years, which is longer than in all other European countries except for Slovenia and Spain. In 2007, 83.9% of Italian children lived with their two married parents. Despite the predominance of the traditional family, the Italian fertility rate is the third lowest in Europe (in 2021, it is 1.25 according to Eurostat[5]). One of the reasons has always been the limited support for families and young mothers in the very early months and years of a child's life compared to other European countries (SIRC (2012)). Parents often rely on family members' support or part-time work of at least one parent (usually the mother). In the early 2000s, studies conducted in Italy showed that women who worked full-time had fewer children. However, this trend has been changing in the last 12 years (Alderotti (2022)). Female employment is now positively associated with fertility at the individual level, both in Northern and Southern Italy. Furthermore, the female employment rate has been steadily increasing since the 1990s, and in 2022 it was 51.1% (Carta et al. (2023)). Moreover, even in Italy, it is becoming evident that a working woman enriches rather than detracts from the family unit, particularly in child-rearing (Del Boca, Pasqua, and Suardi (2016)). Therefore, studying the role of the mother, particularly the emancipated and bread-winning woman, in this Italian context that is transforming but still holds cultural solid norms, can be essential in understanding the mechanisms behind family decisions, such as the choice of university for their children.

To establish the association between student mobility and mothers' emancipation, I elaborate data on a regional level. My primary data source is the aggregated-level data for Italian students' flows provided by MUR (*Portale dei dati della istruzione superiore*[6]). I build a regional analysis where I construct student mobility flows for

[3]ISTAT-Aspetti della vita quotidiana: Pratica religiosa-regioni e tipo di comune ($http://dati.istat.it/index.aspx?queryid = 24349$).

[4]$https://ec.europa.eu/eurostat/databrowser/view/demo\_ndivind/default/table?lang = en$.

[5]$https://ec.europa.eu/eurostat/databrowser/view/demo\_frate/default/table?lang = en$.

[6]Open Data: file *immatricolatixsedescuolasecondariasedecorso on https://dati-*

any possible pairs of Italian regions for the years 2014-2020. These flows serve as my dependent variable. I use a gravity model where the dependent variable is the students' flows between any pairs of regions every year. At the regional level, I measure women's emancipation using the regional female employment rate[7]. I enrich my analysis with controls that have been proposed by previous literature as relevant determinants of student mobility. For instance, I collect information such as regional income from IstatData and rental prices from Immobiliare.it. Finally, I use the joint database of the European Value Study and the World Value Survey to build regional-level cultural indicators on the role of women. All these variables are constructed at the regional level for Italy for 2014-2020.

I find that the level of emancipation of women in the region of origin (and also in the family) significantly affects the internal mobility of students. The negative sign of this effect suggests that higher women's emancipation in the region leads to lower students' flow at the regional level. Overall, my findings suggest that when women are more emancipated and financially independent, the chances that their children temporarily migrate are lower.

I face several endogeneity concerns, such as confounding factors. Specifically, I am concerned that other features, like the dynamics of the labour market, might impact the choice of students and the emancipation of women, thus falsifying the correlation between the two variables. I take several steps to mitigate these issues and claim some causality between mothers' emancipation level and their children's mobility. I use region-pair fixed effects to account for any region-pair time unvarying confounding factor. However, time-varying confounding factors and omitted bias variables issues may persist. To alleviate these concerns, I take two further actions. First, I use an instrumental variable approach (IV). Following Pryor (1985) and Alesina, Giuliano, and Nunn (2013), I instrument my variables of women's emancipation at the regional level with the suitability to plough the land across Italian regions. A seminal paper by Alesina, Giuliano, and Nunn (2013) has shown that ancient agricultural usage of plough affects actual norms of gender roles and women's emancipation outcomes such as employment rate or female labour participation.

ustat.mur.gov.it/dataset).

[7]I also take a robustness approach considering the percentage of households where women are heads. I use the Household Income and Wealth survey of the Bank of Italy to identify the percentage of Italian families with women as family heads (women as the main income earner of the household).

In my case, the idea is that land across Italy regions represents different levels of suitability for the use of ploughs in the past. Therefore, I exploit these regional differences to instrument women's emancipation across regions. The IV analysis confirms my gravity analysis results. Secondly, I use the method proposed by Oster (2017) to measure the size of the omitted variable biases. Following Oster's method, I calculate the coefficient of my variable of women's emancipation. The coefficient passes the Oster test and is higher than one in absolute value. This reassures that omitted variables biases of my analysis shall be limited. I also decided to focus on a more in-depth analysis of the mechanism: I have divided the regions into progressive and conservative based on the EVS-WVS survey and subjected the two groups of regions to the main analysis done previously. The results show that a negative link between female emancipation and student mobility outside their region persists and is significant only for regions classified as progressive. I then test the robustness of the model and the results. First of all, I consider the percentage of women identified as the head of the household, i.e., the main income earner of the family (following Guiso and Zaccaria (2023)), as an alternative variable to employment rate. This variable simultaneously expresses women's emancipation within the family and society. Secondly, I change the type of model, using Poisson, which fits well with the (count) dependent variable. The results are confirmed in both cases.

The rest of this paper is organized as follows: Section 3 presents a literature review, Section 4 introduces the data and the main variables, Section 5 details the empirical model and the main results, Section 6 displays the endogeneity issues and identification strategy, Section 7 is aimed at analyzing the cultural mechanism, Section 8 tests the model's robustness, and finally, Section 9 concludes.

2.3 Related Literature

This work aspires to connect the part of literature that deals with women's (and mothers') emancipation and their resulting increased decision-making/negotiating power with student mobility.

There is a growing body of literature that focuses on the role of mothers and the condition or choice of their children. Previous literature argues that the higher a mother's income in the labour market, both in absolute and relative terms, the greater her relative bargaining power about decisions related to offspring. Among other effects, this can result in a fairer redistribution of household responsibilities and chores within the domestic walls. For instance, Magda, Cukrowska-Torzewska, and Palczyńska (2023) find that in Poland, households where women contribute a larger share of the total income are more likely to share housework equally. In addition, this can lead to an environment that is progressively less gender-based violent. Aizer (2010) shows that in the US the decline in the wage gap in the previous 13 years can explain nine percent of the reduction in violence against women. Moreover, Tur-Prats (2021) shows that the type of family has shaped cultural values: in stem families, as opposed to nuclear families, where the parents help and are an active part of the household, the woman's employment rate increase causes a reduction in intimate partner violence (IPV). As argued by Goldin (1991), female labor participation has steadily increased since the Second World War. In addition, the number of families with female heads has grown significantly over time, from almost 1% in 1991 to 35% in 2014 (Guiso and Zaccaria (2023)). More in detail, Guiso and Zaccaria (2023) start from the cultural norm that domestic work is perceived as feminine, while financial affairs are typically considered masculine. They investigate if familiarity with this gender norm can have effects on household welfare. They find that more egalitarian norms increase households' participation in financial markets, asset diversification and investment returns. This means that gender roles can have large economic costs. They capture changes in gender norms through changes in the gender of the economic decision-maker: for them decision-maker people are the ones with higher income in the household, and they call them the head of the household. All these aspects are different sides of the same coin. The more emancipated role of women can translate into a higher salary (female head of household) or a greater

ability to find work: this increased power has given mothers a more significant role in negotiating and deciding their offspring's future. Furthermore, the link between maternal employment (and job quality), their own psycho-physical well-being, and children's education is heavily debated in the literature (Usdansky et al. (2012)), De Salvo et al. (2023)). While it is true that work-family conflict exists and can generate stress and tensions, the study of Cooklin et al. (2015), among others, has found that the enrichment of one's working life is independently associated with more warm and consistent parenting behaviors. This suggests that positive workplace experiences can enhance, rather than diminish, mothers' interactions with their children, creating a supportive environment for children to grow up in.

Studying student mobility is relevant because an increasing number of young adults decide to study away from their home region or country and tertiary education is undoubtedly an economic driver of internal migration (Fielding (2012)). For approximately four decades, student migration has evolved due to the internationalizing of markets and, consequently, globalization (Hanson Thiem (2009)). Students, *global citizens*, choose to relocate to begin their academic journey, and this choice has economic and social consequences from both the perspectives of sending and host countries. The number of students opting to study abroad has been increasing steadily since the 1970s, witnessing a fourfold increase between 1975 and 2008 (Beine, Noël, and Ragot (2014)). Notably, this growth tripled from 1997 to 2020, with a notable upsurge of around 25% between 2015 and 2020 (Gwenaëlle (2022)). Globally, in 2020, 52% of movers are from Asia, followed by 16% from Europe. The latter remains the predominant host region, accommodating nearly two and a half million international students (approximately 39%), followed by North America at 20%. Approximately 80% of international students who come to Europe prefer to go to the United Kingdom (UK), Germany, and France. Focusing on the European legislation, the Bologna Process and the Lisbon Strategy have played pivotal roles in shaping the current framework of education and tertiary education. Specifically, in 1999, the Bologna Process envisioned the European Higher Education Area with the explicit aim of promoting mobility and fostering cohesion among European nations and the wider world (Attanasio and Priulla (2020)). Additionally, student mobility is important because many of these movements can turn into migration decision later in life. Therefore, studying its determinants is informative for the broader

economics of migration.

The determinants for choosing the destination encompass a wide spectrum within the literature. Beine, Noël, and Ragot (2014) establish a significant network effect and a considerable influence stemming from factors such as housing costs and university rankings, while enrollment fees seem to have relatively little significance. In the context of Europe, the UK stands as the primary destination, even for internal migration. In this regard, Van Bouwel and Veugelers (2013) differentiate between two determinants: the "consumption perspective" (i.e. the urban services utilized by students), and the "investment perspective" essentially determined by the quality of the university. For example, institutions like Oxford and Cambridge in the UK exemplify the "investment perspective". Consequently, a comprehensive examination of local migrations, such as within Europe, can yield valuable insights into the driving forces compelling students to venture away from their home regions. Extending this scrutiny within the same country can be even more enlightening in deciphering the root causes and ensuing consequences of such phenomena. Italy serves as a pertinent case study in this regard.

A significant out-of-region academic migration characterizes Italy. Italian student mobility originates and thrives from the so-called North-South Divide. This makes it a highly interesting phenomenon to analyze, not only for its causes but also for its economically and socially significant consequences, particularly in terms of inequality and loss of human capital. Furthermore, the Italian university system has undergone numerous changes due to various reforms, which have increased competition among institutions and triggered strong market dynamics in the education sector (Attanasio and Enea (2019)). This has exacerbated the preexisting disparities between universities in the Central-Northern and Southern regions. Numerous studies have demonstrated that mobility is influenced not only by the university systems themselves but primarily by the differences in the quality of life and employment conditions between the regions of origin and destination (Dotti et al. (2013)). In numerical terms, following Attanasio and Enea (2019), for freshmen who enrolled in 2014, a percentage of 10.4% and 11% of students moved from the South to the North or Centre respectively; from the Islands, the percentages are 15.9% and 8.8%. Moreover, the percentage of students leaving the Italian islands doubled from 2008 to 2014. In 2008, 13.9% of the total student population migrated. In 2014, this

number rose to 25.7% (Attanasio and Priulla (2020)). Similarly, the percentage of students leaving the southern regions of Italy rose from 18.9% to 22.3% during the same period. In a broader context, between 2003 and 2016, more than 20000 southern students each year (approximately one in five) enrolled at universities outside their regions of residence. This trend is unparalleled in other countries, where out-migration rates reached a maximum of 8%. Furthermore, considering the 2008 and 2017 cohorts, Attanasio and Priulla (2020) demonstrate an overall increase in student mobility across regions, especially towards and out of Piemonte, Lombardia, Veneto, and Lazio. Moreover, many more students left Puglia and Sicilia in 2017 than in 2008.

To gain a better understanding of students' mobility in Italy, a more detailed exploration of the Italian university system is essential. In Italy, tertiary education is delivered through a network of publicly funded universities, providing access to a wide range of disciplines for high school graduates. Over the last two decades, Italian universities have undergone significant transformations to align with European higher education standards. The *3+2* reform resulted in the expansion of degree programs and the establishment of decentralized branches at the provincial (NUTS-3 region) level, contributing to a more equitable distribution of universities across the country. Additional public funding has extended the reach of higher education institutions into peripheral provinces and the South, addressing the previous lack of tertiary education infrastructure and enhancing educational opportunities. This reform significantly influenced the local availability of degree programs, with the number of municipalities hosting a university campus increasing from 104 to 211 between 1990 and 2010, reaching a temporary peak of 244 in 2006. As shown by previous studies (Impicciatore and Tosi (2019)), this increase in the local offer has not reduced the flow of students quitting their origin region.

Previous research consistently underscores the significance of destination universities in the decision-making process of Italian student mobility. To gain a more comprehensive picture of the most popular university destinations, Attanasio and Priulla (2020) analyze the inflows at enrollment from Southern regions into the top eight universities for the 2008 and 2017 cohorts. The findings reveal that La Sapienza is the preferred choice for students relocating from the South. However, for Sicilian students, the top destinations appear to be the Politecnico di Torino, the University

of Pisa, and the University of Bologna.

2.4 Data and Variables

The literature on internal student mobility mainly focuses on the identification of macro and micro-determinants of geographical mobility for educational purposes. The former approach is based on aggregated data at the regional or university level and aims at identifying the institutional and contextual conditions that explain students' mobility choices (Baryla and Dotterweich (2001); Caruso and Wit (2015); Mixon and Hsing (1994); Van Bouwel and Veugelers (2013)). For the students' mobility data, I build regional flows using aggregated data from MUR (*Portale dei dati della istruzione superiore*. Open Data: file *immatricolatixsedescuolasecondariasedecorso on https://dati-ustat.mur.gov.it/dataset*). I also collect regional information from IstatData (*http://dati.istat.it/*) and I exploit Immobiliare (*https://www.immobiliare.it/mercato-immobiliare/*) to find information on house-renting prices. I use the Survey of Household Income and Wealth (SHIW) of the Bank of Italy to identify the percentage of Italian families with women as family heads. Finally, I consider the joint database of the European Value Study and the World Value Survey (EVS-WVS) to build indicators on gender roles.

For my analysis I use aggregate data to build dyadic student mobility flows between regions of origin and destination[8]. More in detail, I consider the period 2014-2020 and thus the final regional dataset contains 2095 observations constituting bilateral student flows among any two pairs of parts for more than 100 variables, excluding intra-regional flows.

Table 2.4.1 provides the descriptive statistics of the main variables at regional levels. *Female* is the percentage of female students (as I already specified the source is on Portale dei dati della istruzione superiore).

Female Employment Rate origin/destination is the regional female employment rate (source on IstatData: Tasso di occupazione - regolamento precedente (fino al 2020): Dati regionali). *Female Head origin/destination* indicates the regional percentage of women who are main income earners of families (SHIW data). *Income* is the average income of the origin and destination regions (source on IstatData: Reddito netto: Regioni e tipo di comune (esclusi fitti imputati)). *Popu-*

[8]The origin is determined by the region where high school graduation occurred (using the school as a proxy for residence), while the destination is identified as the region where matriculation took place.

lation is the number of individuals living in the origin/destination region (source on IstatData: Popolazione residente al 1° gennaio). *Rental prices* are the average renting prices of the provincial capital of the origin and destination regions (*https* : *//www.immobiliare.it/mercato − immobiliare/*). *University Rankings* is the difference in ranking between the biggest university in the origin region and the destination one[9]. *Distance* is the geodetic distance between the centroid of the source and destination region.

Table 2.4.1: Summary Statistics of the Regional Data

	Mean	SD	Min	Max	N
Female	0.58	0.22	0	1	2095
Female Empl. Rate (Origin)	0.48	0.12	0.27	0.65	2095
Female Empl. Rate (Dest.)	0.50	0.12	0.27	0.65	2095
Female Head (Origin)	0.43	0.04	0.33	0.54	2095
Female Head (Dest.)	0.43	0.05	0.33	0.54	2095
Income (Origin)	30280.26	4395.199	21807	38593	2095
Income (Dest.)	31066.56	4250.607	21807	38593	2095
Population (Origin)	3292946	2488687	125034	1.00e+07	2095
Population (Dest.)	3464320	2474868	125034	1.00e+07	2095
Rental Prices (Origin)	9.17	3.27	4.5	19.26	2095
Rental Prices (Dest.)	9.56	3.22	4.5	19.26	2095
University Rankings (Differences)	0.08	0.92	-2.08	2.08	2095
Distance	644.1	412.10	115.92	2209.71	2095

Notes: The table shows the Italian students sample who moved from their region to begin university (2014-20). *Female* is the percentage of female students. *Female Empl. Rate* is the regional female employment rate. *Female Head* indicates the regional percentage of women who are the family's main income earners. *Income* is the income of the origin and destination regions. *Population* is the number of individuals living in the origin/destination regions. *Rental prices* are the renting prices of the provincial capital of the origin and destination regions. *University Rankings* is the difference in ranking between the biggest university in the origin and destination. *Distance* is the geodetic distance between the centroid of the source and destination region.

Examining table 2.4.1, it is evident that 58% of the sample is female. The female employment rate among families in both origin and destination regions is on average 48% and around 50%, respectively. Also, 43% of are headed by a woman. Furthermore, the difference between the destination-origin university rankings is about 8 percentage points.

[9]I consider as a reference the university with the highest number of enrolled in the region of origin and destination. To construct the variable of the ranking differential, I take into account the Shanghai Ranking classifications (*https://www.shanghairanking.com/*), analyzing all the years from 2014 to 2020.

In my analysis the dependent variable is the students' flows between any pairs of regions. The main independent variable (the main predictor) captures women's emancipation. The predictor of the bargaining power at the regional level is the female employment rate recovered using ISTAT data for 2014-2020.
Figure 2.1 shows the distribution of the female employment rate through the Italian map. A color scheme is used, where red indicates the highest intensity and blue the smallest. The data used in the map are averaged data from 2014 to 2020. The map shows significant heterogeneity across regions and the geographical distribution of the female emancipation rate. In particular, the south has lower levels of female employment rates, while the centre-north regions have higher ones.

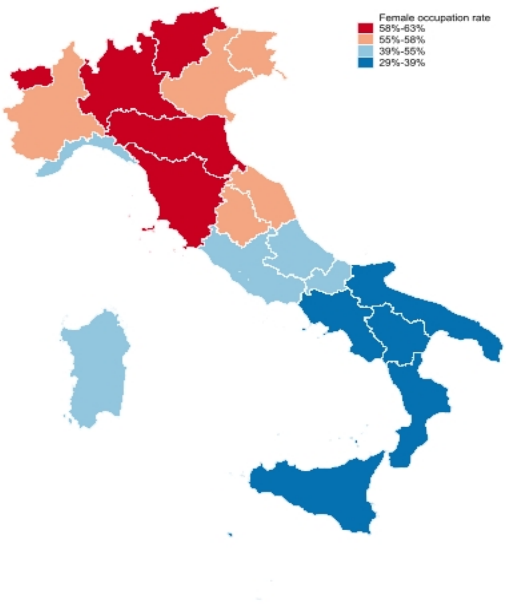

Figure 2.1: The distribution by region of percentages of Female Employment Rates

2.5 Empirical Analysis

2.5.1 The model

The model is a gravity one. Having these aggregated flows data, the gravity model is perfect for representing this type of mobility analysis. It is a widely used model in the literature for studying international trade, migrations, as well as tourist flows. I refer to that part of the literature that uses gravity models to analyze student mobility (for example Agasisti and Dal Bianco (2007), Rodríguez González and Bustillo Mesanza (2011), Kostzyán et al. (2021)).

The most complete form of the model is given by Equation 2.1. The flows between the pairs of regions is the dependent variable $Y_{i,j,t}$, where i indicates the origin, j the destination region and t is the year. The main explanatory variable is the regional female employment rates represented by the $EMPL$ vector. Then several origin-destination controls are added (socio-demographic X and regional Z). As a gravity model, the distance between the origin and destination has also been taken into consideration. All variables are expressed in logarithmic form. In the most complete specification I use region-pair fixed effects.

$$\begin{aligned}\log Y_{i,j,t} =& \beta_0 + \beta_1 \log EMPL_{i,t} + \beta_2 \log EMPL_{j,t} + \beta_3 \log X_{i,t} + \\ &+ \beta_4 \log X_{j,t} + \beta_5 \log Z_{i,t} + \beta_6 \log Z_{j,t} + d_{i,j} + \epsilon_{i,j,t}\end{aligned} \tag{2.1}$$

Notes: The dependent variable is the students' flows between the pairs of regions. $EMPL$ indicates the regional female employment rates. X represents the socio-demographic controls (gender as a percentage of females). Z specifies the regional controls (ranking of Universities, income of the origin and destination region, distance, origin/destination house prices, the population (the number of individuals living in the origin/destination regions)).

2.5.2 The results

Table 2.5.1 presents the main findings. I performed three OLS specifications for the female bargaining power dimension, gradually adding different controls and fixed effect sets. In Model 1, the table presents the female employment rate in the origin and destination region only as the main specification. In Model 2, I add socio-demographic (Gender) and regional controls (such as the income of the origin and destination regions, distance, origin/destination renting prices and the population at origin/destination) through the vectors X and Z. In Model 3, I run a fixed effect model with regional-pair fixed effects ($d_{i,j}$) for the specification just mentioned. Focusing on the FE estimate (Column 3), the main finding is that if the level of female employment rate increases, the extra-regional flows decrease. Women's and mothers' higher bargaining power makes students less mobile. One might expect that societies with more egalitarian gender roles may see higher mobility rates for students. In this paper, I find the opposite. In regions with more emancipated gender roles[10] young adults are less mobile for studying purposes. This result can be contextualized within the substantial body of economic literature that has focused on the differentiated effect of mothers on the life and critical decisions of their offspring. Duflo and Udry (2004) argue that an unexpected increase in women's income share results in greater food expenditures. Conversely, an unexpected increase in men's income leads to higher spending on children's education. This result is also reflected in macro and community-level research. Chattopadhyay and Duflo (2004) observe that men tend to show a greater preference for children's education, while women exhibit a stronger preference for essentials like drinking water. This observation is also confirmed by Benhassine et al. (2015) in the context of a patriarchal society like Morocco, where directing cash transfers for education to fathers results in a rise in primary school enrollment for children. It is evident, therefore, how an increase in the bargaining power and decision-making authority of women and mothers in society (and within the family) certainly has influences on the decision to migrate or not. In my study, I emphasize how the concept of the *mother hen*, especially in a country like Italy, is significant in this decision process. Moreover, an environment where women can successfully achieve emancipation is a better place to raise children

[10]In the Robustness Section 2.8.1 I obtain the same results for regions and so families where mothers earn more than their husbands.

and it encourages mothers to keep with them both daughters and sons[11]. In a scenario where the internal migratory flow (especially from the South to the North) in the education (and labor) market exerts significant influence, the role of women in keeping their children in their native regions acts as a counterbalance to this trend. This role can have a stabilizing effect on local economies and social structures. Therefore, my findings suggest a new perspective in the literature: initiatives aimed at promoting regional development and addressing educational inequalities should acknowledge the central role of women in shaping these dynamics. Additionally, this result provides valuable insights into how facilitating a more equitable distribution of educational opportunities throughout the country can have significant effects on the labor market and local economies (Pastor, Pérez, and Fernández de Guevara (2013)).

Furthermore, female students leave less than male students, a result that aligns with the study of internal mobility of students in Italy (Attanasio and Enea (2019)), but also referring to mobility in Europe and in the Western World (Van Mol (2022)). Moreover, the ranking of the University appears very important in the decision to depart. This result, in line with the literature (Ciriaci (2014)), shows how the quality of universities in the regional context is a fundamental and important driver for mobility. In the second column of Table 2.5.1, it can be observed that distance has a negative correlation with the extra-regional flows, and this is also consistent with gravity models (Agasisti and Dal Bianco (2007)).

[11] This element is analyzed in Section 2.7.

Table 2.5.1: The effect of the female employment rate on student mobility

	(1)	(2)	(3)
Female Empl. Rate (Origin)	-1.240***	-0.320	-1.748***
	(0.140)	(0.308)	(0.570)
Female Empl. Rate (Dest.)	3.058***	2.780***	-0.266
	(0.148)	(0.339)	(0.703)
Female		-0.700***	-0.320***
		(0.072)	(0.055)
Male Empl. Rate (Origin)		-0.919	-0.747
		(0.646)	(0.873)
Male Empl. Rate (Dest.)		0.127	-3.086***
		(0.748)	(1.040)
Income (Origin)		-2.299***	-0.241
		(0.362)	(0.353)
Income (Dest.)		-1.365***	-0.742*
		(0.391)	(0.393)
Distance		-1.151***	0.000
		(0.033)	(.)
Population (Origin)		0.695***	-0.675***
		(0.036)	(0.180)
Population (Dest.)		0.988***	-0.352***
		(0.041)	(0.077)
Rental Price (Origin)		0.302***	-0.332
		(0.104)	(0.242)
Rental Price (Dest.)		1.350***	0.073
		(0.103)	(0.196)
University Rankings (Differences)		0.348***	0.089***
		(0.042)	(0.031)
Cons.	-3.966***	13.198***	52.823***
	(0.783)	(3.694)	(4.440)
R^2	0.19	0.80	0.20
Pair-Region Fixed Effects	N	N	Y
Observations	2095	1976	1976

Notes: Estimation sample: extra-regional Italian students' flows for 2014-2020. Dependent variable: Students' flows. OLS results appear on the left (columns 1:2). All variables are in logarithmic form. Column 3 displays results with region-pair fixed effects. Standard errors are clustered at the regional pair level. Stars correspond to the following p-values: * $p < .10$, ** $p < .05$, *** $p < .001$.

2.6 Endogeneity issues and Identification Strategy

Endogeneity could threaten the identification of the causal effect of female bargaining power on the student's decision to move (or not) outside their region to start a university career. In my case, the main source concerns the confounding factors. The impact of female bargaining power on students' decisions to move outside their region for higher education can be obscured by confounding factors. While I have implemented rigorous controls and advanced statistical techniques, the possibility of unobserved or inadequately considered variables remains. I deal with this endogeneity issue by using a traditional IV approach. I employ an instrumental variables analysis to enhance the robustness and reliability of my findings in a more causal flavour.

Another concern is the omission of unobserved factors that might impact the decision to change region and the variables concerning the role of women. Therefore, despite the regional and social-demographic controls already present, the region-pair fixed effect, and the robustness checks in section 2.8 to evaluate the stability of the coefficient of interest to include observed controls, I refer to the formal approach proposed by Oster (2017).

2.6.1 Instrumental Variable Strategy

I have created an instrumental variable that indicates the so-called suitability to plough (Boserup (1970), Alesina, Giuliano, and Nunn (2013) and Pryor (1985)).

Following Pryor (1985), I instrument my variables of women's emancipation with the suitability to plough lands across Italian regions. Alesina, Giuliano, and Nunn (2013) have shown in a seminal paper that ancient agricultural usage of plough affects actual norms of gender roles and women emancipation outcomes such as female employment rate. More in detail, they demonstrate that contemporary descendants of societies with a historical background in plough agriculture exhibit less egalitarian gender norms. This pertains not only to female involvement in the workplace, politics, and entrepreneurial endeavors but also encompasses reported attitudes toward gender roles. In this case, the idea is that land across Italy represents different levels

of suitability for the use of ploughs in the past. Therefore, I exploit these regional differences to instrument women's emancipation across regions. In particular, I have considered the classification by Pryor (1985), who groups crops into two categories:

1. *Plough-positive*: includes wheat, barley, rye, tea, buckwheat, wet rice, and industrial crops.

2. *Plough-negative*: includes millet, sorghum, root crops, maize, dry rice, and tree crops.

I have therefore considered as my IV the percentage of *plough-negative* production overall at the regional level for the years 2014-2020 (*Surfaces and Production* - ISTAT: $http://dati.istat.it/$). With the available data, I have examined the total regional production of corn and sorghum as *plough-negative* production.

For the instrumental variable regression I use the two-stage generalized least squares method (2SLS, Two-Stage Least Squares).

More in detail, the two specifications are:

- First Stage

$$\begin{aligned}\log EMPL_{i,t} =& \beta_0 + \beta_1 \log Ploughnegative_{i,t} + \beta_2 \log EMPL_{j,t} + \beta_3 \log X_{i,t} + \\ &+ \beta_4 \log X_{j,t} + \beta_5 \log Z_{i,t} + \beta_6 \log Z_{j,t} + \epsilon_{i,t}\end{aligned} \tag{2.2}$$

- Second Stage

$$\begin{aligned}\log Y_{i,j,t} =& \beta_0 + \beta_1 \log EMPLPred_{i,t} + \beta_2 \log EMPL_{j,t} + \beta_3 \log X_{i,t} + \beta_4 \log X_{j,t} + \\ &+ \beta_5 \log Z_{i,t} + \beta_6 \log Z_{j,t} + \epsilon_{i,t}\end{aligned} \tag{2.3}$$

The first-stage equation involves regressing the endogenous variable ($EMPL$, i.e. the female employment rate) on the instrumental variable ($Ploughnegative$) and other explanatory (socio-demographic X and regional Z) variables, where i indicates the origin, j the destination region and t the year. This stage aims to obtain predicted values of the endogenous variable for use in the second stage. After obtaining the predicted values of the endogenous variable from the first stage, these values are used as the independent variable in the regression of the model of interest

($EMPLPred$). Here the dependent variable is again the flows between the pairs of regions ($Y_{i,j,t}$).

The IV results presented in Column 1 of the Table 2.6.1 confirm the OLS conclusions, with the variables expressing the emancipated role of women in society and the family entering negatively and significantly into the specification. Taken overall, the results show that the determinants of student mobility are the same as the previous ones of the main specification (Column 2).

Table 2.6.1: IV Strategy: Suitability to plough

Female Empl. Rate	(1) IV	(2) OLS
Female Empl. Rate (Origin)	-6.805***	-1.748***
	(2.557)	(0.570)
Female Empl. Rate (Dest.)	3.210***	-0.266
	(0.757)	(0.703)
Female	-0.523***	-0.320***
	(0.145)	(0.055)
Male Empl. Rate (Origin)	9.731**	-0.747
	(4.392)	(0.873)
Male Empl. Rate (Dest.)	0.636	-3.086***
	(1.558)	(1.040)
Income (Origin)	-0.552	-0.241
	(0.933)	(0.353)
Income (Dest.)	-2.393***	-0.742*
	(0.927)	(0.393)
Distance	-1.058***	0.000
	(0.0950)	(.)
Population (Origin)	0.357**	-0.675***
	(0.140)	(0.180)
Population (Dest.)	1.096***	-0.352***
	(0.0946)	(0.077)
Rental Prices (Origin)	1.036***	-0.332
	(0.352)	(0.242)
Rental Prices(Dest.)	1.363***	0.073
	(0.237)	(0.196)
University Rankings (Differences)	0.235***	0.089***
	(0.0864)	(0.031)
Cons.	16.40	52.823***
	(13.62)	(4.440)
R^2	0.953	0.20
Observations	1976	1976
F-statistics	36	22.30

Notes: Estimation sample: extra-regional Italian students' flows for 2014-2020. Dependent variable: Students' flows. All variables are in logarithmic form. The instrument of the variables of women's emancipation (column 1) is the suitability to plough lands across Italian regions. Column 2 represents the previous OLS main specification (with region-pair fixed effects). Stars correspond to the following p-values: * $p < .10$, ** $p < .05$, *** $p < .001$.

2.6.2 Omitted variable analysis following Oster

Oster (2017) proposes to measure the size of the omitted variables to invalidate the obtained estimates, by making assumptions about the relationship between selection along with observable and unobservable determinants. Using the coefficient stability and R-squared movements, Oster uses this coefficient of interest:

$$\gamma_{adjusted} = \widetilde{\gamma} - \delta[\gamma^* - \widetilde{\gamma}]\frac{R_{max} - \widetilde{R}}{\widetilde{R} - R^*} \tag{2.4}$$

I consider the OLS specifications with and without controls of Table 2.5.1. $\widetilde{\gamma}$ and $\widetilde{R}$ are the coefficients resulting from the regression with controls, while γ^* and R^* from the base regression without controls. My approach is putting one as the maximum value of R_{max} and computing the degree of selection on unobserved factors proportional to the observable characteristics (δ) for which $\gamma = 0$ (statistically insignificant). The coefficient passes the Oster test with a value of -6.4, demonstrating an absolute value exceeding one. This offers assurance that potential biases arising from omitted variables will be effectively constrained.

Table 2.6.2: Omitted variable analysis following Oster

	δ
Female Employment Rate (Origin)	-6.4

Notes: The Table represents the analysis of the potential omitted variable bias (Oster (2017)).

2.7 The role of gender attitudes in the region of origin

In Section 2.5, I have established that the effect of mothers on student mobility is reinforced by a societal development measure that captures the role of women in the region where the household lives. In this section, I check a similar aspect using the gravity specification. In Table 2.7.1, I use the EVS-WVS survey question *When jobs are scarce, men have more right to a job than women* to categorize origin regions into two groups. This question is widely used in the literature on the economics of culture as a proxy for gender attitudes. I assign a part to the conservative group if the majority of the respondents select they agree with the statement. On the contrary, a region is considered progressive if most respondents of that region disagree with the idea of the question. I then run the exact specifications as in the table above. Interestingly, the effect is present only in progressive regions. This confirms once again the previously obtained results and even adds something more. The more emancipated the woman is, the less her children leave. In addition, this *mother-hen effect* manifests itself in environments where the view on the role of women is more progressive. The results are two sides of the same coin: a woman with more bargaining power willingly keeps her children with her in a context where the children are free to grow with less traditional gender ideas, breaking away from the patriarchal societal norms. Overall, the determinants of student mobility are quite similar across the two categories of areas. The income of the region of origin is the only result that differs both in terms of significance and direction, which is not significant and positive for progressive regions but enters negatively and significantly in more conservative regions. It appears that the income relationship with the regional context of origin is stronger in regions with still very traditional gender role ideas.

After analyzing the results in Table 2.7.1, it is evident that gender attitudes in the region play a moderating role in my findings. Regions characterized by individuals with attitudes that do not prescribe a strict housewife role for women are the ones where female emancipation has a negative impact on the extent of student mobility. In regions that, on average, uphold conservative views regarding gender roles, female

employment rate does not influence student mobility.

Table 2.7.1: Cultural channel: Progressive versus Conservative regions

Female Empl. Rate	Progressive region (1)	Conservative region (2)
Female Empl. Rate (Origin)	-1.542**	-1.305
	(0.723)	(0.950)
Female Empl. Rate (Dest.)	0.050	-0.967
	(0.861)	(1.210)
Female	-0.325***	-0.310***
	(0.073)	(0.080)
Male Empl. Rate (Origin)	-2.111	-0.752
	(1.420)	(1.176)
Male Empl. Rate (Dest.)	-3.816***	-1.932
	(1.230)	(1.878)
Income (Origin)	0.485	-1.908***
	(0.441)	(0.614)
Income (Dest.)	-0.809*	-0.917
	(0.471)	(0.737)
Population (Origin)	-0.645***	-7.370**
	(0.180)	(3.663)
Population (Dest.)	-0.284***	-0.372***
	(0.096)	(0.141)
Rental Prices (Origin)	-0.386	0.266
	(0.271)	(0.570)
Rental Prices(Dest.)	0.049	-0.064
	(0.215)	(0.422)
University Rankings (Differences)	0.065	0.101**
	(0.040)	(0.050)
Cons.	51.808***	162.530***
	(4.798)	(58.950)
R^2	0.22	0.19
Pair-Region Fixed Effects	Y	Y
Observations	1229	747

Notes: Estimation sample: extra-regional Italian students' flows for the period 2014-2020. Regions are categorized into two groups (Progressive and Conservative) depending on whether the average score at the regional level to the questions *When jobs are scarce, men have more right to a job than women* is below or above the total mean (0.5) of the score in logarithmic form. Dependent variable: Students' flows. OLS results with region-pair fixed effect with the Female Empl. Rate as the main control. All variables are in logarithmic form.
Stars correspond to the following p-values: * $p < .10$, ** $p < .05$, *** $p < .001$.

2.8 Robustness Analysis

In this section, I conduct a twofold robustness analysis. On the one hand, I consider another variable to express the level of women's emancipation, and on the other hand, I employ a different model. Both studies show robust and consistent results with the previous conclusions outlined in Section 2.5.

2.8.1 Another way to capture women's emancipation: Family Head

One way to test the robustness of the model and the results is to try to capture the state of women's emancipation in a different way. I do this by considering the regional percentage of households where women are family heads (following Guiso and Zaccaria (2023)) instead of the employment rate. As shown in Section 2.3, there is a wide range of literature that illustrates that women who work, and even those who earn more than men within the household, have strong contractual and decision-making power in the family leading to greater social emancipation.

The variable

As already mentioned, this data comes from the Household and Income Survey of the Bank of Italy. More in detail, given that the available data spans almost every two years (2014-2016-2020), I proceeded with the multiple imputations (using the method of linear regression for a continuous variable) of the missing data. The summary statistics of the variable are already presented in Table 2.4.1. Again, the map 2.2 shows heterogeneity across regions. Moreover, the are some differences compared to the female employment rate: in this case, the difference between north and south is less evident.

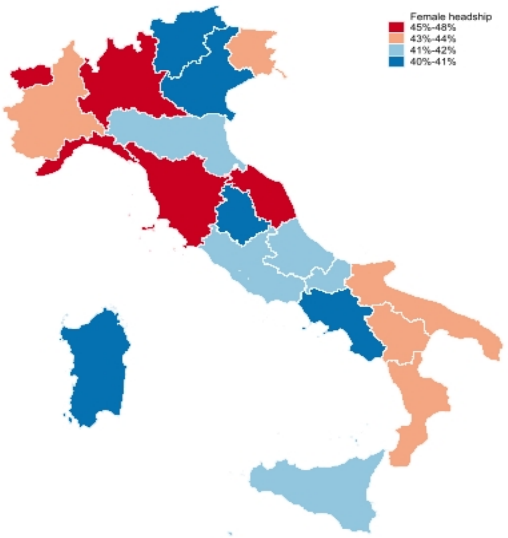

Figure 2.2: The distribution by region of percentages of families with Female Head

The empirical model

The model closely follows the one used for the main variable. It is given by Equation 2.5. The flows between the pairs of regions is the dependent variable $Y_{i,j,t}$, where i indicates the origin j, the destination region and t is the year. The vector $FamilyHead$ indicates the main explanatory variables in this robustness analysis and it is the regional share of families with female heads. Then several origin-destination controls are added (socio-demographic X and regional Z). As a gravity model, the distance between the origin and destination has also been taken into consideration. In the most complete specification I use region-pair fixed effects.

$$\begin{aligned}\log Y_{i,j,t} =& \beta_0 + \beta_1 \log FamilyHead_{i,t} + \beta_2 \log FamilyHead_{j,t} + \beta_3 \log X_{i,t} + \\ &+ \beta_4 \log X_{j,t} + \beta_5 \log Z_{i,t} + \beta_6 \log Z_{j,t} + d_{i,j} + \epsilon_{i,j,t}\end{aligned} \tag{2.5}$$

Notes: The dependent variable is the students' flows between the pairs of regions. $FamilyHead$ indicates the share of families with female heads. X represents the socio-demographic controls (gender as a percentage of females). Z specifies the regional controls (ranking of Universities, income of the origin and destination region, distance, origin/destination house prices, the population at origin/destination).

Results

Table 2.8.1 presents the main results. I perform again three OLS specifications for the family head variable, adding different controls and region-pair fixed effects. In Column 1, the table shows the base specification with the female householder percentages in the origin and destination country. In Column 2, I add Gender as a socio-demographic variable and regional controls (the same as the main specification) through the vectors X and Z. In Column 3, I consider region-pair fixed effects ($d_{i,j}$). Focusing on the FE estimate (Column 3), the results confirm the previous ones. The main observation is that an increase in the level of the percentage of women who are the main income earner of the household leads to a decrease in their children's extra-regional flows. Once again, it is observed that greater bargaining power for women translates into a decrease in student mobility. Furthermore, as before, female students are less likely to leave than male students and the University ranking plays a significant role in the decision to leave their home region.

Table 2.8.1: The effect of the Female Head on student mobility

Female Head	(1)	(2)	(3)
Female Head (Origin)	-0.355	-0.087	-0.317***
	(0.439)	(0.206)	(0.096)
Female Head (Dest.)	1.001**	-0.488**	-0.335***
	(0.424)	(0.199)	(0.096)
Female		-0.844***	-0.316***
		(0.074)	(0.055)
Income (Origin)		-3.550***	-1.175***
		(0.200)	(0.336)
Income (Dest.)		2.977***	-1.881***
		(0.194)	(0.348)
Distance		-1.155***	0.000
		(0.033)	(.)
Population (Origin)		0.782***	-0.723***
		(0.030)	(0.187)
Population (Dest.)		0.689***	-0.375***
		(0.035)	(0.078)
Rental Price (Origin)		0.314***	-0.401
		(0.102)	(0.247)
Rental Price (Dest.)		1.628***	-0.052
		(0.101)	(0.199)
University Rankings (Differences)		0.478***	0.088***
		(0.042)	(0.031)
Cons.	3.711***	-10.574***	51.294***
	(0.503)	(2.758)	(4.309)
R^2	0.00	0.78	0.18
Pair-Region Fixed Effects	N	N	Y
Observations	2095	1976	1976

Notes: Estimation sample: extra-regional Italian students' flows for 2014-2020. Dependent variable: Students' flows. OLS results appear on the left (columns 1:2). All variables are in logarithmic form. Column 3 displays results with region-pair fixed effects. Standard errors are clustered at the regional pair level. Stars correspond to the following p-values: *p $<$ .10, ** p $<$ .05, *** p $<$ .001.

2.8.2 Poisson Regression

I use a Poisson model as an alternative model to check the robustness of the previous results. Many situations involving flows, such as the number of people moving from one place to another, can be represented as counts of events. The Poisson model is pertinent into such scenarios. Hence, in this case, this model is useful because it fits well with a dependent variable like the students' flows, which is essentially a count variable. The results remain coherent compared to gravity (2.8.2).

Table 2.8.2: Robustness check: Poisson regression and Female Employment Rate

Female Empl. Rate	(1)	(2)	(3)
Female Empl. Rate (Origin)	-0.385***	-0.038	-0.358*
	(0.042)	(0.197)	(0.184)
Female Empl. Rate (Dest.)	1.165***	0.747***	-0.488*
	(0.056)	(0.242)	(0.292)
Female		-0.406***	-0.179***
		(0.053)	(0.032)
Male Empl. Rate (Origin)		-0.510	0.034
		(0.411)	(0.262)
Male Empl. Rate (Dest.)		0.500	-1.177***
		(0.571)	(0.427)
Income (Origin)		-0.761***	-0.018
		(0.229)	(0.110)
Income (Dest.)		-0.302	-0.298**
		(0.275)	(0.141)
Distance		-0.403***	
		(0.022)	
Population (Origin)		0.209***	-0.220**
		(0.024)	(0.087)
Population (Dest.)		0.317***	-0.096***
		(0.029)	(0.026)
Rental Prices (Origin)		0.033	-0.128
		(0.066)	(0.081)
Rental Prices (Dest.)		0.244***	0.167***
		(0.063)	(0.056)
University Rankings (Differences)		0.096***	0.018**
		(0.026)	(0.009)
Cons.	-1.947***	3.216	
	(0.272)	(2.371)	
Pseudo R^2	0.06	0.22	
Pair-Region Fixed Effects	N	N	Y
Observations	2095	1976	1930

Notes: Estimation sample: extra-regional italian students' flows for the period 2014-2020. Dependent variable: Students' flows. All variables are in logarithmic form. Poisson regression results appear without (columns 1-2) and with region-pair fixed effect (column 3). Standard errors are clustered at regional pair level. Stars correspond to the following p-values: * p < .10, ** p < .05, *** p < .001.

2.9 Conclusions

My results show a noteworthy phenomenon called the *mother-hen* effect. This phenomenon highlights the profound influence of women's empowerment in terms of employment (and income) on their children's choices regarding higher education. As women achieve greater financial and occupational independence, a substantial reduction in the geographic mobility of their offspring at the beginning of their university careers becomes evident. This phenomenon prompts intriguing questions about the intricate relationship between maternal influence, economic autonomy, and educational choices. The research underlines the distinctive cultural landscape of Italy, where the maternal role holds significant weight, often overshadowing women's individual identity. Within this context, I observe how maternal empowerment can create a ripple effect on the educational paths of the next generation. This observation opens up a fertile avenue for further exploration into the intersection of gender dynamics, societal expectations, and educational decisions. For this reason, in a forthcoming work with two co-authors[12], I am delving more deeply into the role of a woman's bargaining power within the family in influencing the decision of children to depart and begin their university journey.

Moreover, these findings carry profound economic implications, particularly in a country like Italy. While the pervasive brain drain phenomenon exerts a potent influence, the role of women in keeping their children in their home regions serves as a counterbalance to this trend. It is crucial to acknowledge that retaining students within their regions can have a stabilizing effect on local economies and social structures. Thus, my findings suggest that initiatives aiming to promote regional development and alleviate educational disparities should recognize the pivotal role of women in shaping these dynamics. The study's implications extend to a more nuanced understanding of the south-north flow of students, which is a defining aspect of the Italian university system. By exploring the factors that either encourage or hinder this migration, valuable insights emerge on how to facilitate a more balanced distribution of educational opportunities throughout the country. This in-depth exploration holds the potential to guide policy decisions, promote regional development, and foster more equitable access to higher education for all.

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Chapter 3

The *young side* of agriculture

3.1 Abstract

Over the last decades, the issue of young farmers and generational turnover in agriculture has increasingly taken center stage at the European level. The purpose of our work is to determine whether access to European policies for Italian young farmers is positively correlated with the farmers' economic performances (measured by the Return on Equity - ROE). Our study utilizes the comprehensive individual-level Italian FADN (Farm Accountancy Data Network). This database serves as the primary harmonized source of microeconomic data, allowing us to examine income trends and structural dynamics within the agricultural sector. The study covers the period from 2008 to 2020, taking into account two different programming periods. In order to evaluate the connection between performance and the access to the European measures, we use simple, random and province fixed effects linear regressions models. Our analysis employs the economic performance (ROE) as the dependent variable, while the key variable of interest represents the access to dedicated funding for young farmers. We incorporate individual controls for the farmer's characteristics (age, gender) and company-related controls (size, type of management, etc.). The results demonstrate how this type of support is important for the business performance of young farmers.

Keywords: Young farmers, generational turnover, Common Agricultural Policy, economic performance.

J.E.L. Classification: Q18, Q12, Q13.

3.2 Introduction

European agriculture is currently entangled in a profound and intricate crisis. Income levels consistently cause distress and exhibit a declining trend (ISMEA (2012)). The departure of farmers from the sector is a recurring and troubling phenomenon (EPRS (2016)). Efforts to mitigate the adverse environmental consequences (Herring and Sorrell (2008)), have shown little progress, and reliance on fossil energy is on the rise (Showstack (2017)). Compounding these challenges, several European nations seem to be moving further from food sovereignty rather than toward it (McMichael (2007)).

This scenario is a contributing factor that significantly intensifies the focus on the role of young farmers and generational turnover in agriculture at the European level (Zagata and Sutherland (2015) and Rogoznicki, Baranowska, and Kondracki (2018)). To identify the young farmer we use the definition by the Regulation (EU) 2021/2115: a young farmer can be maximum 35-40 years old (we consider the Italian threshold which is fixed at 40 years), he or she must be a *head of the holding* (i.e. must have effective control over the holding, and EU countries must detail the specifications), and he or she must have appropriate training and/or skills. The decline in the population of young farmers within the EU27 is evident, and the transition of farms from older to younger generations is not happening at a pace adequate for replacement. In the document by CEJA (2019), the past president Alan Jagoe of the European Council of Young Farmers observed that: *"Generational renewal and supporting young farmers has never been more critical than it is today. With only 6% of young farmers under 35, policymakers and civil society must ask themselves who will produce the food to feed families in the future. The answer is simple. By supporting young farmers today, we can provide the food for society tomorrow"*.

Following this awareness, we aim to analyze whether young farmers who benefit from the Common Agricultural Policy (CAP) are able to translate the supports they receive into economic performance.

In the existing literature, the attention of researchers is mainly attracted by the relationship between farm performance in general and the effectiveness of European policies (Salvioni and Sciulli (2011); Pavić et al. (2020)). Yet, this strand of literature

greatly adopts qualitative analysis. This study aims at contributing to this branch of literature by analysing the linkage between the economic performance measure (i.e., ROE) and the European instruments fostering young entrepreneurship.

More specifically, our contribution to the literature is threefold. Primarily, this study is the first to verify and corroborate a positive relationship between the economic performance and the access to the European funds by Italian youth. Indeed, to the best of our knowledge, this relation has been tested in a limited set of countries, e.g. Lithuania (Balezentis et al. (2020)), Poland (Rogoznicki, Baranowska, and Kondracki (2018)), Slovenia (Pavić et al. (2020)). Thus, Italy is an interesting case study. According to the report by CREA (2011), Italy ranks 8^{th} in terms of land area among European countries, with a high agricultural vocation of the territory (over 50% of the surface). The considerable extension in latitude causes a great environmental diversity of the Italian territory, favoring the development of highly diversified cropping systems that generate agri-food products with high specialization. Focusing on young farmers, Italy has grappled with an aging agricultural demographic in recent decades. Nevertheless, Albani et al. (2021) illustrate that in 2020 an average of 17 businesses helmed by individuals under the age of 35 (young farmers) were established each day.

As for our second contribution, the literature about young farmers mainly shows qualitative analysis (Schimmenti et al. (2015); Rogoznicki, Baranowska, and Kondracki (2018)). Instead, we build our results through a quantitative method, we validate our findings through several robustness checks and we test the heterogeneous effects in different samples. As far as we know, only the seminal paper by Salvioni and Sciulli (2011) investigates this relation under scrutiny in the Italian context applying a quantitative model. Third, we cover a time span corresponding to two programming periods. In literature, studies usually analyse only one programming period at time. Furthermore, our data represent the most update available.

To study the relationship between the economic performance and the support policies to young farmers, we exploit the comprehensive individual-level Italian Farm Accountancy Data Network. This database serves as the primary harmonized repository of microeconomic data. We focus our attention on farms managed by young farmers for the period 2008-2020, taking into consideration the two distinct pro-

gramming periods.

We perform different specifications (simple, with random and with province fixed effects) of a linear regression model whose dependent variable is the *Return on Equity* (ROE) and the key variable of interest is the access to dedicated funds for young farmers. We add individual controls for the farmer's characteristics (age, gender) and company-related controls (size, type of management, etc.).

Our findings illustrate the very pivotal role that economic support can play for young farmers (Salvioni and Sciulli (2011), Severini and Tantari (2015)). Results show that, even when a complete set of controls enters the model, the relation between firms' economic performance and the measures addressed to the young individuals is significant and positive. In particular, the most complete specification with fixed effects suggests that one unit change in the measure of access to funds dedicated to young farmers increases ROE by 0.04 %, ceteris paribus. Moreover, The F-test verifies the fixed effects model, and the Hausman test suggests that the fixed effects model is preferable to the random effects model. In order to validate our findings, we provide a robustness check by reanalyzing the data through the application of a probit model. The results are confirmed and a Wald test is performed to test whether at least one of the independent variables has a significant correlation with the ROE. Finally, a section is devoted to study possible heterogeneous effects, dividing the sample according to certain individual and geographic characteristics. Firstly, we divide the sample between North and South. Mainly, it turns out that the relation between the economic performance and the access to young farmers measures is more pronounced in the South probably due to a major presence of young farmers in this area. Secondly, the sample is split according to the conductor's educational level, dividing between individuals with a degree of education above or below professional diploma. What stands out is the substantial and positive association between access to funds and enhanced economic performance only among the most educated farmers.

The rest of this paper is organized as follows: Section 3 presents the related literature, Section 4 is a focus on the Common Agricultural Policy, Section 5 introduces the data and the main variables, Section 6 shows the empirical model, the main results and the tests, Section 7 displays the robustness check, Section 8 is about the heterogeneity analysis, Section 9 concludes.

3.3 Related Literature

This study contributes to the branch of literature that considers the broad topic of young farmers. More specifically, we shed light on the issue of generational turnover in the agricultural sector in Italy, focusing on the role of agricultural policies aimed at young entrepreneurs and their economic performance.

Focusing on Europe, Zagata and Sutherland (2015) show how a generational replacement issue is occurring in Europe, although it is not equally true for all European countries. Several countries demonstrate a clear balance between the share of young farmers and the aging agricultural population. The authors' findings indicate that there is no shortage of young farmers in countries such as Austria, Poland, Switzerland, Finland, Luxembourg, France, Germany. In particular, Rogoznicki, Baranowska, and Kondracki (2018) show that the significant rise in the percentage of young Polish farmers and the decline in the percentage of older farmers from 2002 to 2010 have been linked to the enforcement of CAP measures. In these contexts, farms are larger than the European average, and young individuals seem capable of establishing themselves, despite significant differences in incentives among these countries (for example, France is one of the biggest supporters of young farmers, while Germany is one of the countries that spends less).

Generally, it is possible to claim that the issue of generational turnover in agriculture is a burning topic in many European contexts. The "young farmer problem" has been explored from various perspectives, including demographic, economic, and sociological points of view. Discussions about young farmers extend beyond merely addressing the challenges of aging. Instead, they should encompass broader considerations such as family farm succession, the significance of new individuals entering agriculture, and the effectiveness of policy measures in shaping generational renewal within the agricultural sector. Grasping the full complexity of the problem is essential to enhance the success of support and measures targeting young farmers. By reviewing academic studies, it becomes possible to identify various underlying topics that contribute to the intricacies of the aforementioned "young farmer problem" (Zagata, Hrabák, et al. (2017)). First, it appears necessary to reconstruct the agricultural sector. In fact, a notable trend of concentration is underway in European farming, marked by a substantial decrease in the number of farms in the EU-27

by approximately 3.8 million and a simultaneous 36% increase in the average farm size between 2005 and 2015 (Eurostat[1]). This has led to a competitive scenario involving both farming and non-farming investors, as well as different generations of farmers competing for land in the market. Consequently, it has become increasingly challenging for young farmers and newcomers to agriculture to secure access to land (Noichl (2017)). While some EU Member States already regulate agricultural land markets to prevent undue land speculation (EC (2017a)), access to land remains a significant barrier to entry into farming. Secondly, the concern surrounding "young farmers" is intricately linked to the dynamics of farm succession, a process that significantly shapes generational turnover in the agricultural sector. Academic research indicates that farms typically transition from one generation to the next within the family structure, given the strong hereditary nature of the agricultural industry (De Haan (1994)). In certain countries, agriculture is regarded as a "closed profession" (Symes et al. (1990)), making family succession the predominant method of entering the farming profession (Zagata and Sutherland (2015)). Generally, the successful transfer of a farm from an older generation to a younger one is primarily influenced by the economic viability of the farm and the younger generation's willingness to enter farming (referred to as the "entry problem"). However, recent evidence suggests that the insufficient rate of generational turnover in agriculture is also tied to the reluctance of elderly farmers to pass on the farm to the younger generation (referred to as the "exit problem"). This reluctance stems from the increasing capital value of farming land, coupled with substantial emotional and time investments made in the farms over their lifespan, diminishing the inclination to sell or pass on the farm (Zagata and Sutherland (2015); Ingram and Kirwan (2011)). This behaviour aligns with the framework of the CAP, where the system of decoupled farm support is perceived by some farmers as a substitute for their pensions. As a result, these subsidies in agriculture act as a barrier to retirement and passing on the farm (Bika (2007); Rossier (2016)). The third problem linked to the generational renewal within the agricultural sector is the ageing farmer population. The aging of farmers is a prominent concern in European agriculture. EU Commissioner Phil Hogan has emphasized that the absence of a younger generation of farmers poses a significant challenge in achieving the goal of a "better life for rural areas", as outlined in the

[1] $https://ec.europa.eu/eurostat/databrowser/product/page/ef\_m\_farmleg$.

Cork 2.0 document (EC (2016)). The age distribution of farmers in EU Member States is closely intertwined with the size and structure of farms. A common trend observed throughout the EU is that smaller farms are predominantly operated by older farmers (Zagata and Sutherland (2015)). This implies that the challenge of aging has a more pronounced impact on countries with a higher proportion of small farms, such as Hungary, Romania, Greece, Italy, or Portugal. A more detailed assessment of the pressing nature of the aging issue is revealed through statistical surveys examining the age structure and total farmed land. From this perspective, it becomes apparent that the aging challenge is particularly urgent in the countries just mentioned. Finally, the issue of distinguishing young farmers from new entrants is a crucial point. According to the EU regulation's definition (*Regulation (EU) No 1305/2013*), the administration categorizes "young farmers" as "new entrants into agriculture". However, this classification may be misleading. Many young individuals who embark on farming by inheriting a farm through the succession process are not truly new entrants; rather, they are successors who have typically grown up on the farm and have already contributed to its operation through their labour. In contrast, new entrants are individuals starting farming without inheriting the farm they grew up on; instead, they enter agriculture from an external perspective. New entrants to agriculture, regardless of their age, represent potential innovators. While this aspect has not been thoroughly examined, certain agricultural studies support this notion. Sutherland et al. (2015) discovered that newcomers to farming are more involved in diversifying activities and establishing new markets, leveraging their experiences and contacts from outside the agricultural context. This aligns with earlier findings that indicate a tendency among many new entrants to agriculture to engage in organic farming (Rigby, Young, and Burton (2001); Padel (2001); Lobley, Butler, and Reed (2009)).

In literature, many authors try to understand whether European policies aimed at supporting young farmers are effective. In this regard, Balezentis et al. (2020) use an empirical analysis based on a survey in Lithuania to understand the possible effects of the CAP[2] support on agricultural sustainability, considering both pay-

[2]To obtain public support for starting a farming business, young European people mainly draw on resources from the CAP (in Italy a more marginal role is also played by instruments fielded by the Institute of Agricultural and Food Market Services (ISMEA)). Specifically, at the European level, the two main measures that interest young agricultural entrepreneurship are the measure 112 (for the programming period 2007-2013) and the sub-measure 6.1 (for the programming period

ments for the establishment and expansion of farms and advisory services. Their results indicate that the system appears more effective for income support without significant differences among different groups of farmers. Moreover, Gkatsikos et al. (2022) analyze the effects of the Young Farmers Scheme (YFS) in Greece, focusing on two regions. Their empirical results demonstrate that these types of generational renewal policies contribute to the growth of rural economies, especially in terms of employment and production. Furthermore, Pavić et al. (2020) show that young farmers' measures, particularly *Measure 112*, have yielded positive results in Slovenia, especially in terms of labor units, total revenue, and added value. In addition, in the UK the study conducted by May et al. (2019) indicates how these types of policies also impact the emotional sphere: they indeed have a positive influence on farmers' motivation.

The young farmer issue is particularly valid when the Italian context is taken into consideration. Agriculture is a sector of fundamental importance to the Italian economy, but it has faced significant challenges in recent decades, especially due to an aging farming population and the agricultural production fabric. Indeed, a paradigm shift is observed: from the cultivation of fields and the raising of livestock to a multiplicity of related activities that over time have shaped the concept of *multifunctionality*. One might hypothesize that young farmers are more adept at actively participating in this transformation compared to others. Not only do they bear fewer established routines, but they also possess the ability to leverage new ICT technologies and fulfill their desire for greater autonomy in the inputs and outputs market. For instance, Milone and Ventura (2019) show that the Italian young farmers' success relies on their innovative approach, their ability to collaborate and their ability to respond quickly and effectively to market demands. Recently, Albani et al. (2021) have shown how innovation in the agri-food sector is crucial: more than half of young people consider the application of innovation a fundamental element for the development of their businesses and the sector in general. For instance, the percentage of young farmers adopting computerised management practices is double that of their colleagues aged over 40 (34% compared to 14%).

However, while it is true that data about youth agricultural entrepreneurship is encouraging, a closer look at Figure 3.1 shows that not all Italian regions are

2014-2020). We will present the measures in more detail in the next section 3.4.

experiencing the same trend in generational turnover. To understand properly the generational renewal in the agricultural sector, it is insightful to observe data from the 7^{th} Censimento dell'Agricoltura provided by ISTAT. In 2020, the proportion of farm leaders aged up to 40 years old decreased to 9.3 percent from 11.5 percent with respect to 2010. This decline indicates a minimal influx of young individuals into the agriculture sector. According to an estimate by Fargione, Modesto, and Riccio (2022) for the study center *Divulga*, new agricultural establishments supported by the CAP funds would have been approximately 20 thousand during the last seven-year programming period (2014-2020); this means, on average, about 3 thousand young people per year. In comparison, France, a country with fewer farms than Italy (less than 30 percent), boasts around 9 thousand young farmers. In this regard, Schimmenti et al. (2015) question the success of the policy and the adequacy of the measure. In particular, they analyze the implementation of the RDP (Rural Development Programme) 2007-2013 for Sicily, with a specific focus on Measure 112. Their results demonstrate the success of this measure. However, only one-third of the submitted applications are funded due to the limited programmed budget. We will delve deeper into this data in the next Section 3.4. Schimmenti et al. (2015) highlight timing and expenditure issues, attributed to the challenging economic situation, bureaucratic problems, difficulties in accessing credit, and the limited time for realizing investments, resulting in the failure to achieve the set objectives. Related to the access to policies issue, Albani et al. (2021) show that over 41400 applications were submitted considering the programming period 2014-2020. Among these, less than half (20216) were approved for funding. Actually, therefore, one out of two young individuals will not be able to benefit from the opportunities provided by Rural Development Programme for settling in agriculture. The report by the association Terra! (2023) extensively addresses the "young farmer problem", demonstrating how Italy is a rather hostile environment for generational turnover in the primary sector. To truly support young farmers for a more inclusive and rapid generational change, the Report concludes that there should be an increase in economic support for the youth because the current 3% of CAP funds are insufficient to achieve the substantial transformation the country needs. Additionally, there is a necessity to redistribute resources downward through the first pillar, excluding medium and large farms and reserving complementary income support for small and

medium-sized young farmers. This issue is symptomatic of a system struggling to safeguard both a sector and a generation. Moreover, Capitanio, Adinolfi, and Malorgio (2011) use an empirical model to analyze the factors influencing the probability of farmers in applying rural policy measures in disadvantaged areas, such as in the southern regions of Italy. Their results indicate that the geographic location and economic characteristics of the farm are the main aspects. Following this, Pascucci et al. (2013) examine participation in different axes of RDP, seeking to understand the key driving factors. Their results highlight the significant importance of regional and local policies in the Italian context. Regional policymakers choose RDP measures from the national menu that align most closely with the needs of their specific area. This is particularly evident in the case of SAS (Support for Agri-environmental Services) measures: they observe a greater proportion of the regional RDP budget being allocated in regions with extensive forestland and natural areas. Moreover, farmers in regions with substantial budgets dedicated to such measures, especially those with small farms characterized by limited mechanization and younger farming management, are more inclined to engage in these measures.

In literature, many authors have stressed the Italian farmers' benefit of accessing CAP measures. For instance, Salvioni and Sciulli (2011) use a conditional difference-in-difference matching estimator to evaluate the impact at the farm level of the implementation of the first Italian RDP. Their results highlight that farms receiving a RDP payment tend to increase family labor. Furthermore, there is an evident rise in labor profitability and added value. In addition, the initial implementation of the RDP had a positive direct effect on rural GDP. Severini and Tantari (2015) analyze the connection between the First and Second pillars of the Common Agricultural Policy and the distribution of household income. They have found that direct payments have been effective in pursuing a more equitable income distribution, especially in mountainous areas. For this reason, any reduction in the budget for such a policy is likely to result in an increase in income concentration. Severini, Tantari, and Di Tommaso (2016) focus on direct payments and their relationship with income. In particular, they analyze their ability to reduce the variability of agricultural income over time. What they discover, examining the decade 2003-2012, is that direct payments stabilize agricultural income, mostly because they are less variable than the remaining part of the income.

Our contribution mainly aims to delve into an aspect still unexplored in the literature, especially at the Italian level: the connection between access to CAP funds for young farmers and the economic performance of the company (measured through the Return on Equity).

3.4 The Common Agricultural Policy

As previously mentioned, in seeking public support to begin a farming business, young individuals primarily leverage resources from the Common Agricultural Policy. Since one of the objectives of the CAP is fostering a more balanced territorial development, this policy encompasses numerous instruments and mechanisms available to Member States (MS) and regions, facilitating effective generational renewal in agriculture and fostering broader rural vitality. This involves the retention or establishment of rural jobs and growth, along with support for economic diversification, ensuring a high quality of life for residents in rural areas. Young farmers can benefit both from Pillar I and Pillar II of the Common Agricultural Policy. Indeed, under Pillar I, direct payments play a crucial role in offering substantial income support to agriculture, benefiting around 7 million farms throughout the EU. This support is particularly vital for sustaining farms in regions characterized by low productivity. The young farmer supplement, an additional component of direct payments, seeks to incentivize young individuals to establish a future in agriculture by providing extra support to their incomes during the initial years of farm ownership. Moreover, specific coupled measures can be crafted to assist in preserving farming systems with socio-cultural and environmental significance, contributing to the ongoing vitality of rural areas. The European Agricultural Guarantee Fund (EAGF), which serves as the financial instrument for CAP Pillar I, is entirely funded by the European Union (EU). In 2015, around 4.1% of basic payment applicants in the EU received the young farmer payment, according to the European Commission (EC (2017b)), with the Czech Republic having the highest share at 12%. The total payments allocated to young farmers accounted for approximately €317 million, representing 0.79% of direct payments. This figure was notably below the initial estimates, which projected around 1.3% of the direct payment envelope to be allocated to young farmers. The young farmer payment per hectare exhibited variation, ranging from 20 EUR/ha to over 80 EUR/ha. As far as Pillar II is concerned, EU rural development policy identifies six priority areas as significant concerns, as outlined in Article 5 of Regulation (EU) No 1305/2013. Among these, facilitating the entry of adequately skilled farmers into the agricultural sector falls under Priority 2, specifically categorized as "Enhancing farm viability and competitiveness of all types of agriculture in all re-

gions and promoting innovative farm technologies and the sustainable management of forests". In particular, among the measures, in our study we take into consideration Measure 112 (for the programming period 2007-2013) and Sub-Measure 6.1 (for the programming period 2014-2020). The former, also known as the first establishment, involves a one-time premium for farmers up to 40 years of age who are setting up for the first time as the head of an agricultural enterprise. To be eligible, individuals must possess adequate professional qualifications and skills and apply through participation in the appropriate calls (Piras (2018)). The latter serves as a reinforcement of the first establishment measure. More specifically, this measure focuses on the business start-up aid for young farmers. Pillar II is financed by the European Agricultural Fund for Rural Development (EAFRD) and is implemented by each Member States which can choose their own "national tailoring path". With the introduction of EU Regulation 2017/2393, young farmers now have a clear opportunity to establish themselves as the head of the farm, either individually or in collaboration with other farmers, regardless of the chosen legal structure. It is emphasized that a business plan must be submitted by the young farmer, outlining a specific time-frame of 5 years. To address the challenges faced by aspiring farmers and to complement CAP interventions, national measures are implemented. These measures aim to promote the establishment and growth of young agricultural ventures, facilitate access to land and credit, and support the overall development of the agricultural sector. In Italy, the institution responsible for assisting young agricultural enterprises is ISMEA. One of its notable initiatives is the Agricultural Land Bank (Law n.154/2016), which aims to maintain a comprehensive record of available agricultural land, including cases resulting from production abandonment and early retirement. The goal is to efficiently match the supply and demand for agricultural land.

In Figure 3.1 we illustrate the percentage of agricultural young entrepreneurs in Italy (left panel). It is possible to observe that Valle d'Aosta, Lazio and Abruzzo are regions with a higher percentage of young agricultural entrepreneurs compared to the total number of enterprises. Following closely are Sardegna and Sicilia, both with almost 21 percent of young agricultural entrepreneurs. The right panel of Figure 3.1 shows the percentage of young farmers who access to dedicated funds: it is evident how the percentage dramatically falls with respect to the percentage

of young entrepreneurs, confirming the difficulties in accessing these funds. For instance, Valle d'Aosta stands out with 5.02% of young entrepreneurs who access to dedicated funds, followed by Piemonte with 3.8% and Veneto with 2.17%.

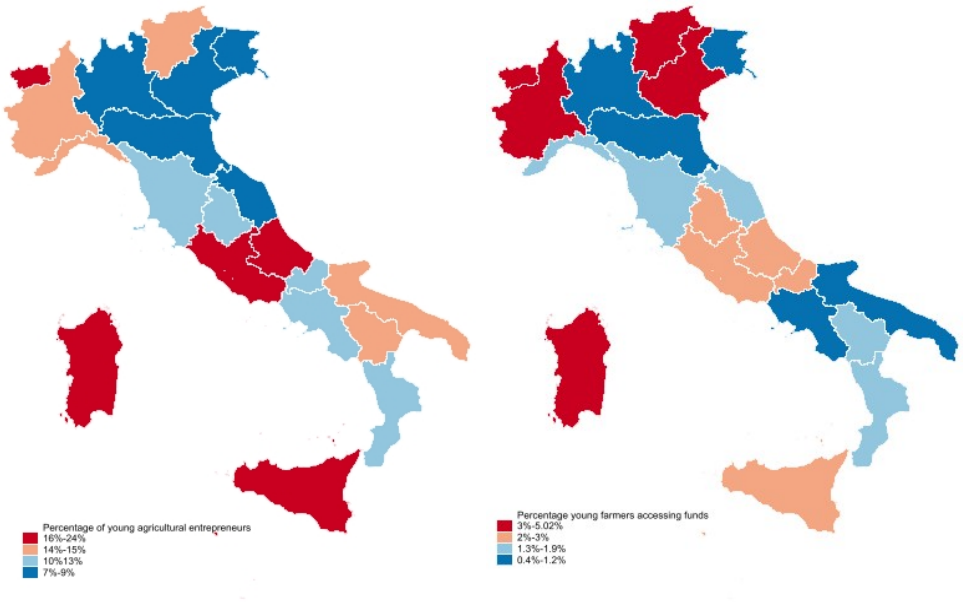

Figure 3.1: The distribution by regions of Young Entrepreneurs and Young Policies Accesses

3.5 Data

This paper seeks to investigate the role of young managers' access to funds (from both European and national sources) specifically aimed at promoting young agricultural entrepreneurship.

We exploit FADN data, a European survey that gathers data to accurately depict the European commercial agriculture sector. European Commission[3] defines the role of FADN as overseeing the income and business operations of farms, serving as a crucial information source to comprehend the repercussions of actions taken under the Common Agricultural Policy. It stands out as the singular origin of microeconomic data grounded in standardized bookkeeping principles and it relies on national surveys and exclusively encompasses European Union agricultural holdings. The employed methodology strives to furnish data that is representative across three dimensions: region, economic scale, and farming type.

The FADN was launched in 1965 as a result of an effort by the European Commission. FADN functions as the definitive storage of microeconomic data due to its strict adherence to standardised accounting principles. The Council for Research in Agriculture and Agricultural Economics (CREA) is responsible for annually collecting and organising the FADN in Italy. The Italian FADN dataset consists of almost 11000 farms recorded on an annual basis. This sample is specifically tailored to provide a true representation of the wide variety of production kinds, sizes, and geographical locations that exist throughout the entire national territory. The sample is divided into strata based on three primary variables: location, economic size, and farm productivity. More precisely, the sample consists of 21 NUTS-2 areas, 6 economic size categories, and 19 types of farms (Istituto Nazionale di Economia Agraria (INEA)). Data validation is performed by the National Institute of Statistics (ISTAT). The technique allows for a coverage of 93% of the total agricultural land being used and 98% of the value of the standard production across the entire

[3]See for more details https://agriculture.ec.europa.eu/data-and-analysis/farm-structures-andeconomics/fadn en. As already specified for the FADN Data Availability Statement: restrictions apply to the availability of these data. The data were obtained from the Council for Agricultural Research and Economics (CREA) and are accessible at the URL https://bancadatirica.crea.gov.it/Account/Login.aspx with the permission of CREA. We gratefully acknowledge the support of CREA for making the RICA data available to the research team (https://www.crea.gov.it/accordi-nazionali).

country.

Our final database comprises 16991 observations and 6126 firms led by young farmers and covers the period from 2008 to 2020. Descriptive statistics are presented in the Table 3.5.1. As evident, less than 20% of the farm owners are women. The result regarding access to agricultural policies is even more remarkable: on average, only 1% of farmers have access to funds, particularly referring to Pillar II. Additionally, 62% of the considered enterprises are engaged in agricultural activities rather than livestock farming. The variable Size is the ratio between UL (Total Labor Units including inter-firm labor exchange) and the total surface and measures firms' dimension. The variable ROE is the Return on Equity, calculated as net income divided by the net equity (on a percentage level).

Table 3.5.1: Summary Statistics

	Mean	SD	Min	Max	N
Gender	0.18	0.39	0.00	1.00	16991
YoungPol	0.01	0.11	0.00	1.00	16991
Pillar I	0.00	0.05	0.00	1.00	16991
Pillar II	0.012	0.11	0.00	1.00	16991
ROE	16.08	15.52	-32.98	66.51	16991
Size	0.19	0.81	0.00	20.27	16991
Agriculture	0.62	0.49	0.00	1.00	16991

Notes: Gender is a dummy variable that assumes value 1 if the firm's head is a female and 0 otherwise. *Pillar I* and *Pillar II* represent the percentages of young farmers who can access the funds of the first and second pillars, respectively. *YoungPol* is a dummy variable that assumes value 1 if the firm has benefited from funds dedicated to young entrepreneurs, 0 otherwise. *ROE* (Return on Equity) is the main dependent variable and measures firms' economic performance. *Size* is the scaled ratio between UL (Total Labor Units including inter-firm labor exchange) and the total surface and measures firms' dimension. *Agriculture* is a binary variable that takes the value 1 if the production is entirely agricultural and 0 otherwise. All the variables contained in the analysis are taken from FADN.

3.6 Empirical Model

In this paper, we aim to establish a link between the access to European funding and the performance of young farmers. Many sources of endogeneity may rule this relationship. Using province fixed effects, we do mitigate issues of unobserved heterogeneity[4]. We consider the use of three different linear specifications for the main econometric analysis: a standard OLS, an OLS model with random effects, and an OLS with province fixed effects. The empirical model 3.1 represents our main specification. We want to investigate the role of youth-oriented policies. In particular, we focus our attention on the economic results of the farm: our dependent variable *ROE* is a continuous variable that measures the firm economic performance and that is calculated as net income divided by the net equity (on a percentage level). The main independent variable is *YoungPol* which is a dummy variable that assumes value 1 if the firm has benefited from funds dedicated to young entrepreneurs, and 0 otherwise. Then, several control variables are taken into consideration. Firstly, we introduce some socio-demographic variables that describe entrepreneurs' characteristics. *Gender* is a dummy variable that assumes value 1 if the firm's manager is a female and 0 if he is a male. *Education* is a categorical variable and describes the conductor's educational attainment which ranges from *primary school certificate* to *university degree*[5]. Furthermore, the categorical variable *ProfCond* details the conductor's professional condition and it can be *looking for a job, employed outside the firm, part-time employee in the firm, full-time employee in the firm, retired from work, or others which represent all the other professional conditions*. Then, controls related to the firm enter the model. *Management* represents the type of company management: *direct with only family members, direct with a prevalence of non-family members, direct with a prevalence of family members, or with salaried employees*. *Organic* is a dummy variable that assumes value 1 if the firm's production is Organic and 0 otherwise. The variable *Size* describes the firm's dimension: as we saw it is the ratio between UL (Total Labor Units including inter-firm labor exchange) and the total surface. Moreover, *Agriculture* is a binary variable that

[4]In a future project, we aim to establish a causal relationship between the access to EU funding and performances making use of RDD techniques.

[5]The levels are: elementary school certificate, middle school diploma, high school diploma, professional qualification diploma, bachelor's degree, master's degree and postgraduate specialization.

takes the value 1 if the production is entirely agricultural and 0 otherwise. Finally, the variable *Altimetric zone* is a categorical variable which defines where the firm is located. It can assume three different levels: *Plain, Hill and Mountain.* All the variables are normalized. Definitively, the baseline profile is a young female farmer, who accesses policies and leads her business in a mountainous area, producing organic. In addition, her farm is run directly by only family members. As far as qualification is concerned, she has a middle school degree and is employed full-time in the firm.

$$\begin{aligned} ROE_{i,t} =& \beta_0 + \beta_1 YoungPol_{i,t} + \beta_2 Gender_{i,t} + \beta_3 Altimetriczone_{i,t} + \beta_4 Organic_{i,t} \\ &+ \beta_5 Size_{i,t} + \beta_6 Agriculture_{i,t} + \beta_7 Management_{i,t} \\ &+ \beta_8 Degree_{i,t} + \beta_9 Profession_{i,t} + d_j + \epsilon_{i,t} \end{aligned} \tag{3.1}$$

$ROE_{i,t}$ is the continuous dependent variable. $YoungPol_{i,t}$ is the main independent variables of interest. The data set is panel data, and the period from 2008 to 2020 is taken into account. Province fixed effects are also considered (d_j). In a further specification we also use random effects.

3.6.1 Results

The results are shown in Table 3.6.1. The first column refers to a simple Ordinary Least Squares (OLS), the second one with random effects and the last with province fixed effects. We can see that for all specifications the presence of young individuals leading the company that can access the CAP funds has a positive linkage with a better performance. In particular, the most complete specification with fixed effects (third column) suggests that one unit change in the measure of access to funds dedicated to young farmers increases ROE by 0.04%. This result explains how crucial economic support can be for a young farmer, both in the initial phase and during the course of their activity, in order to enhance the performance of their farm. This is in line with different results in the literature concerning other types of performance measures (e.g. Salvioni and Sciulli (2011), Severini and Tantari (2015)). Indeed, the CAP, and particularly Direct Payments, have among their main objectives the stabilization of agricultural income. The agricultural sector is

highly subject to income variability (due, among other, to climatic, seasonal, and geographical factors). Therefore, income support aimed at its stabilization is crucial not only in farmers' operational and investment decisions but also for the entire production chain (Severini, Tantari, and Di Tommaso (2016)).

We can focus on the simple OLS (first column) and on the fixed effects specification (third column), as the latter is the preferable specification based on the results of the tests in the next section. The economic result shows a positive relationship with the farm size, as well as with organic production. The latter result is not surprising: Läpple and Rensburg (2011) show how young farmers can be considered pioneers in adopting organic farming as well as Milone and Ventura (2019), who demonstrate how young farmers are innovative in these terms. A study conducted by DiGiacomo and Van Nurden (2022) reveals that the average net farm income for all organic farms in Minnesota (MN) and Wisconsin (WI) was $132319 in 2020-2021. In comparison, partial organic farms report $105687, and transitioning farms record $109880. Another measure, very reliable when there is considerable variation among farms, is the median net farm income. The median net farm income for all organic farms is $76404. Similar patterns are observed for partial organic farms, with a median net farm income of $67746, and transitioning farms, with a median net farm income of $54025. ISMEA Report 2020 demonstrates that in 2019, Italy had over 80000 organic operators, with approximately 1600 new operators joining the organic farming certification system, reflecting a 2% increase compared to 2018. Among these, 58697 are exclusive producers, 9576 exclusive processors, while producers/processors are 11843.

It also seems that family-owned businesses (without employees) are successful. This emphasizes the importance of family management in Italy, which is reflected in economic performance and social cohesion (De Castro, Adinolfi, and Capitanio (2014), Cucculelli and Storai (2015)).

As far as the educational level is concerned, it is possible to highlight that a conductor with a *high school* degree has better results with respect to the baseline. Instead, those who possess a professional qualification record a worse economic performance with respect who have a middle school degree. This result is coherent with the branch of literature showing how education, and especially the second level, is positively associated with agricultural output through mechanisms such as improv-

ing farmers' information-processing abilities and decision-making skills. Farmers with high school graduation efficiently allocate scarce resources, employing superior combinations of inputs compared to their less-skilled counterparts (Reimers and Klasen (2013), Taylor and Yunez-Naude (2000), Asadullah and Rahman (2009)).

Finally, occupational status has an important role: in particular being fully employed in the company (the baseline) can improve the level of ROE (Gordini (2012)).

Table 3.6.1: Main Estimations

	Dependent variable: Economic Performance		
	OLS	RE	FE
YoungPol	0.0004*	0.0002	0.0004**
	(0.0002)	(0.0001)	(0.0002)
Gender Female	0.0001*	0.0002*	0.00001
	(0.00005)	(0.0001)	(0.00005)
Altimetric zone Mountain	−0.0001**	−0.0001	0.00003
	(0.00004)	(0.0001)	(0.0001)
Management Form: Direct with a prevalence of non-family members	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)
Management Form: Direct with a prevalence of family members	−0.00001	−0.0001*	0.0001*
	(0.00004)	(0.0001)	(0.00004)
Management Form: With salaried employees	−0.0004*	−0.0001	−0.0002
	(0.0002)	(0.0002)	(0.0002)
Organic	0.0002***	0.0002***	0.0002***
	(0.00005)	(0.0001)	(0.00005)
Size	0.0003***	0.0002***	0.0002***
	(0.00003)	(0.00003)	(0.00003)
Degree: High school	0.0001**	0.0002*	0.0001
	(0.00005)	(0.0001)	(0.00005)
Degree: Professional qualification	−0.0002***	−0.0001	−0.0001
	(0.0001)	(0.0001)	(0.0001)
Degree: University diploma or short degree	−0.00001	−0.0002	0.00002
	(0.0001)	(0.0002)	(0.0001)
Degree: University Degree	0.00001	−0.0001	−0.0001
	(0.0001)	(0.0001)	(0.0001)
Degree: Primary school	0.0003	0.0004	0.00005
	(0.0002)	(0.0002)	(0.0002)
Degree: Post University Degree	0.0001	0.0001	−0.0005
	(0.0004)	(0.001)	(0.0004)
Professional Status: Looking for a job	−0.001	−0.001	−0.001
	(0.002)	(0.002)	(0.002)
Professional Status: Employed outside the firm	−0.001*	−0.001	−0.001
	(0.0005)	(0.001)	(0.0005)
Professional Status: Part-time employee in the firm	−0.0004***	−0.0004***	−0.0002**
	(0.0001)	(0.0001)	(0.0001)
Professional Status: Retired from work	−0.0003	−0.002	0.0001
	(0.001)	(0.001)	(0.001)
Professional Status: Student	−0.001	−0.0002	−0.001
	(0.001)	(0.001)	(0.001)
Agriculture	−0.00001	0.00005	−0.00002
	(0.00004)	(0.0001)	(0.00004)
Constant	0.004***	0.004***	0.005***
	(0.00005)	(0.0001)	(0.0002)
Observations	12473	12473	12473
R^2	0.022	0.129	0.008
Adjusted R^2	0.020	0.127	-0.002
Note:			*p<0.05; **p<0.01; ***p<0.001

3.6.2 Tests

We conduct two tests on the last specifications.

1. F-Test

   This test checks if there are significant effects due to province in our regression. The obtained p-value is very close to zero ($p - value < 2.2e - 16$), which is much lower than the common significance level of 5% (0.05). Consequently, we can reject the null hypothesis and conclude that there are significant effects due to province in the model.

2. Hausman Test (Hausman (1978))

   The Hausman test compares two parameter estimates, one estimated with the fixed effects model (our province fixed effect) and the other with the random effects model. The idea is that if the parameter estimates differ significantly, then at least one of the models is incorrect. Again, the p-value is very close to zero ($p - value < 2.2e - 16$), indicating that there is a significant difference between the two models. In this case, since the alternative hypothesis is that one of the models is inconsistent, the result suggests that the fixed-effects model is preferable to the random effects model.

In summary, both tests provide significant evidence in favor of the alternative hypothesis. The F-test confirms the validity of fixed effects models, and the Hausman test indicates that the fixed effects model is preferable to the random effects model.

Table 3.6.2: Test on the models

	p-value
F-Test	$< 2.2e - 16$
Hausman Test	$< 2.2e - 16$

3.7 Robustness Check

3.7.1 Probit models

In this robustness test section, we want to assess whether the results are consistent. We consider the use of Probit models. The specification is represented by Equation 3.2 and mirrors the main one. Again, we focus our attention on the economic results of the farm. In this framework our dependent variable *ROE* is a dummy that takes a value equal to one if the company exceeds the median value of the ROE of the entire sample, and zero otherwise. *YoungPol* is, as before, the main independent variables of interest. The socio-demographic controls and the firm-specific controls are the same as in the main specification. The baseline remains unchanged.

$$\begin{aligned} ROE_{i,t} =& \beta_0 + \beta_1 YoungPol_{i,t} + \beta_2 Gender_{i,t} + \beta_3 Altimetriczone_{i,t} + \beta_4 Organic_{i,t} \\ &+ \beta_5 Size_{i,t} + \beta_6 Agriculture_{i,t} + \beta_7 Management_{i,t} \\ &+ \beta_8 Degree_{i,t} + \beta_9 Profession_{i,t} + \epsilon_{i,t} \end{aligned} \tag{3.2}$$

$ROE_{i,t}$ is the binary dependent variable. $YoungPol_{i,t}$ is the main independent variables of interest. The socio-demographic controls and the firm-specific controls are the same as in the previous section. The baseline profile is a young female farmer, who accesses policies, and leads her business in a mountainous area, producing organic. Her farm is run directly by only family members. As far as her qualification is concerned, she has a middle school degree and is employed full-time in the firm.

3.7.2 Results

The results are shown in Table 3.7.1. The first column refers to a standard specification with only our main independent variable and no controls, the second one with socio-demographic controls and the last with also farm-based controls. Again, for all specifications the access to the CAP funds has a significant and positive link to the probability of performing better.

Focusing on the third column, as it is the most complete specification, we can see

that the results of the main specification are confirmed also regarding size, organic production, and being fully employed in the company. Moreover, regarding the altitude zone, having a business in the mountains is likely to be less performative compared to having the company in a hilly area. This result is coherent with the existing literature: El Benni and Finger (2013), for example, show that farm income is much lower for businesses located in the mountains rather than those in the hills, and even more in the plains.

Table 3.7.1: Robustness Check: Probit Models

	Dependent variable: Economic Performance		
	No Controls Variables	Individual Controls	Individual-Farm Controls
YoungPol	0.233*	0.247**	0.212*
	(0.090)	(0.091)	(0.106)
Gender Female		0.081**	0.051
		(0.025)	(0.029)
Degree: High school		0.061*	0.082**
		(0.025)	(0.030)
Degree: Professional qualification		−0.075*	−0.140***
		(0.031)	(0.036)
Degree: University diploma or short degree		−0.004	0.008
		(0.069)	(0.081)
Degree: University Degree		−0.019	0.025
		(0.041)	(0.050)
Degree: Primary school		0.151	0.176
		(0.084)	(0.111)
Degree: Post University Degree		0.128	0.135
		(0.241)	(0.273)
Professional Status: Looking for a job		−4.233	−4.347
		(25.798)	(57.936)
Professional Status: Employed outside the firm		−0.713**	−0.884*
		(0.255)	(0.358)
Professional Status: Part-time employee in the firm		−0.320***	−0.256***
		(0.041)	(0.049)
Professional Status: Retired from work		0.058	4.204
		(0.627)	(40.967)
Professional Status: Student		−0.814	−4.505
		(0.681)	(33.294)
Altimetric zone Mountain			−0.070**
			(0.024)
Organic			0.091**
			(0.029)
Size			0.185***
			(0.022)
Agriculture			−0.090***
			(0.025)
Management Form: Direct with a prevalence of non-family members			0.027
			(0.047)
Management Form: Direct with a prevalence of family members			−0.021
			(0.025)
Management Form: With salaried employees			−0.240*
			(0.120)
Constant	−0.003	−0.012	0.105***
	(0.010)	(0.021)	(0.030)
Observations	16991	16991	12473

Note: *p<0.05; **p<0.01; ***p<0.001

3.7.3 Wald Test

The Wald test (Wald (1943)) is used to test the null hypothesis that each coefficient is equal to zero, indicating that the associated variable does not effect on the probability that the dependent variable will take a particular value (one in this case).

In the probit model framework, the Wald test helps to determine whether the independent variables are globally significant in predicting the binary dependent variable.

We test the specifications with all the controls (third column of Table 3.7.1).

The p-value associated with the Wald test is zero. In this way the null hypothesis can be rejected, concluding that at least one of the independent variables has a significant effect on the dependent variable in the probit model.

3.8 Heterogeneity Analysis

The analysis is extended by investigating whether having access to measures dedicated to young individuals has a positive relationship with a higher ROE according to individuals' characteristics or socio-economic and geographical aspects. For this heterogeneity analysis, we compare North and South and farm managers with different levels of education.

3.8.1 North-South

For this analysis, we split the sample into North and South. More in detail, we have included into the *North* the north-east, north-west and central regions; while we have considered as *South* the southern regions and the islands[6].

The *North-South divide* is a recurrent issue in literature: an underdeveloped South against an advanced North. Therefore, it is not surprising that access to these supports for young farmers yields more significant results in terms of performance in the South. Moreover, the South has a population of young farmers that is almost double that of the North.

We can assert that in the South family management (respect to having salaried employees) plays an even more decisive role. Indeed, Cucculelli and Storai (2015) show how the highest percentages of family firms are exactly in the South.

Moreover, organic production seems to be more important for the performance in the South: the ISMEA Report (2020) shows that the organic farming accounts for an average of 15.8% of the national Utilised Agricultural Area (UAA)[7]. More in detail, the Central, Southern, and Island regions exhibit percentages of 21%, 20.4%, and 18.7% respectively, in contrast to a significantly lower percentage of 8.1% related to the North. The mountainous altimetric zone seems more likely to yield better results in the South (and vice versa in the North).

Furthermore, mixed agricultural or livestock activities appear to have more success compared to solely agricultural ones in the southern regions (contrary to the

[6]We use this geographic distribution: North (Liguria, Lombardia, Piemonte, Valle d'Aosta, Emilia-Romagna, Friuli-Venezia Giulia, Trentino-Alto Adige, Veneto, Lazio, Marche, Toscana, Umbria) and South (Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, Sardegna, Sicilia).

[7]In 2019, the Regions with the highest number of organic operators are Sicilia (10596), Calabria (10576) and Puglia (9380).

north). Regarding education, the results are not immediate. In the North the result is controversial: it appears that high school degree and elementary school diploma have a positive linkage with greater ROE compared to those with a middle school diploma. This ambiguous effect of education in the North is confirmed by observing the negative sign of vocational qualification compared to the baseline. In accordance with these results, Odoardi and Muratore (2019) demonstrate how the workforce with tertiary education has a negative link with GDP when considering the Central-Northern regions. They explain this relationship by pointing out the low economic specialization of companies: unskilled and low-skilled labor is required due to high labor-intensive and low-tech production processes. These peculiar working conditions make highly educated workers migrate from the northern regions more than those from the South. Furthermore, they suggest that these effects might be influenced by the increasing returns of different educational levels, which may have finished their positive effects in the North but remained in the South, considering the slight lag in the development of southern human capital.

Table 3.8.1: North vs South

	Dependent variable: Economic Performance	
	North	South
YoungPol	0.0001	0.001*
	(0.0003)	(0.0002)
Gender Female	0.00003	0.0001
	(0.0001)	(0.0001)
Altimetric zone Mountain	−0.0003***	0.0002***
	(0.0001)	(0.0001)
Management Form: Direct with a prevalence of non-family members	0.0002	0.0001
	(0.0002)	(0.0001)
Management Form: Direct with a prevalence of family members	0.00003	0.00004
	(0.0001)	(0.0001)
Management Form: With salaried employees	0.001	−0.001**
	(0.0005)	(0.0002)
Organic	0.0001	0.0002***
	(0.0001)	(0.0001)
Size	0.0003***	0.0003***
	(0.00003)	(0.00005)
Degree: High school	0.0002*	0.0001
	(0.0001)	(0.0001)
Degree: Professional qualification	−0.0004***	0.00004
	(0.0001)	(0.0001)
Degree: University diploma or short degree	0.0003	−0.0002
	(0.0002)	(0.0002)
Degree: University Degree	−0.0002	0.00002
	(0.0002)	(0.0001)
Degree: Primary school	0.001**	−0.0001
	(0.0002)	(0.0003)
Degree: Post University Degree		−0.0001
		(0.0005)
Professional Status: Looking for a job		−0.001
		(0.002)
Professional Status: Employed outside the firm	−0.001	−0.001
	(0.001)	(0.001)
Professional Status: Part-time employee in the firm	−0.0004***	−0.0002
	(0.0001)	(0.0001)
Professional Status: Retired from work		−0.0002
		(0.001)
Professional Status: Student		−0.001
		(0.001)
Agriculture	0.0002**	−0.0001*
	(0.0001)	(0.0001)
Constant	0.004***	0.004***
	(0.0001)	(0.0001)
Observations	4,270	8,203
R^2	0.072	0.013
Adjusted R^2	0.068	0.011
Note:		*p<0.05; **p<0.01; ***p<0.001

3.8.2 Educational level attainments

In this case, the sample is split according to the level of individuals' education. The former sub-sample consists of people with a degree of education higher than the professional diploma, while the latter includes individuals with a lower level. Generally, it is possible to claim that the main results are confirmed.

Concerning the first sub-sample, a notable finding is the positive correlation observed between the access to funds and improved economic performances. This is significant only for the most educated farmers, and not so for the second sub-sample. This result is in line with the part of the literature that emphasizes the link between high level of education, economic performance and greater access to policies (Adinolfi et al. (2020)).

The significant and positive correlation between the firm's dimension, the typology of cultivation (i.e. organic) and the economic performance (Lobley, Butler, and Reed (2009)) is confirmed for both the sub-sample.

Moreover, looking at the professional status, in particular for the first sub-sample, we can observe a significant and negative relationship between being employed part-time with respect to the baseline (i.e. being full-employed in the firm) and the economic performance. These findings are consistent with the branch of literature analysing the structure of farm business (Gordini (2012)).

On the other hand, in the second sub-sample, the variable *Gender* stands out. Indeed, less educated female seems to perform better in terms of economic performance. This counter-intuitive finding is in line with that strand of literature that highlights how female conductors have a positive relation with economic productivity also considering low-educated managers. Anthopoulou (2010) shows how in Greece, the low level of education has not prevented entrepreneurial women from engaging in business activities in the agri-food sector, where they have gained empirical mastery of production techniques. In response to the question, *How did you initially acquire knowledge and learn the techniques for manufacturing your products*, the majority of women replied that this took place within the family. This obviously relates to the importance of family businesses, playing a role in transmitting knowledge.

Furthermore, for the less educated managers, being a firm that focuses only on agricultural business appears to have a significant and negative correlation with the

economic performance (Ramankutty et al. (2019).

Table 3.8.2: Educational level attainments

	Dependent variable: Economic Performance	
	(Degree >= to Diploma)	(Degree < to Diploma)
YoungPol	0.0004*	0.001
	(0.0002)	(0.001)
Gender Female	0.0001	0.0004***
	(0.0001)	(0.0001)
Altimetric zone Mountain	−0.0001**	−0.0002**
	(0.00005)	(0.0001)
Management Form: Direct with a prevalence of non-family members	0.0002*	−0.0001
	(0.0001)	(0.0002)
Management Form: Direct with a prevalence of family members	−0.00001	0.00003
	(0.00005)	(0.0001)
Management Form: With salaried employees	−0.0005*	0.001
	(0.0002)	(0.001)
Organic	0.0002**	0.001***
	(0.0001)	(0.0001)
Size	0.0003***	0.0003***
	(0.00003)	(0.0001)
Professional Status: Looking for a job		−0.001
		(0.002)
Professional Status: Employed outside the firm	−0.001	−0.001
	(0.001)	(0.001)
Professional Status: Part-time employee in the firm	−0.0005***	−0.0002
	(0.0001)	(0.0002)
Professional Status: Retired from work	−0.0003	
	(0.001)	
Professional Status: Student	−0.001	
	(0.001)	
Agriculture	0.0001	−0.0002**
	(0.00005)	(0.0001)
Constant	0.004***	0.004***
	(0.00005)	(0.0001)
Observations	9,427	3,046
R^2	0.017	0.033
Adjusted R^2	0.015	0.028
Note:		*p<0.05; **p<0.01; ***p<0.001

3.9 Conclusions and future research

Our work is connected to the heart of the debate about the European generational renewal (Balezentis et al. (2020), Rogoznicki, Baranowska, and Kondracki (2018), Salvioni and Sciulli (2011)).

We focus on the Italian agricultural context that is aging like its population, but that is proving to be an excellent economic element to bet on.

The aim of this study is to examine the effectiveness and suitability of the agricultural policy structure designed for young individuals in the Italian context. More specifically, we want to understand if the access to European policies for Italian young farmers has a positive link with the improvement in their economic performances measured by ROE.

The findings show that Italian young farmers' access to these policies has indeed led to enhanced farm performance: the most complete specification suggests that one unit change in the measure of access to funds dedicated to young farmers increases ROE by 0.04%, ceteris paribus. This study wants to stress the necessity to provide support to young individuals, aiming not only to encourage new agricultural activities but also to provide concrete assistance for those who already have started a business.

Our contribution is multiple. First of all, it enriches the strand of literature about the effectiveness of European funds addressed to young farmers and the relation with farms' economic performance. Secondly, this study contributes to provide a quantitative analysis to robustly describe the link between our dependent variable and the co-founders (previously, to the best of our knowledge, only Salvioni and Sciulli (2011) try to assess the relation in the Italian scenario). Finally, this study exploits the most updated available data, provided by the major authority in the field.

In this paper, we have explored the relationship between access to dedicated funds for young Italian farmers and the subsequent economic performance of their businesses. Our future research aims to conduct a thorough investigation into the causal linkages between these two factors. To achieve this, we will employ a Regression Discontinuity Design (RDD) model, which will enable us to systematically compare farmers just below the age threshold of 40 (those eligible for the reforms

and, therefore, access to funds) with their counterparts just above the threshold who share similar characteristics. The implementation of the RDD model will facilitate a causal analysis, shedding light on the impact of age-specific eligibility on economic outcomes. By focusing on farmers straddling either side of the age threshold, we can discern and quantify the causal effects of accessing dedicated funds on their business performance. This examination will provide valuable insights into the dynamics at play and contribute to a more accurate understanding of the relationship under scrutiny. Finally, it is imperative to explore whether the perceived positive but weak effect of these funding mechanisms stems primarily from inadequate financial allocations to young farmers or, alternatively, from challenges related to their access to these funds. This additional layer of investigation will involve scrutinizing the implementation process and identifying potential bottlenecks that could prevent a large expected positive impact of financial support. By disentangling these elements, we aim to provide a comprehensive analysis that not only highlights the existing dynamics but also offers actionable recommendations for improving the efficacy of support mechanisms for young farmers.

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Conclusions

My thesis has focused on one of the main social issues in our society, inequality. More specifically, I have focused on three main actors who experience inequality in the labor market (and beyond): the poor and unemployed, women, and youth. My approach aims to present and shed light on the disadvantaged condition of these actors on one hand, but also to analyze the effectiveness of implemented policies and identify new possible roles and strengths for them.

In the first paper, I analyze inequality in the labor market in Germany. Germans perceive a higher-than-average earnings inequality, even though objective measures of income disparities are below the OECD average and have remained fairly stable in the last decade. One possible explanation for this discrepancy between data and perceptions lies in the fact that most indicators of inequality rely on a single price or cost-of-living index for all categories of individuals, even though it is well known that tastes vary with income. The first article addresses this point. Positive productivity changes in the tradable sector or stricter regulations in local housing supply have a different impact on employed and unemployed workers, with the latter experiencing a greater variation in their cost-of-living index. Our contribution aims to underline, also in relation to specific policies supporting the unemployed, how inequality is greater than it would be implied using an identical price index for all individuals. In this sense, policies to support the income of the unemployed could be crucial, but above all, policies to make the real estate market less inaccessible, especially for the poorest segments of the population, could be fundamental.

In the second article, I analyze the role of women's empowerment, including mothers, in terms of employment (and income), in influencing their children's decision to pursue higher education outside their region of origin in Italy. The results show what I have called the "mother-hen" effect: as women achieve greater financial

and occupational independence, there is a noticeable reduction in the geographic mobility of students. This study demonstrates how increased female empowerment can have significant implications for student mobility and can serve as a counterbalance, for example, to the brain drain phenomenon, and also as a way to stabilize and balance local economies and regional structures. This could certainly provide a new perspective for policymakers both in analyzing student mobility and in reducing the gender gap in the labor market and family management.

The last work focuses on young Italians entrepreneurs in agriculture and the debate on generational renewal in this complex yet fundamental sector. The results have shown an evident need to provide support to young individuals, aiming not only to encourage new agricultural activities but also to provide concrete assistance to those who have already started a business. CAP, and especially Direct Payments, are sources of income support, which in agriculture is known to be very volatile and dependent on highly important environmental and climatic factors. The article therefore emphasizes the importance of generational renewal in Italy and the support that young farmers need to continue this virtuous goal.

In the end, these three studies converge to present a panoramic perspective on socio-economic challenges and inequalities, but also opportunities. Ranging from the complexities of housing affordability to the gender issues and the necessities of agricultural generational turnover, each study offers unique insights and empirical findings to enrich the broader topic of societal well-being and progress.

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