Regional Misallocation, Wage Rigidities, and Imperfect Labor Mobility

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Abstract

The constraints imposed by the wage regulation of many countries are thought to be the cause of substantial employment losses and regional disparities. We set up a quantitative spatial equilibrium model with wage-constrained labor markets, unemployment, commuting, and migration to assess the local and aggregate effects of wage rigidities. We quantify the model on Belgium, where wages are strictly regulated and do not correlate with local productivity. We calculate the impact of removing wage rigidities by simulating the economy under different labor mobility scenarios. We find that, when workers can only change workplace, welfare increases by 0.5% to 2% across municipalities, depending on the initial local unemployment rate. Instead, allowing workers to also change residence equalizes the welfare effects at about 1%. However, the effects on local wages and employment are not quantitatively different across scenarios, highlighting the importance of commuting as insurance. Finally, the endogenous reduction in social security contributions generates welfare effects three times larger than those from the pure reallocation of workers.

JEL Classification: J3, J5, J61, R10, R13, R23

Keywords: wage rigidities, collective bargaining, spatial equilibrium, labor mobility, internal migration, commuting, local unemployment.

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1 Introduction

The economic effects of wage regulation, such as the minimum wage and collective wage bargaining, have been the subject of an extensive theoretical and empirical literature, and, in recent years, the debate has attracted considerable political attention in many developed countries. For instance, in 2022 the European Council has adopted a directive establishing procedures to achieve adequate minimum wages and promoting the coverage of collective agreements in all the EU member countries.[1] The main purpose of such measures is to guarantee fair wages and decent living conditions, and to reduce in-work poverty and wage inequality. However, according to economic theory, these policies might not be free of consequences.

When a binding minimum wage is introduced in a competitive market, the neoclassical model of the labor market predicts increasing levels of unemployment.[2] Moreover, in the presence of within-country differences in local productivity, this adverse effect would be more pronounced in some locations than in others. Within this framework, Boeri et al. (2021) have argued that the centralized wage bargaining system typical of some European countries, while successful in reducing nominal wage inequality, could be the cause of a costly misallocation of labor across regions. According to the authors, national wage equalization can lead to higher unemployment in the least productive locations, while, at the same time, generating lower housing prices and higher real wages. This effect depends on the mobility of workers, who, by migrating from high to low unemployment locations, exert pressure in the destination housing market. The magnitude of the welfare effects, however, is still not known.

In this paper we quantify the local and aggregate effects of wage rigidities and study to which extent these effects depend on the degree of geographical labor mobility. To address this question, we set up a quantitative spatial equilibrium model with an arbitrary number of locations characterized by heterogeneous local productivities and housing supplies. We introduce wage rigidities in the form of exogenous wage constraints, for example, as those imposed by collective agreements. Binding wage constraints are source of unemployment risk, which workers must account for in their location choices. Workers are geographically mobile, can choose where to live and work, and have heterogeneous preferences for workplace and residential locations. We distinguish between commuting and migration, emphasizing the importance of commuting as potential insurance channel against unemployment risk.

[1]Directive (EU) 2022/2041 of the European Parliament and of the Council of 19 October 2022 on adequate minimum wages in the European Union.

[2]The employment effect of the minimum wage is one of the most debated topics among economists. While the existing empirical evidence suggests a negative effect (Neumark and Shirley, 2022), the estimates are not robust to alternative regression specifications (Manning, 2021). However, it is commonly accepted that, above a certain threshold, a high enough minimum wage would have a negative effect.

We conduct our analysis using data from Belgium, as it constitutes an interesting case study. First, the country is characterized by a wide gap in productivity and unemployment across regions: the average productivity in Flanders is about 12 percentage points higher than in Wallonia, whereas the respective unemployment rates are 5% and 10%. Second, wages in Belgium are regulated by a highly centralized wage bargaining system. Collective agreements are negotiated at the sectoral level and define minimum wages for workers of given age, occupation, and experience. These sectoral minimum wages amount on average to about 70% of the median wage (Vandekerckhove et al., 2020) and cover 96% of the entire workforce (OECD, 2023b).

Given these premises, we provide empirical evidence in support of the hypothesis of the existence of wage rigidities in Belgium. As predicted by Boeri et al. (2021), we would expect a weak relationship between local wages and productivity. We estimate the relationship across Belgian districts by regressing log average wages (after controlling for workers and job characteristics) on log gross value added per worker. The elasticity we obtain is small: a 10% higher local productivity is associated with a 0.7% higher average wage. This elasticity is less than half the one found by Boeri et al. (2021) for Italian provinces, and it is consistent with other existing studies on Belgium (Rusinek and Tojerow, 2014; Konings and Marcolin, 2014; Kampelmann et al., 2018; Garnero et al., 2020).

We then turn to housing prices and real income per capita. Housing prices in Flanders are 33% higher than in Wallonia, whereas, on the contrary, real income per capita is 3% higher in the latter. While this pattern is analogous to what has been shown for Italy in Boeri et al. (2021), the migration mechanism proposed by the authors is not plausible in the context of Belgium. Examining the mobility patterns of workers we find very little migration: about 88% of workers live in the same residence of the previous year, and, if they do migrate, they rarely relocate outside the same district (3%).[3] On the other hand, about 40% of all workers commute to a district different from that of residence, and in total about 15% live and work in a different region. These patterns are also common to other countries and motivate our methodological approach to labor mobility.[4]

In the quantitative analysis, we study the effects of wage rigidities by simulating the model after unemployment is eliminated from all local labor markets. In our framework unemployment originates uniquely from the existence of wage rigidities, and, as such, our results should be interpreted as an upper bound on the potential effects of removing such constraints. More generally, the exercise can be interpreted as an assessment of the local

[3] Note that, while Flanders and Wallonia adopt different official languages (i.e., Dutch and French), language and cultural barriers are less likely to be the main cause of the lack of internal migration, since people rarely move even within their own region.

[4] Molloy et al. (2011) show similar rates of internal migration across European countries, while Manning and Petrongolo (2017) find similar commuting patterns in England and Wales.

and aggregate costs of unemployment.

The elimination of unemployment generates a positive local labor supply shock, whose magnitude is determined by the initial unemployment rate in any given local labor market. However, while the official statistics report the unemployment rate measured as the fraction of unemployed workers residing in a given location, the theoretical unemployment rate is defined as the fraction of unemployed workers willing to work in a given workplace, and, therefore, it is not directly observable unless residence and workplace coincide.[5] To recover the unemployment rate by workplace, we use the structure of the model and data on the commuting matrix and local unemployment rates by residence. We show that in our model the local residential unemployment rate can be expressed as a weighted average of all the workplace unemployment rates, where the weights are given by the commuting probabilities conditional on residence. The unemployment rate at the workplace can then be recovered by simply solving a system of linear equations.

We disentangle the importance of labor mobility by carrying out the analysis at the municipality level under three different scenarios: (i) workers cannot change their residence and workplace; (ii) workers can change their workplace but cannot migrate; and (iii) workers can change both residence and workplace. When unemployment is removed, expected income increases in local labor markets with a higher initial unemployment probability, attracting workers from other locations. However, we find no quantitative differences in the effects on local wages and employment once workers are allowed to change workplace, regardless of whether they can migrate or not. This suggests that commuting can provide sufficient insurance against nominal income shocks, making migration redundant. Differences across scenarios are instead noticeable when looking at the local effects on real income or welfare. When workers can only change workplace, we find positive welfare effects ranging between 0.5% and 2% and increasing in the initial local unemployment rate. Instead, when workers are allowed to migrate, the welfare effects are equalized across municipalities at about 1%. In general, we find that the residents of high unemployment locations would benefit the most from removing wage rigidities if workers were not able to adjust their location choices.

At the national level, the aggregate effects are similar across mobility scenarios: employment would increase by 8%, the average wage would drop by 4%, and aggregate labor income would increase by 4%. Remarkably, these effects are very close to those found in Boeri et al. (2021), notwithstanding the different context and methodology. In contrast, we also calculate the aggregate welfare effect: despite the large positive impact on employment, welfare would increase on average by 1 percentage point in all mobility

[5] In most of the literature, this problem is avoided by conducting the analysis at the level of commuting zones, defined as areas where most people live and work. However, these pre-defined areas are still an imperfect proxy for local labor markets since cross-border commuting could still occur (Monte et al., 2018).

scenarios. This effect is robust to alternative calibrations of the model.

Finally, we investigate the role of the social security system. The aggregate welfare effect remains modest even with lower unemployment benefits, whereas a too generous unemployment insurance would cause opposite effects at the local level. In fact, with high unemployment benefits, eliminating wage rigidities would cause a decrease in expected income, as the drop in wages more than compensates the elimination of the unemployment risk. As a consequence, workers would relocate towards less affected local labor markets. Lastly, allowing for the endogenous reduction in social security contributions would almost completely offset the negative effect on the average wage, and would increase welfare by 3.6%. Overall, most of the welfare effect would stem from reducing the burden of financing the social security system.

Related Literature

Our research contributes to the literature on spatial misallocation (e.g., Desmet and Rossi-Hansberg, 2013; Brandt et al., 2013; Behrens et al., 2017; Fajgelbaum et al., 2018; Hsieh and Moretti, 2019; Boeri et al., 2021).[6] The most closely related paper to ours is Boeri et al. (2021), who study the effect of collective wage bargaining in spatial equilibrium by the means of an analytical two-region model with perfect labor mobility. The authors provide empirical evidence in support of their theoretical predictions using Italian and German data, and calculate the aggregate costs of misallocation in Italy by assuming that the wage and employment elasticities to productivity were the same as in Germany. We build on their analysis and provide evidence for the Belgian case in line with their hypothesis. Differently, in our analysis we rely on a quantitative spatial equilibrium model, we assess the welfare effects of removing wage rigidities, we study the importance of labor mobility, and we investigate the role of unemployment insurance. While we find similar large aggregate effects on employment and wages, the welfare effect is small.

We also drew inspiration from Hsieh and Moretti (2019), who quantify the aggregate costs of labor misallocation across US cities due to restrictions on the housing supply. The authors find that cities with higher productivity have adopted stricter restrictions on the supply of new housing units, limiting the number of workers having access to such highly productive workplaces. According to the authors, in absence of these constraints aggregate US output would have grown significantly more from 1964 to 2009. On the contrary, in our analysis we find virtually no differences in local labor market outcomes once workers can change workplace, regardless of their migration choices. Our results suggest that, at least for systems of cities characterized by relatively short distances, commuting can be an effective substitute for migration, implying a potentially high return

[6] See Restuccia and Rogerson (2017) for a survey on misallocation in general.

on investments in transport infrastructure.

Our approach originates from the growing literature on quantitative spatial economics (Redding and Rossi-Hansberg, 2017; Redding, 2023).[7] In particular, we follow the approach of Ahlfeldt et al. (2015), Monte et al. (2018), Heblich et al. (2020), and Severen (2021), who nest a discrete choice model of commuting in a spatial general equilibrium framework, while we extend the model to include wage constraints and unemployment. In this literature, the paper closest to ours is Ahlfeldt et al. (2023), who develop a quantitative spatial equilibrium model with monopsonistic labor markets and study the introduction of the minimum wage in Germany in 2015. There, the focus is on calculating the optimal minimum wage, since a sufficiently low minimum wage could actually increase employment and welfare in a monopsonistic setting. Ahlfeldt et al. (2023) find that a federal minimum wage equal to 58% of the average wage would increase welfare by about 4%, while causing an employment loss of the same magnitude. However, for minimum wages above 70% of the average wage, the welfare effect would turn negative and employment would drop by more than 20%. In contrast, we study an economy in which collective agreements set minimum wages around 70% of the median wage, and find mild positive welfare effects when such constraints are removed from a competitive environment. Overall, the findings in the two papers complement each other.

Our paper is also related to the literature on local labor markets (Moretti, 2011). While most papers in this literature investigate the migratory response of workers to local labor demand shocks (e.g., Blanchard and Katz, 1992; Diamond, 2016; Amior and Manning, 2018; Notowidigdo, 2020), we focus instead on the impact of local labor supply shocks after unemployed workers are re-absorbed by the labor market.[8] In particular, we relate to Monras (2019), who studies the employment and migration effects of the minimum wage in a two-region spatial equilibrium model. Theoretically, Monras (2019) shows that, if the increasing burden of financing unemployment insurance is shared nationwide, the increase of the minimum wage in a local labor market may still make the location more attractive despite large dis-employment effects. Analogously, we find that, if unemployment insurance is too generous, locations with a high initial unemployment become less attractive when wage rigidities are removed. Differently, we also discuss the effects on housing prices and welfare, and stress the importance of commuting (e.g., as in Manning and Petrongolo (2017) and Monte et al. (2018)).

[7]Models with heterogeneous locations and mobile workers have been recently adapted to studying a variety of topics: the impact and spatial propagation of local shocks (Caliendo et al., 2017; Monte et al., 2018), trade and migration shocks (Caliendo et al., 2019; Caliendo et al., 2021, 2023); urban agglomeration effects and city structure (Ahlfeldt et al., 2015; Owens et al., 2020); fiscal policy (Fajgelbaum et al., 2018; Henkel et al., 2021); infrastructure investments and commuting (Heblich et al., 2020; Severen, 2021).

[8]This is similar in spirit to the literature on international migration, which assesses the impact of foreign migrants on the labor market outcomes of the natives.

Finally, other papers have studied unemployment in local labor markets using a job search approach (e.g., Kline and Moretti, 2013; Beaudry et al., 2014; Lutgen and Van der Linden, 2015; Manning and Petrongolo, 2017; Marinescu and Rathelot, 2018; Bilal, 2023). Here, instead, we adopt the neoclassical labor market framework, relying on wage constraints to rationalize the existence of unemployment. Thus, in this paper we do not provide a theory of spatial unemployment, but we assess the quantitative effects of wage rigidities assuming that in their absence full employment would be restored.[9]

The remainder of the paper is organized as follows. Section 2 provides the evidence motivating our analysis. Section 3 describes the model. Section 4 discusses our methodology and presents the results of the quantitative analysis. Section 5 investigates the policy aspects concerning unemployment insurance. Section 6 concludes.

2 Motivating Facts

In this section we document the main facts that motivate the quantitative analysis of this paper. First, we document the productivity and unemployment differences across Belgian districts, highlighting the gap between the Flemish Region (in the North) and the Walloon Region (in the South). Second, we provide suggestive evidence in favor of the existence of wage rigidities in Belgium. Third, we examine the spatial distribution of housing prices and real income per resident across municipalities and regions. Fourth and last, we document the mobility patterns of workers. Throughout the paper we use several data sources which we describe more in detail in the Appendix.

2.1 Regional Misallocation

We begin by discussing the relationship between productivity and unemployment in Belgium in 2010, as presented in Figure 1.[10]

We use Gross Value Added (GVA) per worker as a proxy for productivity. Panel A shows the map of productivity in relative terms to the national (unweighted) average. As the figure makes clear, there is a noticeable difference in local productivity between Flanders and Wallonia, with a regional gap of about 12% in 2010. This gap is not specific to the year considered here: over the period 2010-2019, the productivity in Flanders has been on average 15% higher than in Wallonia. Even accounting for differences in industrial

[9] Note that we could similarly interpret our counterfactuals under the lens of job search theory. Specifically, in a job search framework unemployment drops to zero if search frictions are removed (Michaillat, 2012). Hence, setting unemployment to zero in the counterfactuals could be interpreted as the effect of removing either wage rigidities, search frictions, or both. Nevertheless, we provide empirical evidence suggesting that wage rigidities could be the relevant case for Belgium.

[10] We use 2010 as reference because all data are available in that year. The pattern presented here would have been the same if we had used another year, given an autocorrelation well above 90%.

(A) Productivity (B) Unemployment

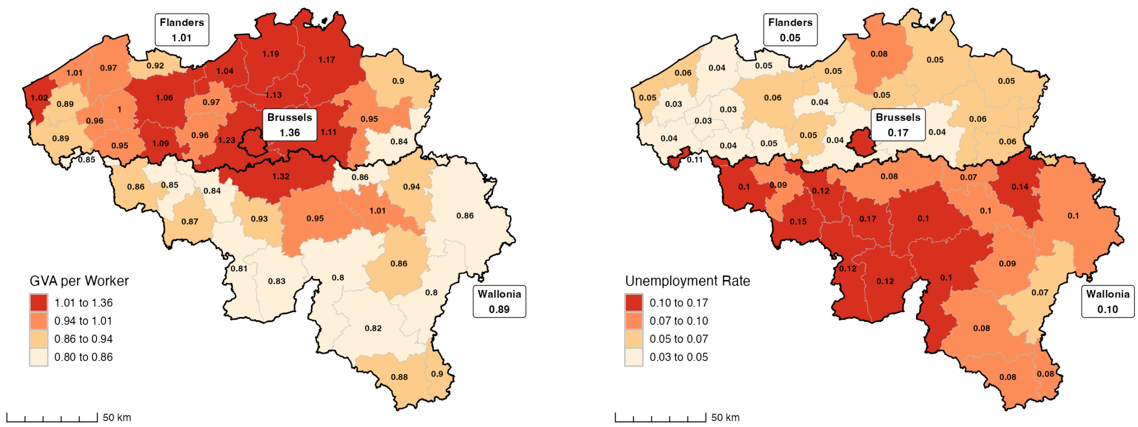

Figure 1: Regional Misallocation

Note: Panel A: Gross Value Added (GVA) per worker, relative to the national (unweighted) average. Data have been obtained from the Regional Accounts of the National Bank of Belgium. Panel B: local unemployment rate. Data have been obtained from IWEPS. Regional values for Brussels, Flanders, and Wallonia are calculated as the unweighted average across all districts belonging to that region. The maps are colored by quartiles. Values are rounded to the nearest hundredth. All figures pertain the year 2010.

composition, that is, had Flanders the same industrial composition of employment of Wallonia, the gap would still be 14%.[11] Overall, the productivity gap between the two regions is in line with what has been shown for Italy by Boeri et al. (2021), who document a gap between Northern and Southern provinces of about 18 percentage points.

Panel B displays a similar, but reverse, gap in unemployment rates. We notice first that, while in Flanders the unemployment rate of the average district is about 5%, in Wallonia the average unemployment rate is twice as high, about 10%.[12] Second, the variability of unemployment rates in Flanders is limited, with rates ranging mostly between 2% and 6% and, at the highest, 8% in Antwerpen. On the contrary, in Wallonia the unemployment rate varies significantly more, with a minimum of 7% in Bastogne and reaching levels well above 10% in some districts, up to a maximum of 17% in Charleroi.

Finally, we note that Brussels, which constitutes a separate region, displays both high productivity (36% above the national average) and high unemployment (17%). This is probably due to the special role of Brussels as the capital, hosting both national and European institutions, and attracting international migrants of all skill levels. Thus, in the remainder we will mostly focus on the differences between Flanders and Wallonia.

Overall, from Figure 1 we discern an inverse relationship between regional produc-

[11] To adjust the productivity in Flanders for differences in industrial composition, we first measure the productivity for each sector in Flanders and then take a weighted average based on the sectoral employment shares in Wallonia.

[12] The unemployment gap is not a temporary fact. Over the period 2000-2016, the average unemployment rates were 4.8% in Flanders and 11% in Wallonia.

tivity and unemployment. Differences in productivity could arise from various reasons, mostly historical. In this paper local productivity will be taken as given, however we will consider unemployment as an equilibrium phenomenon. As argued in Boeri et al. (2021), the inverse productivity-unemployment relationship could be explained by the existence of a centralized wage bargaining system constraining wages above the market-clearing level. The unemployment rate would then tend to be higher in locations where the wage constraint is above the market-clearing wage, that is, in less productive locations. In support of this hypothesis, in the next section we provide some evidence suggesting that wages in Belgium may indeed be constrained by the actual wage bargaining system.[13]

2.2 Wage Rigidities

We split the discussion about wage rigidities in two subsections. First, we provide a concise description of the wage regulation in Belgium. Second, we provide empirical evidence suggesting the existence of wage rigidities.

2.2.1 Wage Regulation in Belgium

Wages in Belgium are bound by three main institutional devices: a hierarchical collective bargaining system, an automatic inflation indexation scheme, and a ceiling on the allowed nominal wage growth.

The collective bargaining system is structured in three tiers. In the first, a national and legally binding minimum wage is established. The national minimum wage applies to all workers of all sectors, with the exception of public sector employees and apprentices who are covered by specific agreements. In the second tier, private wages are bargained at the sectoral level within Joint Committees (*Commissions Paritaires*), institutional bodies composed equally of representatives of employers' associations and of trade unions. There are more than one hundred active Joint Committees and Sub-committees, each representing a specific sector or branch of activity.[14] The Joint Committees determine the minimum wage in their respective sector for each category of worker, which is usually defined by the combination of age, experience, and occupation. These sectoral minimum wages cannot be set below the national minimum wage. Finally, the collective agreements concluded at this stage apply to all workers employed in the sector of the Joint Committee concerned, regardless of the worker's affiliation to any trade union. Thus, even if only

[13] Alternative explanations for the spatial dispersion of unemployment are based on search and matching frictions (e.g., Beaudry et al., 2014; Lutgen and Van der Linden, 2015; Bilal, 2023). However, it is unlikely that search frictions alone can explain very high unemployment rates (Michaillat, 2012). Another possibility is provided by Amior and Manning (2018), who argue that sluggish migratory responses to persistent local labor demand shocks could cause local unemployment to endure.

[14] As of January 2023 there are 100 Joint Committees and 64 joint Sub-committees. The sectors represented by the Joint Committees are comparable to those in the NACE Level 3 nomenclatures.

about 50% of all employees are unionized (OECD, 2023a), 96% of them are actually covered by a collective agreement (OECD, 2023c). In the third and last tier, wages are negotiated at the firm level, where, however, wages can only be set at or above the national and sectoral minima. According to Rusinek and Tojerow (2014), about 23% of employees are covered by collective agreements concluded at the firm level.

In addition to the collective bargaining system, there exist both a floor and a ceiling on nominal wage growth. Wages are automatically linked to average past inflation, although the exact timing of the inflation adjustment is determined within the Joint Committees and thus varies across sectors. This automatic wage indexation scheme de facto determines the minimum growth rate of nominal wages and therefore limits downward real wage adjustments. Moreover, since 1996 the Wage Norm, a ceiling on the negotiable wage increases, has been imposed to maintain international competitiveness. This upper bound is based on the forecasts of the hourly labor cost in the three main trade partners of Belgium, that is, Germany, the Netherlands, and France, and, while not legally binding, it has been respected in practice (Van Gyes, 2009).

All together, the collective bargaining system, the automatic indexation scheme, and the Wage Norm constitute a strong wage compression mechanism and could effectively define the shape of the wage distribution. Specifically, while the collective bargaining system sets a benchmark for the variation of wages across workers, the other two mechanisms control variation over time. Some direct evidence on the impact of the wage regulation on the wage distribution has been advanced recently, for example, in Vandekerckhove et al. (2020). The authors show that, while the ratio between the national minimum wage and the median wage is about 60%, the sectoral minimum wages are on average 19% higher than the national minimum, that is, about 70% of the median wage. Since almost all employees are covered by a collective sectoral agreement, very few employees are paid at the national minimum wage (3%), while a non-negligible fraction results being paid at the sectoral minimum (10%). Furthermore, the authors document a remarkable and complete lack of variation in wage inequality over time, with a ratio between the 10th and 90th percentiles stable at 41% over the period 2000-2015.[15] Finally, Vandekerckhove et al. (2020) provide estimates of spillover effects of the minimum wages across the entire distribution, with positive effects at the bottom of the distribution and negative effects at the top, which further support the hypothesis of a wage compression effect.

2.2.2 Empirical Evidence

From the above description of the wage regulation in Belgium, there are reasons to believe that wages may not fully reflect local productivity. We provide here some empirical

[15]As a comparison, in the US, where wages are significantly less regulated, the p10/p90 ratio was about 21% in 2010, according to the summary statistics presented in Autor et al. (2016).

evidence in support of this claim. Since wage standards are centrally set for each sector and worker category, we would expect to observe similar wages for workers with similar characteristics and employed in similar sectors and occupations, regardless of the location of employment and therefore of local productivity. In other words, conditionally on worker and job characteristics, average local wages should be uncorrelated to local productivity.

We proceed in two steps following Boeri et al. (2021). First, we use the 2010-2019 employee-level data from the Structure of Earnings Survey (SES) to obtain a measure of wages comparable across workers of different types. The selected sample consists of private sector employees, between 20 and 60 years old, on an indefinite contract, and working full-time or for at least 35 hours per week. The hourly wage is constructed as the ratio between gross earnings and paid hours over the reference working period, typically a month. Separately for each year, we residualize the hourly wage by regressing it on second-order polynomials in age and tenure, NACE Level 2 sector dummies, ISCO Level 2 occupation dummies, and education dummies.[16] We then calculate the district-average residual hourly wage and scale it up by adding the nationwide-average (non-residualized) hourly wage. This is our measure of conditional wage.

In the second step, we regress the district-level log conditional wage on log GVA per worker, our proxy for productivity.[17] We control for year fixed effects to capture general inflation and common macroeconomic shocks. Figure 2 displays the scatter plot corresponding to this regression. As the figure makes visually clear, the relationship between wages and productivity is weak: for workers with the same characteristics, a 10% higher local productivity is associated with a 0.7% higher average wage.

In Table 1 we present the regression output for some subsamples. Column 1 shows for comparison the output obtained by using the log unconditional wage as dependent variable. In this case the elasticity is substantially higher: a 10% higher local productivity is associated with a 4.8% higher average wage, that is, an elasticity seven times larger than that in Figure 2. In other words, in the raw data wages do vary with local productivity, however this is only due to differences in workers characteristics. Columns 2 to 9 use the log conditional wage as dependent variable. The regression in column 2 is our baseline (represented in Figure 2), while the others are regressions performed separately for each sector. Here sectors are defined at the NACE Level 1 and we do not further control for subsectors when constructing the conditional wage. The overall picture remains unchanged, and, if anything, we observe larger elasticities for Retail Trade (0.107) and Professional Services (0.137). Nevertheless, these elasticities are still small in magnitude.

[16]Except for education, these variables are the same considered in the collective agreements. However, controlling for education can compensate for the coarse categorization of sectors and occupations.

[17]Since the SES covers only private sector employees, in this analysis the district-level productivity is measured including only the relevant sectors: Manufacturing, Construction, Retail Trade, IT Services, Finance, Real Estate, and Professional Services.

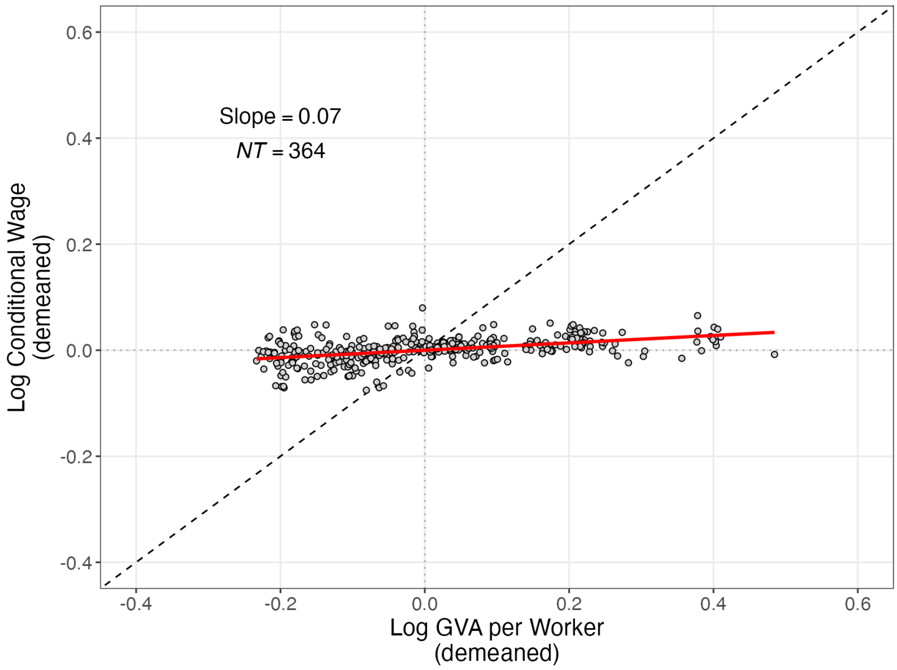

Figure 2: Wage Rigidities

Note: Each dot corresponds to a year-district observation for the period 2010-2019. The dashed line is the 45-degree line. Each variable has been demeaned by residualizing on year fixed effects. The conditional wage has been calculated by first regressing individual hourly wages on workers' characteristics (age, tenure, sector, occupation, and education) and then averaging at the district-level. Details in the main text. Conditional wages have been calculated from the SES data provided by Statbel. Data on GVA and total employment have been obtained from the Regional Accounts of the National Bank of Belgium.

To put our results in perspective, we can compare our estimates with those in Boeri et al. (2021). Performing the same regression on Italian provinces over the period 2009-2013, they find an elasticity of conditional wage to productivity of about 0.20, almost three times as large as our benchmark estimate. Based on their estimate, Boeri et al. (2021) conclude that there is little or no correlation between wages and productivity across Italian provinces. On the other hand, they find an elasticity of 0.74 across German provinces, providing supporting evidence of a more flexible wage setting system than in Italy. In comparison, this estimate is about twice as large as our unconditional elasticity (column 1 in Table 1) and ten times our benchmark estimate.

Other papers have studied the wage-productivity gap in Belgium before. Rusinek and Tojerow (2014) investigate whether the Belgian collective bargaining system is flexible enough to account for regional differences in productivity. They find that the relationship between the regional wage gap and the regional productivity gap is stronger in sectors in which the share of employees covered by firm-level collective agreements is higher. That is, the collective bargaining system does already account for differences in local productivity. However, since the share of employees covered by firm-level agreements

Table 1: Estimates of the Wage-Productivity Relationship

	Log Wage	Log Conditional Wage							
	All Sectors (1)	All Sectors (2)	Manuf. (3)	Constr. (4)	Retail Trade (5)	IT Services (6)	Finance (7)	Real Estate (8)	Professional Services (9)
Log GVA per Worker	0.478***	0.070***	0.069***	0.036**	0.107***	0.019	0.034**	-0.032	0.137***
	(0.027)	(0.009)	(0.011)	(0.013)	(0.011)	(0.012)	(0.013)	(0.027)	(0.023)
Year fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	364	364	364	346	364	224	276	120	355

Note: This table presents the coefficients of a district-level regression of log average wage on log Gross Value Added (GVA) per worker over the period 2010-2019. In column 1 the dependent variable is the log district-average wage, while in columns 2-9 the log district-average conditional wage. The conditional wage is calculated by residualizing worker-level hourly wages on age, tenure, sector, occupation, and education. Details in the main text. Columns 1-2 pool all sectors, while in columns 3-9 the regressions have been performed separately for each sector. All regressions include year fixed effects. Average wages have been calculated from the SES data provided by Statbel. Data on GVA and total employment have been obtained from the Regional Accounts of the National Bank of Belgium. HAC robust standard errors are reported in parentheses: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

is small, in practice productivity is poorly reflected in wages.[18] Konings and Marcolin (2014) and Kampelmann et al. (2018) instead study the regional wage-productivity gap using linked employer-employee panel data and estimate directly the gap between value added and wages at the firm level, conditioning on both workers and firms characteristics. Both studies conclude that regional differences in productivity are more pronounced than those in wages and agree on the existence of a regional gap in cost competitiveness, with Wallonia being less competitive than Flanders. Finally, Garnero et al. (2020), following the approach in the two previous papers, show that firm-level agreements tend to increase wages, although this mostly occurs in sectors less exposed to competition.

Overall, the evidence provided in this section lends credibility to the hypothesis of a rigid wage setting system, according to which firms across different locations face the same wage constraints, despite the differences in local productivity.

2.3 Spatial Distribution of Real Income

Here we examine the spatial distribution of housing prices and income per resident, both in nominal and real terms. Average housing prices are calculated from aggregate data on the sales of land and housing units by dividing the total selling value of houses, flats, and manors by the total number of transactions. Average income per resident is calculated from the sum of labor income and unemployment benefits divided by the number of employed and unemployed residents. Real income per resident is calculated by deflating

[18] A close inspection of their preferred estimates in Table 5 column 3 shows that in sectors in which no employee is covered by a firm-level agreement the predicted effect of productivity on the wage gap would be negligible (the coefficient is small and not significant). Instead, if the share of employees covered by firm-level agreements were equal to the national average (i.e., 23.5%), the predicted effect of a 10% productivity increase would be $23.5\% \times 10\% \times 0.365 = 0.85\%$, similarly to what we find.

average income per resident by a local price index built on the housing prices.[19]

Figure 3 presents the facts. Panels A-C show the spatial distribution across municipalities of housing prices and income per resident in relative terms to the national median municipality, whereas Panel D displays the respective densities for Flanders and Wallonia in percentage deviation from the national median municipality.

From the two top panels we first notice that both housing prices and nominal residential income are clustered mostly around Brussels, at the center of the country. Two additional small clusters of housing prices can be detected in the northwestern area next to Bruges, a touristic city close to the seacoast, and in the North next to Antwerpen, the second largest Belgian city. Similarly, a small cluster of income per resident is noticeable in the South next to the border, most likely due to the presence of cross-country commuters to Luxembourg, an attractive location for high skill workers.

Although the two maps look similar, Panel D emphasizes the difference in the variability of the two measures. Housing prices in Flanders are on average 17% higher than the median Belgian municipality, whereas in Wallonia housing prices are 16% lower, implying a regional gap of about 33 percentage points. Moreover, some municipalities in Flanders exhibit housing prices as high as 50% above the median, whereas others in Wallonia as low as 50% below the median. Income per resident is also higher in Flanders than in Wallonia, however the regional gap is only 5 percentage points and the two densities almost overlap.

The map of real average income per resident in Panel C is not dissimilar from that in B, with clusters around the center and in the South. However, it seems that higher levels of real income per residents are slightly more concentrated in Wallonia than in Flanders. This is confirmed in Panel D, where the density for Wallonia is shifted to the right of that for Flanders. On average, real income per resident in Wallonia is 2% higher than the median, while in Flanders it is less than 1% lower than the median, implying a regional gap of about 3 percentage points.[20] Notice that here income per resident incorporates the effect of workers' characteristics. However, as we have shown in Subsection 2.2.2, conditional wages vary significantly less than unconditional wages. Thus, had we controlled for workers' characteristics, the regional gap in real income per

[19] Anticipating the notation used in the model below, let v_i, Q_i, P, and β denote respectively income per resident, the local housing price index, the general consumption price index, and the housing expenditure share. Real income per resident is then calculated as $v_i/(Q_i^{\beta}P^{(1-\beta)})$, where the price index at denominator can be micro-founded by Cobb-Douglas preferences in housing and non-durable consumption goods, and the price of consumption can be normalized to 1 as it is assumed to be constant across locations, for instance due to negligible shipping costs.

[20] This result may be due to the high income earned by workers commuting to Luxembourg. To check the robustness of this finding we drop all municipalities with a share of residents working in a foreign country higher than 10% (i.e., 55 out of 581 municipalities). Note that in most cases (i.e., 90%) the share is 8% or lower, while the highest share is 60% in Messancy, at the border with Luxembourg. Dropping these locations would reduce the regional gap by only 0.7 percentage points.

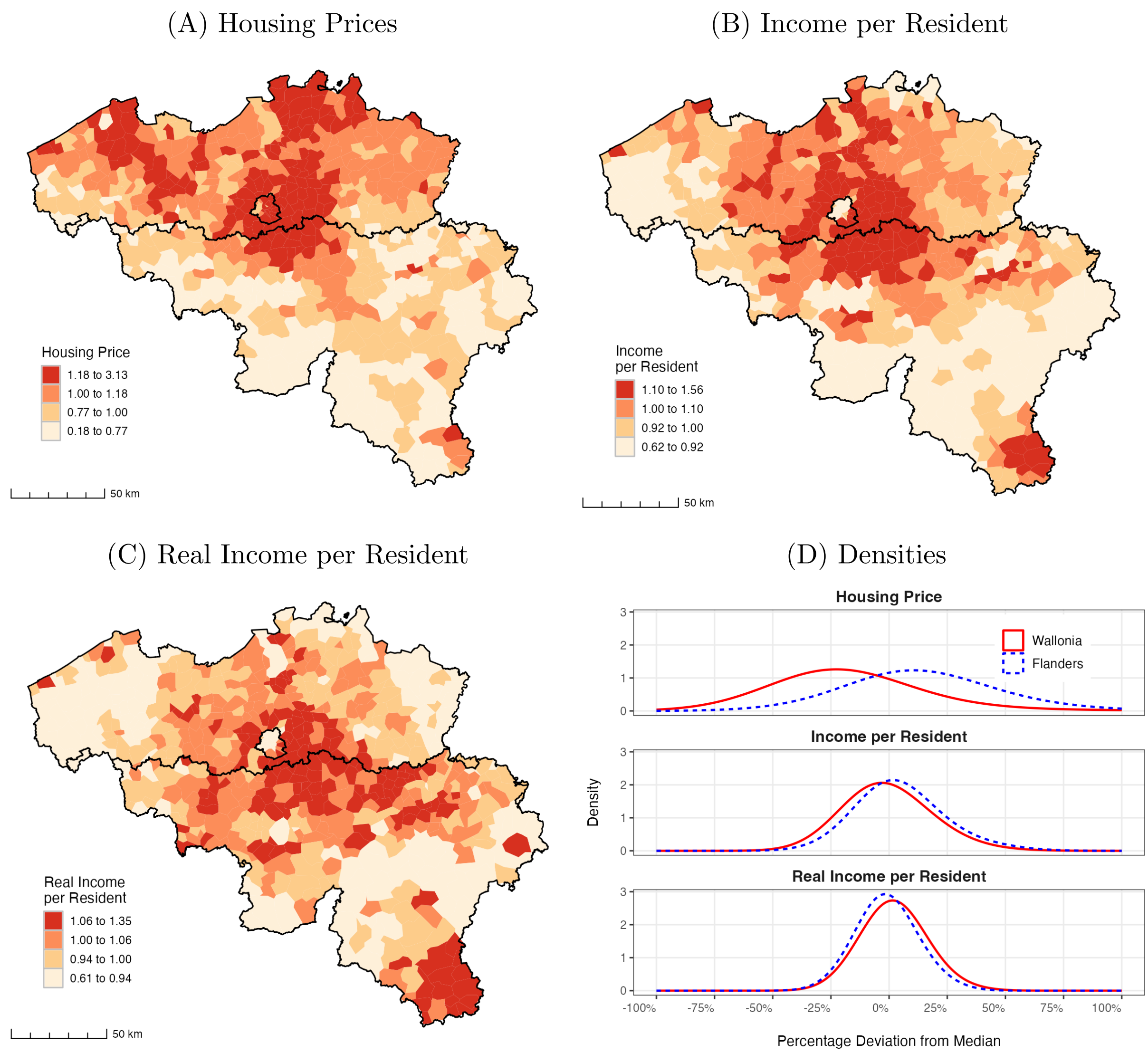

Figure 3: Spatial Distribution of Real Income

Note: Panel A: Average housing price. Panel B: Average income per resident. Panel C: Real average income per resident. Panel D: Densities of average housing price, average income per resident, and real average income per resident, for Flanders and Wallonia. The maps in panels A-C are colored by quartiles and the legend values are relative to the national median municipality. The densities in panel D are in percentage deviation from the national median municipality. All figures pertains the year 2010. Authors' elaborations based on data obtained from Statbel. Details in the main text.

resident could have been substantially larger.

Overall, the data point towards an inverse relationship between productivity (Figure 1) and real income per resident (Figure 3): a regional gap in productivity of about 12 percentage points is associated with a reverse gap in real income per resident of about 3 percentage points. This fact is in line with the theoretical predictions and empirical findings in Boeri et al. (2021), who argue that, in the long-run, the migratory flow of workers from the least to the most productive locations would tend to increase (decrease) housing prices in the destination (origin) locations, thus generating a reverse gap in real income. However, this theoretical possibility would hardly fit the Belgian case. Since language and cultural differences divide Flanders and Wallonia, a priori we would expect very little cross-regional migration.[21] Moreover, given the relatively small geographical size of the country, commuting might be a viable alternative to migration. We thus explore labor mobility next.

2.4 Labor Mobility

We describe the main patterns of migration and commuting in Table 2, using the raw data from the 2011 Census of the Belgian population.

Panel A displays the share of 20-59 year old individuals, either employed or unemployed, by their current region of residence (by column) and by their residence one year before the Census (by row). Strikingly, more than 80% remained in the same residence as the one declared in the previous year. By adding the changes of residence within the same district we observe that, if they indeed moved, more than 95% remained in the same district. This pattern holds across regions and by employment status. Notice that, while we would have expected a low rate of cross-regional migration due to language and cultural barriers, the lack of within-region migration indicates that other factors such as preferences and relocation costs are likely to be the main drivers. As a comparison, Molloy et al. (2011) provide the internal mobility rate for some European countries and the US in 2005 in their Figure 5. Our measure of internal migration is in line with their reported estimate for Belgium, and, interestingly, it is similar to the mobility rate of Italy and many other countries. Overall, this suggests that the low rate of internal migration is not a unique feature of Belgium.

Turning to commuting, Panel B shows the share of local commuters by region of residence (by column) and workplace destination (by row). Most of the commuting occurs across municipalities within the same region, either within or outside the same district of residence, as similarly documented in Persyn and Torfs (2015). Specifically, about 70% of workers work in a municipality different from that of residence, and about 40% in a different district. However, fewer than 20% commute to a different region. In general, residents in Flanders tend to commute less to other regions than workers living in Wallonia (11% compared to 16%), and, if they do, they almost exclusively commute to Brussels (9%). Similarly, about 19% of Brussels residents commute to a different region, and they are twice more likely to commute to Flanders than Wallonia.

Panel C provides additional information on commuting distance, calculated as the great circle distance between municipality centroids. The median distance is about 9 km

[21] In Boeri et al. (2021) housing prices are higher in the most productive region because of the larger population size caused by migration. In Belgium 60% of the population lives in Flanders, 30% in Wallonia, and 10% in Brussels, which could explain the regional gap in housing prices. This spatial distribution of the population has historical roots and persists over time. Thus, although we can plausibly rule out migration as the main mechanism behind the regional gap in Belgium, the proximate cause may indeed be the same, that is, a difference in local population size.

Table 2: Labor Mobility

	Current region of residence		
	Brussels	Flanders	Wallonia
Panel A. Share of workers by residence in previous year			
Employed			
Unchanged residence	0.82	0.89	0.88
Different residence, same district	0.13	0.08	0.08
Different district	0.03	0.03	0.03
Foreign residence	0.03	0.00	0.00
Unemployed			
Unchanged residence	0.82	0.84	0.82
Different residence, same district	0.15	0.12	0.13
Different district	0.02	0.04	0.04
Foreign residence	0.00	0.00	0.00
Panel B. Share of commuters by commuting destination			
Same municipality of residence	0.28	0.36	0.34
Different municipality, same district	0.53	0.26	0.26
Different district, same region	–	0.27	0.24
Different region	0.19	0.11	0.16
Brussels	–	0.09	0.11
Flanders	0.12	–	0.05
Wallonia	0.06	0.02	–
Panel C. Commuting distance			
Municipality size (median)			
Area (km^2)	6.30	38.63	50.98
Radius (km)	1.42	3.51	4.03
Commuting distance (km)			
Min	0.55	0.59	1.34
p25	2.17	4.76	5.18
p50	4.45	8.61	9.97
p75	7.57	19.83	24.78
Max	178.42	281.51	281.51

Note: This table presents summary statistics about migration and commuting in Belgium. Panel A: share of individuals by current region of residence (by column) and residence in previous year (by row). Panel B: share of commuters by region of residence (by column) and destination (by row). The last three rows of this panel display the regional commuting matrix conditional on cross-regional commuting. Panel C: median municipality size and commuting distance distribution. The radius has been calculated from a simple approximation to a circle given the actual municipality area. Authors' elaborations based on the 2011 Census of the population provided by Statbel. Details in the Appendix.

for commuters living in Flanders and Wallonia, whereas it is half of that for those living in Brussels. Still, about 25% of commuters in Flanders and Wallonia travel more than 20 km to reach their workplaces. For a comparison, these numbers are similar to those reported for England and Wales by Manning and Petrongolo (2017), who find that about 50% of workers commute less than 6 km and about two-thirds less than 10 km. To have a sense of the commuting distance, Panel B displays also the median municipality area and the corresponding radius obtained from a simple approximation to a circle. For example, the median distance in Flanders and Wallonia is about three times the radius of the median municipality, thus spanning approximately two to three municipalities. To visualize the spatial pattern of commuting, we map in Figure C.1 in the Appendix the share of local residents commuting to the major cities of Belgium. Except for Brussels, whose influence extends throughout the entire country, the other major cities draw workers from relatively close municipalities, especially from within the same district.

Summing up, changes of residence are not frequent in Belgium, and if they do occur, they are confined within the same district. Moreover, although most workers commute to a municipality different from that of residence, the commuting distance is usually short. All in all, the evidence suggests a low degree of labor mobility, which also appears to be common in other countries. We shall account for these facts in the quantitative analysis.

3 Model

In this section we outline a spatial general equilibrium model with commuting and migration, and we introduce unemployment by assuming the existence of exogenous wage rigidities in the local labor markets. We quantify this model in Section 4 to assess the impact of removing wage rigidities on local and aggregate outcomes.

The economy consists of a discrete set of locations $i, j \in \mathbb{N}$, where in general we denote residential locations with i and workplace locations with j. It is populated by an exogenous measure $\overline{L}$ of geographically mobile workers, each of whom supplies a unit of labor.

3.1 Production

The local representative firm produces a homogeneous final good by employing workers (E_j) at a wage w_j using the following technology:[22]

$$Y_j = A_j E_j^{\alpha}, \quad \alpha < 1, \tag{1}$$

where α is the labor income share, and A_j denotes local productivity. Profit maximization implies the following downward-sloping labor demand:

$$E_j = \left(\frac{\alpha A_j}{w_j} \right)^{\frac{1}{1-\alpha}}, \tag{2}$$

[22]As shown in Hsieh and Moretti (2019), a model with final good homogeneity is isomorphic to a model with product differentiation by location and frictionless trade. This also encompasses the case with non-tradable goods but with consumers allowed to shop outside their location of residence. In any case, the price of the final good bundle would be equalized across residential locations. This is a reasonable approximation for the Belgian context, given the relatively short shipping distances across municipalities.

Notice that, while a downward-sloping labor demand is necessary to allow for unemployment in this framework, the assumption of decreasing returns to scale in labor is not. For example, the formulation of the production function adopted here is isomorphic to one with constant returns to scale in labor and land, with the latter assumed to be in fixed supply in each location.[23] Since the calibration of the elasticity of the labor demand would depend on the exact model specification, in the Appendix we will test our results against alternative values of α. Finally, notice that under decreasing returns to scale the local firm generates profits, which we assume are distributed to absentee business owners.[24]

3.2 Preferences

Workers are risk-neutral and geographically mobile, have heterogeneous preferences for locations, and can either be employed or unemployed. Each worker chooses where to live and work and how much to spend on final good consumption and housing. The model is static and each worker can participate to one local labor market only. Conditional on the choice of workplace, the worker's unemployment probability is determined by the unemployment rate (u_j^W) in the chosen local labor market. If employed, the worker receives the wage (w_j), otherwise she is partially insured by a fixed amount of unemployment benefits (ζ).[25] Notice that, since workers are identical from the perspective of the local firm, all workers commuting to the same workplace location will be paid the same wage and will face the same unemployment probability.

A risk-neutral worker ω with Cobb-Douglas preferences over consumption goods and housing chooses where to live and work by maximizing the indirect utility (derived in the Appendix):

$$V_{ij}(\omega) = \frac{b_{ij}(\omega)}{\kappa_{ij}} \frac{y_j}{Q_i^{\beta}}, \tag{3}$$

where: y_j is the expected income from participating to labor market j, that is, $y_j = (1 - u_j^W)w_j + u_j^W\zeta$; Q_i is the local housing price in location i, weighted by the housing

[23] This is the approach adopted in Severen (2021). Capital could also be added as in Boeri et al. (2021), with a canonical constant return to scale technology in labor and capital paired with an upward-sloping local supply of capital, or as in Hsieh and Moretti (2019), with constant return to scale in labor, capital, and fixed local land.

[24] Here we follow Hsieh and Moretti (2019), however an alternative approach is possible. Caliendo et al. (2017) instead assume that local factors are owned partially by local governments and partially by the national government, which in turn redistributes the rents to residents across the entire economy. Depending on the calibration of the model, this may incentivize workers to locate in more productive locations to benefit from higher transfers. We abstract from this additional effect.

[25] In practice unemployment benefits are calculated as a fraction of the foregone wage. However, the actual benefits are also limited by a floor and a cap, which both vary by household composition and unemployment duration (Nevejan and Van Camp, 2013). Since the effective replacement rate varies considerably along the wage distribution because of these constraints, for simplicity here we fix the amount of benefits to ζ, while in Section 5 we probe the sensitivity of the results to alternative values.

expenditure share β; $\kappa_{ij} \in [1, \infty)$ is an iceberg commuting cost in terms of utility; and $b_{ij}(\omega)$ is an idiosyncratic amenity draw capturing all the omitted factors that could affect the residence-workplace choice of worker ω. Note that commuting costs and amenities capture also language and cultural barriers between locations, while real expected income (y_j/Q_i^β) is the systematic component of welfare endogenous to the economy.

We assume that idiosyncratic amenities are independently drawn from a Fréchet distribution $F_{ij}(b) = e^{-B_{ij}b^{-\epsilon}}$, where B_{ij} is the scale parameter controlling the mean amenity draw, and $\epsilon > 0$ is the shape parameter controlling the dispersion of amenities and the sensitivity of workers' location choices to real expected income.[26] Given this distributional assumption, it can be shown (in the Appendix) that the probability of a worker choosing to live in location i and commute to location j can be expressed as:

$$\lambda_{ij} = \frac{L_{ij}}{\overline{L}} = \frac{B_{ij}\left(\kappa_{ij}Q_i^\beta\right)^{-\epsilon} y_j^\epsilon}{\sum_{r,s\in\mathbb{N}} B_{rs}\left(\kappa_{rs}Q_r^\beta\right)^{-\epsilon} y_s^\epsilon}, \tag{4}$$

where L_{ij} is the corresponding measure of commuting workers. Equation 4 defines a gravity equation of commuting where the probability of commuting from i to j depends not only on the characteristics of residence i and workplace j ("bilateral resistance"), but also on the characteristics of all the other possible paired locations ("multilateral resistance").

The marginal distributions λ_i^R and λ_j^L determine respectively the residential population living in location i ($L_i^R = \sum_{j\in\mathbb{N}} L_{ij}$) and the labor supply to local labor market j ($L_j = \sum_{i\in\mathbb{N}} L_{ij}$):

$$\lambda_i^R = \sum_{j\in\mathbb{N}} \lambda_{ij} = \frac{L_i^R}{\overline{L}}, \tag{5}$$

$$\lambda_j^L = \sum_{i\in\mathbb{N}} \lambda_{ij} = \frac{L_j}{\overline{L}}. \tag{6}$$

For convenience, it is worth defining here also the conditional commuting probabilities given the location of residence:

$$\lambda_{ij|i}^R = \frac{\lambda_{ij}}{\lambda_i^R} = \frac{B_{ij}\left(\kappa_{ij}\right)^{-\epsilon} y_j^\epsilon}{\sum_{s\in\mathbb{N}} B_{is}\left(\kappa_{rs}\right)^{-\epsilon} y_s^\epsilon} = \frac{L_{ij}}{L_i^R}. \tag{7}$$

Finally, the expected utility conditional on having chosen the optimal residence-workplace

[26] This modelling approach is common in the literature. See for example Ahlfeldt et al. (2015), Monte et al. (2018), Heblich et al. (2020), and Severen (2021).

pair is equalized across all pairs of locations:

$$\mathbb{E}\Big[\max_{ij} V_{ij}(\omega)\Big] = \Gamma\left(\frac{\epsilon-1}{\epsilon}\right)\left[\sum_{r,s\in\mathbb{N}} B_{rs}\left(\kappa_{rs}Q_r^{\beta}\right)^{-\epsilon} y_{rs}^{\epsilon}\right]^{\frac{1}{\epsilon}} = \overline{V}, \tag{8}$$

where the expectation is taken over all possible values of the maximum of the indirect utility, which is also Fréchet distributed (see Appendix), $\Gamma(.)$ is the gamma function, and $\overline{V}$ is a scalar representing the reservation utility outside the current economy. The equality $\mathbb{E}\Big[\max_{ij} V_{ij}(\omega)\Big] = \overline{V}$ implies a free mobility condition according to which workers are indifferent in expectation between living within or outside the current economy.[27]

3.3 Labor Market Equilibrium

We assume that each local labor market is subject to a workplace-specific wage constraint such that $w_j \geq \underline{w}_j$. Heterogeneity in the wage constraint could arise, for example, due to differences in local sectoral composition and the existence of sector-specific wage constraints, as suggested in Subsection 2.2.1. Notice that, since we do not model job type heterogeneity, this assumption is necessary in this class of models to rationalize both the existence of unemployment and the observed wage dispersion across locations.[28] However, in practice, this assumption will not affect our quantitative exercise when we will solve for counterfactuals in Section 4 below.

A binding wage constraint would determine a positive unemployment rate in the local labor market (u_j^W), whereas a slack constraint would allow the market to achieve full employment. In either case, employment (E_j) is determined by the labor demand in equation 2. Given the local labor supply (L_j) in equation 6, the equilibrium in the local labor market is characterized by the complementary slackness condition:

$$\begin{aligned} &E_j = (1-u_j^W)L_j \\ &u_j^W(w_j - \underline{w}_j) = 0 \\ &u_j^W \geq 0, \quad w_j \geq \underline{w}_j, \end{aligned} \tag{9}$$

where u_j^W denotes the unemployment rate in labor market j, that is, the unemployment probability faced by all workers participating to the market. Notice that, while the local

[27]The economy can be thought of being nested within a wider global economy. In such a setting, the total size of the population ($\overline{L}$) would be endogenously determined by the international migration flows between the current and the global economy such that the expected utility is equalized.

[28]If the wage constraints were identical, then workers employed in constrained local labor markets would receive all the same wage. Notice that, even extending the model with worker heterogeneity by skill type, the issue would still arise, in this case conditionally on the skill type. A viable but more elaborated approach is proposed by Ahlfeldt et al. (2023), who model both the firm productivity distribution in each location and workers' preferences for individual firms, thus allowing for the co-existence of constrained and unconstrained firms in the same local labor market.

unemployment rate reported in the official statistics measures the unemployed fraction of the active population residing in a given location, u_j^W is determined by the excess labor supply in a particular labor market. Under the assumption that each worker can participate to one local labor market only, we can define the residential unemployment rate (u_i^R) such that the number of unemployed resident in a given location corresponds to the sum of all commuters who are unemployed in their labor market of choice:

$$u_i^R L_i^R = \sum_{j \in \mathbb{N}} L_{ij} u_j^W, \tag{10}$$

which can be rewritten as a weighted average of the workplace unemployment rate (u_j^W), using the conditional commuting probabilities ($\lambda_{ij|i}^R$) as weights:

$$u_i^R = \sum_{j \in \mathbb{N}} \frac{L_{ij}}{L_i^R} u_j = \sum_{j \in \mathbb{N}} \lambda_{ij|i}^R u_j^W. \tag{11}$$

In Section 4 we make use of equation 11 to recover the unobservable workplace unemployment rate (u_j^W) given data on the commuting matrix (E_{ij}) and the residential unemployment rate (u_i^R).

Finally, given the residential unemployment rate (u_i^R) and the number of residents (L_i^R), the total number of employed workers residing in location i can be calculated from:

$$E_i^R = (1 - u_i^R) L_i^R. \tag{12}$$

3.4 Housing Market Clearing

Each residential location i is populated by a measure L_i^R of workers determined in equation 5. Resident workers generate total residential income ($v_i L_i^R$) composed of labor income and unemployment benefits:

$$v_i L_i^R = \sum_{j \in \mathbb{N}} w_j (1 - u_j^W) L_{ij} + \sum_{j \in \mathbb{N}} \zeta u_j^W L_{ij} = \sum_{j \in \mathbb{N}} y_j L_{ij}, \tag{13}$$

where y_j is the expected labor income. For convenience, we can define here the following quantities of interest:

$$v_i = \sum_{j \in \mathbb{N}} \frac{L_{ij}}{L_i^R} y_j = \sum_{j \in \mathbb{N}} \lambda_{ij|i}^R y_j, \tag{14}$$

$$v_i^E = \sum_{j \in \mathbb{N}} \frac{E_{ij}}{E_i^R} w_j = \sum_{j \in \mathbb{N}} \frac{(1 - u_j^W)}{(1 - u_i^R)} \lambda_{ij|i}^R w_j, \tag{15}$$

corresponding respectively to income per resident (v_i), that is, inclusive of both employed and unemployed workers, and labor income per employed resident (v_j^E), where E_{ij} denotes the number of commuters who are employed in workplace j, that is, $E_{ij} = (1 - u_j^W) L_{ij}$.

All workers allocate a fraction β of their income to housing expenditure, while the remaining is spent on final good consumption. Housing is supplied by an absentee landlord according to:[29]

$$H_i = \underline{H}_i Q_i^{\gamma}, \tag{16}$$

where γ is the elasticity of housing supply and $\underline{H}_i$ is an exogenous component allowed to vary across locations. Given total residential income $(v_i L_i^R)$ and the housing supply, the housing market clearing condition is:

$$Q_i H_i = \beta v_i L_i^R, \tag{17}$$

which determines the equilibrium housing price:

$$Q_i = \left(\frac{\beta v_i L_i^R}{\underline{H}_i}\right)^{\frac{1}{1+\gamma}}. \tag{18}$$

3.5 General Equilibrium

Given parameters $\{\alpha, \beta, \epsilon, \zeta, \gamma\}$, an exogenous population of workers $\overline{L}$, and exogenous location characteristics $\{A_j, B_{ij}, \kappa_{ij}, \underline{w}_j, H_i\}_{j,i\in\mathbb{N}}$, the general equilibrium of the economy can be referenced by a vector of prices $\{w_j, Q_i\}_{i,j\in\mathbb{N}}$, a vector of allocations $\{\lambda_{ij}, u_j^W\}_{i,j\in\mathbb{N}}$, and a scalar $\overline{V}$ such that: firms choose employment (equation 2), workers choose where to live and work (equations 4, 5, 6), the complementarity slackness condition is satisfied in all local labor markets (equation 9), the housing markets clear (equations 13, 16, 17), and the free mobility condition is satisfied (equation 8).

4 Quantitative Analysis

In this section we assess the quantitative effects of eliminating wage rigidities from the economy. First, we describe how we compute the counterfactuals when the wage constraints are removed, or equivalently, when unemployment is set to zero everywhere. Second, we take the model to the data, by showing how to recover the unemployment rate at the workplace (unobservable) from the residential unemployment rate (observable) given knowledge of the commuting matrix. Third, we simulate the model and investigate the effects both at the local level (i.e., by municipality) and at the aggregate level (i.e., by region and nationwide) under alternative labor mobility scenarios. We discuss the robustness of the results to other calibrations in the Appendix.

[29] Here we follow the approach in Hsieh and Moretti (2019). Alternatively, we could have assumed that housing is supplied by an immobile local landlord who consumes the entirety of her income on the consumption good, as in Monte et al. (2018).

4.1 Computing Counterfactuals

In the theoretical framework presented in Section 3, unemployment originates uniquely from the existence of the wage constraints. Thus, to answer our quantitative question, we could simulate the model by setting $u_j^W = 0$ in all labor markets. In our model this outcome would be achieved if all wages were set according to a free market clearing condition. Note that, since we are overstating the importance of wage rigidities in determining unemployment, our results should be interpreted as an upper bound on the potential effects of removing such constraints.

We simulate the model using the "exact hat algebra" approach following Dekle et al. (2007), as is typical in the literature of quantitative international trade and spatial economics. Let $x_{(0)}$ and $x_{(1)}$ be respectively the initial and the counterfactual values of variable x. Then the ratio change can be defined as $\hat{x} = x_{(1)}/x_{(0)}$. In the analysis that follows we solve directly for these changes instead of their corresponding levels.

We start by expressing the market-clearing prices in hat algebra form. From equations 2 and 18 we get:

$$\hat{w}_j = \hat{E}_j^{\alpha-1}, \tag{19}$$

$$\hat{Q}_i = \left(\hat{v}_i \hat{L}_i^R\right)^{\frac{1}{1+\gamma}}. \tag{20}$$

The change in employment ($\hat{E}_j$) is in turn defined by the change in labor supply ($\hat{L}_j$) and the change in the employment rate $(\widehat{1-u_j^W})$, obtained by combining equations 9 and 6:

$$\hat{E}_j = (\widehat{1-u_j^W})\hat{L}_j = \frac{1}{1-u_{j(0)}^W} \sum_{i \in \mathbb{N}} \hat{\lambda}_{ij} \lambda_{ij|j(0)}^L, \tag{21}$$

where the change in the employment rate is $(\widehat{1-u_j^W}) = (1-u_{j(1)}^W)/(1-u_{j(0)}^W) = 1/(1-u_{j(0)}^W)$ given that in the counterfactuals unemployment is set to zero everywhere ($u_{j(1)}^W = 0$), and $\lambda_{ij|j(0)}^L = \lambda_{ij(0)}/\lambda_{j(0)}^L$ is the initial share of workers in market j commuting from residential location i.

Similarly, the change in total residential income ($\hat{v}_i \hat{L}_i^R$) is obtained from equation 13:

$$\hat{v}_i \hat{L}_i^R = \sum_{j \in \mathbb{N}} \hat{y}_j \hat{\lambda}_{ij} \frac{y_{j(0)} L_{ij(0)}}{v_{i(0)} L_{i(0)}^R} = \sum_{j \in \mathbb{N}} \hat{y}_j \hat{\lambda}_{ij} \frac{y_{j(0)}}{v_{i(0)} \lambda_{ij|i(0)}^R}, \tag{22}$$

where $y_{j(0)} L_{ij(0)}/v_{i(0)} L_{i(0)}^R$ is the initial share of residential income earned by workers commuting to market j, and the change in expected income is:

$$\hat{y}_j = (\widehat{1-u_j^W})\hat{w}_j \frac{(1-u_{j(0)}^W) w_{j(0)}}{y_{j(0)}} + \hat{u}_j^W \frac{u_{j(0)}^W \zeta}{y_{j(0)}} = \hat{w}_j \frac{w_{j(0)}}{y_{j(0)}}, \tag{23}$$

where we simplified using $\hat{u}_j^W = u_{j(1)}^W / u_{j(0)}^W = 0/u_{j(0)}^W = 0$.[30] We point out here that since expected income is at most equal to the wage ($y_j \leq w_j$), the *ratio change* in expected income will be higher than that of the wage ($\hat{y}_j \geq \hat{w}_j$). This may yield unexpected results in terms of *percentage changes*: if the effect of the drop in the unemployment risk is sufficiently large, expected income may actually increase even when the wage decreases. Specifically, this occurs if $\hat{w}_j > y_{j(0)}/w_{j(0)} = 1 - u_{j(0)}^W(1 - \frac{\zeta}{w_{j(0)}})$, which could be the case if unemployment benefits were particularly low or the initial unemployment probability particularly high.

Finally, both the changes in employment and total residential income depend on the change in the joint residence-workplace probability distribution, which can be usefully decomposed into $\hat{\lambda}_{ij} = \hat{\lambda}_{ij|i}^R \hat{\lambda}_i^R$. To assess the importance of labor mobility, we perform the simulations under three scenarios:

Scenario 1: Exogenous Mobility – Workers cannot adjust their residence and workplace choices:

$$\hat{\lambda}_{ij} = 1. \tag{24}$$

Note that in this scenario, although individuals cannot adapt, they are nonetheless commuting according to the choices they made in the initial equilibrium. Notice also that this scenario corresponds to the case in which $\epsilon = 0$.

Scenario 2: Commuting, No Migration – Workers can adjust their workplace choices but cannot migrate ($\hat{\lambda}_i^R = 1$):

$$\hat{\lambda}_{ij} = \hat{\lambda}_{ij|i}^R = \frac{\hat{y}_j^\epsilon}{\sum_{s \in \mathbb{N}} \hat{y}_s^\epsilon \lambda_{ij|i(0)}^R}, \tag{25}$$

where we hold constant both amenities ($\hat{B}_{ij} = 1$) and commuting costs ($\hat{\kappa}_{ij} = 1$). Although amenities and commuting costs do not change between equilibria, workers nevertheless take them into consideration when adjusting their choices, as captured by the initial conditional commuting probabilities ($\lambda_{ij|i(0)}^R$) at denominator. This scenario could be interpreted as a short-term adjustment, for example, if migration entails relocation costs (not included in our model). Moreover, given the relatively immobility of workers documented in Section 2.4, this scenario constitutes a better approximation to the data than one in which workers are assumed to be freely mobile.

[30]Note that in principle the wage could drop below the level of unemployment benefits (ζ), which are assumed to be constant ($\hat{\zeta} = 1$). The model could be extended to allow unemployment benefits to vary in response to the general change in wages ($\hat{\zeta} \neq 1$), nevertheless this would not affect the counterfactual, since in equation 23 $\hat{\zeta}$ would multiply $\hat{u}_j^W$ and disappear. In practice, in the simulations below, the decrease in wages is never large enough to fall below the level of benefits, even at the lowest initial wage.

Scenario 3: Commuting and Migration – Workers can adjust both their residence and workplace choices:

$$\hat{\lambda}_{ij} = \frac{\hat{y}_j^{\epsilon}\hat{Q}_i^{-\beta\epsilon}}{\sum_{r,s\in\mathbb{N}}\hat{y}_s^{\epsilon}\hat{Q}_r^{-\beta\epsilon}\lambda_{ij(0)}}, \tag{26}$$

where as in Scenario 2 both amenities and commuting costs are held constant at their initial values. In this last scenario, since we are not imposing language barriers or any other migration cost, workers are free to relocate anywhere within the country. Thus, this can be interpreted as a best-case or long-run scenario in which there are no migration frictions. Nevertheless, notice that workers still face bilateral amenities and commuting costs when choosing where to work conditional on residence.

Equations 19 to 26 allow us to solve for the changes between equilibria when the wage constraints are removed given parameters $\{\alpha, \beta, \epsilon, \gamma\}$ and initial values $\{u^W_{j(0)}, \lambda_{ij(0)}, y_{j(0)}, v_{i(0)}\}_{j,i\in\mathbb{N}}$.

4.2 Measurement

The model in hat algebra form can be quantified given knowledge of the parameters and the initial values of few variables, thus avoiding the calibration of a large set of exogenous location characteristics.[31] Here we define the baseline calibration of the parameters, whereas we discuss the sensitivity of the results to alternative calibrations in the Appendix. The labor income share is calculated from the National Accounts, and it is set to $\alpha = 0.68$. The housing expenditure share is calculated as the ratio of housing expenditure to final household consumption using aggregate data from the National Accounts, and it is set to $\beta = 0.23$. The price elasticity of the housing supply is taken directly from Caldera and Johansson (2013), and it is set to $\gamma = 0.30$. The last parameter, the elasticity of commuting to real expected income, is set to $\epsilon = 6$, in between the estimates of Ahlfeldt et al. (2023) and Ahlfeldt et al. (2015), who work with a spatial resolution similar to ours.[32] Since this value is in the upper range of the estimates observed in the literature, the importance of labor mobility might be overemphasized. Nevertheless, our first counterfactual scenario coincides with the case in which $\epsilon = 0$, thus providing a lower bound to the range of the possible effects. In the following we explain how to recover

[31] This approach implicitly assumes that the economy, as observed in the data, is in equilibrium. Thus, for example, the initial distribution $\lambda_{ij(0)}$ becomes a sufficient statistic for the initial level of amenities (B_{ij}) and commuting costs (κ_{ij}).

[32] Ahlfeldt et al. (2023) use a value of $\epsilon = 5.5$ for 2015 German municipalities, while Ahlfeldt et al. (2015) set it to 6.8 for 1986 Berlin city districts. Other estimates are provided by Monte et al. (2018) (3.3 for US Commuting Zones), Heblich et al. (2020) (5.25 for locations within 19th century Greater London), and Severen (2021) (2.13 for census tracts in Los Angeles). Hsieh and Moretti (2019) set an analogous migration elasticity equal to 3.3 across US Metropolitan State Areas, which, according to the authors, implies a high degree of labor mobility over a 45-year time horizon.

model-consistent initial values for the unemployment probability (u_j^W), the commuting probabilities (λ_{ij}), expected income (y_j), and average income per resident (v_i).

4.2.1 Recovering Unemployment Probabilities

Official statistics report the unemployment rate measured as the fraction of unemployed workers residing in a particular location, that is, u_i^R in the model's notation. On the other hand, u_j^W measures the unemployment rate at workplace, which is not directly observable. To recover the unemployment probability we can invert the linear system defined in equation 10, which constitutes a mapping from u_j^W to u_i^R given commuting flows L_{ij}. Note that in the model L_{ij} includes both employed and unemployed workers, whereas the observable commuting matrix includes only employed workers. Given that $L_i^R = \frac{E_i^R}{1-u_i^R}$ and $L_{ij} = \frac{E_{ij}}{1-u_j^W}$ we can rewrite equation 10 as:

$$\frac{u_i^R}{1-u_i^R} = \sum_{j \in \mathbb{N}} \frac{E_{ij}}{E_i^R} \frac{u_j^W}{1-u_j^W}, \tag{27}$$

which defines a linear system that can be solved for $\frac{u_j^W}{1-u_j^W}$, and where E_{ij} are the entries of the commuting matrix.[33]

Although the solution to the system is bound to be lower than one, it may still be negative. Thus, we solve the system via least squares imposing non-negativity constraints, obtaining a zero unemployment rate in 247 out of 581 municipalities.[34] The fit is reasonably good: the R^2 between predicted and observed values is 96.6% for the log number of unemployed and 89.5% for the residential unemployment rate.

Figure 4 displays the results. Panel A shows the map of the predicted residential unemployment rate (u_i^R), which, reassuringly, is similar to that presented previously in Figure 1. Panel B shows instead the map of the predicted unemployment probability (u_j^W), which highlights the municipalities with zero probability in white. In particular, these municipalities are scattered around locations with a high unemployment probability, which in the data correspond to large municipalities with a high unemployment rate (u_i^R). Finally, we point out the range of the unemployment probability, which can reach values as high as 48%.

Given the recovered unemployment probabilities (u_j^W) and the observable commuting matrix (E_{ij}) we construct our model-implied measure of commuting flows as $L_{ij} = E_{ij}/(1-u_j^W)$, from which we can calculate the commuting probabilities λ_{ij}.

[33] Since in our analysis we consider a closed economy, we remove from the commuting matrix all the cross-border commuters (about 2% of the total count).

[34] The exact solution of the linear system yields negative unemployment probabilities in 297 out of 581 municipalities.

(A) Unemployment Rate u_i^R (B) Unemployment Prob. u_j^W

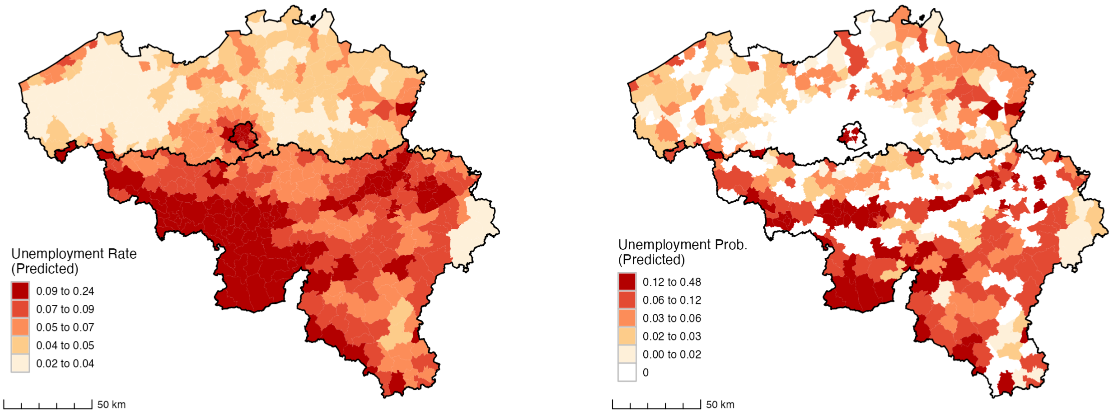

Figure 4: Predicted Unemployment

Note: Panel A: Predicted residential unemployment rate (u_i^R). Panel B: Predicted unemployment probability (u_j^W). Maps colored by quintiles. Details in the main text.

4.2.2 Recovering Wages

To recover expected income (y_j) we need a measure of wages (w_j) at the municipality level. The geographical coverage of the SES data at the municipality level is limited, moreover it does not account for public employees and self-employed workers, which are instead included in the commuting matrix. Therefore, we adopt a similar procedure as done for the unemployment probabilities, and we invert the linear system defined by equation 15 given the commuting matrix (E_{ij}) and data on average labor income (v_i^E). As before, we solve the system via least squares imposing lower and upper bounds, which are set respectively equal to the 5th and 95th percentiles of the gross earnings observed in the SES data. In particular, the lower bound ensures that the resulting wages are above the national average unemployment benefit (ζ), which we set at €870 per month as reported by the Office National de l'Emploi (2012), or approximately 56% of the lower bound.[35] The fit is almost perfect with an R^2 of 98.8% between observed and predicted labor income (v_i^E).

Finally, given the unemployment probability (u_j^W), the wage (w_j), and the average unemployment benefit (ζ), we can calculate the expected income (y_j) in each labor market, and, given the constructed commuting probabilities (λ_{ij}), we can use equation 14 to calculate the average income per resident (v_i).

[35]On a yearly basis the average unemployment benefit is approximately €10,440, while the wage lower and upper bounds are set respectively to €18,600 and €72,400. In comparison, average labor income ranges from about €20,100 to €45,100, whereas the exact solution to the linear system yields values below the average unemployment benefit in 36 out of 581 municipalities and above the upper bound in 8 cases, up to about €90,600.

4.3 Counterfactuals

4.3.1 Local Effects

We begin the quantitative analysis by exploring the effect of eliminating unemployment across municipalities. In Figure 5 we plot the percentage change of several outcome variables against the initial unemployment rate by workplace ($u^W_{j(0)}$) in Column A and by residence ($u^R_{i(0)}$) in Column B. The solid black line represents the benchmark scenario in which workers are not allowed to adjust their choices, whereas the dashed blue and red lines represent respectively the cases in which workers can change only their workplace or both workplace and residence.

Starting from the top left panel in Column A, the solid black line displays the increase in local employment before mobility adjustments, therefore representing the direct effect of the shock. Differences across scenarios emerge as the size of the shock increases. In particular, when workers are allowed to change their workplaces, they choose to relocate to labor markets with a higher initial unemployment probability, thus increasing employment in these locations further. This adjustment is dictated by the change in wages and expected income, shown respectively in the middle and bottom left panels of Figure 5. Since the labor demand is not perfectly elastic, the increase in employment is accompanied by a decrease in wages, however, because the unemployment probability also drops to zero, the effect on expected income is more than compensated. Thus, even if labor markets with higher initial unemployment experience large decreases in wages, more workers are willing to relocate there because of the positive effect on expected income, which in turn only reinforces the drop in wages via the labor demand channel. As a consequence, when workers change workplace from low to high initial unemployment locations, the change in expected income exhibits less variation across labor markets compared to the scenario without adjustments. In other words, workplace adjustments equalize the impact of the shock on expected income across local labor markets.

We point out that, across all panels in Column A, there is no notable difference in the effects on local labor market outcomes once workers can adjust their workplace, whether they are allowed to change their residence or not. More pronounced differences across scenarios can be noticed instead in Column B, when looking at outcomes by municipality of residence.

The top right panel displays the change in residential population, clearly only for the third scenario. Similarly to the previous discussion on changes of workplace, workers would migrate from low to high initial unemployment rate municipalities. Here we emphasize the magnitude of the effect, which ranges between -1% and 3%. The migratory response is weak compared to the raw data shown in Table 2, despite the high value assigned to ϵ. This stems partially from the modest change in expected income, which is less than 1.5% on average.

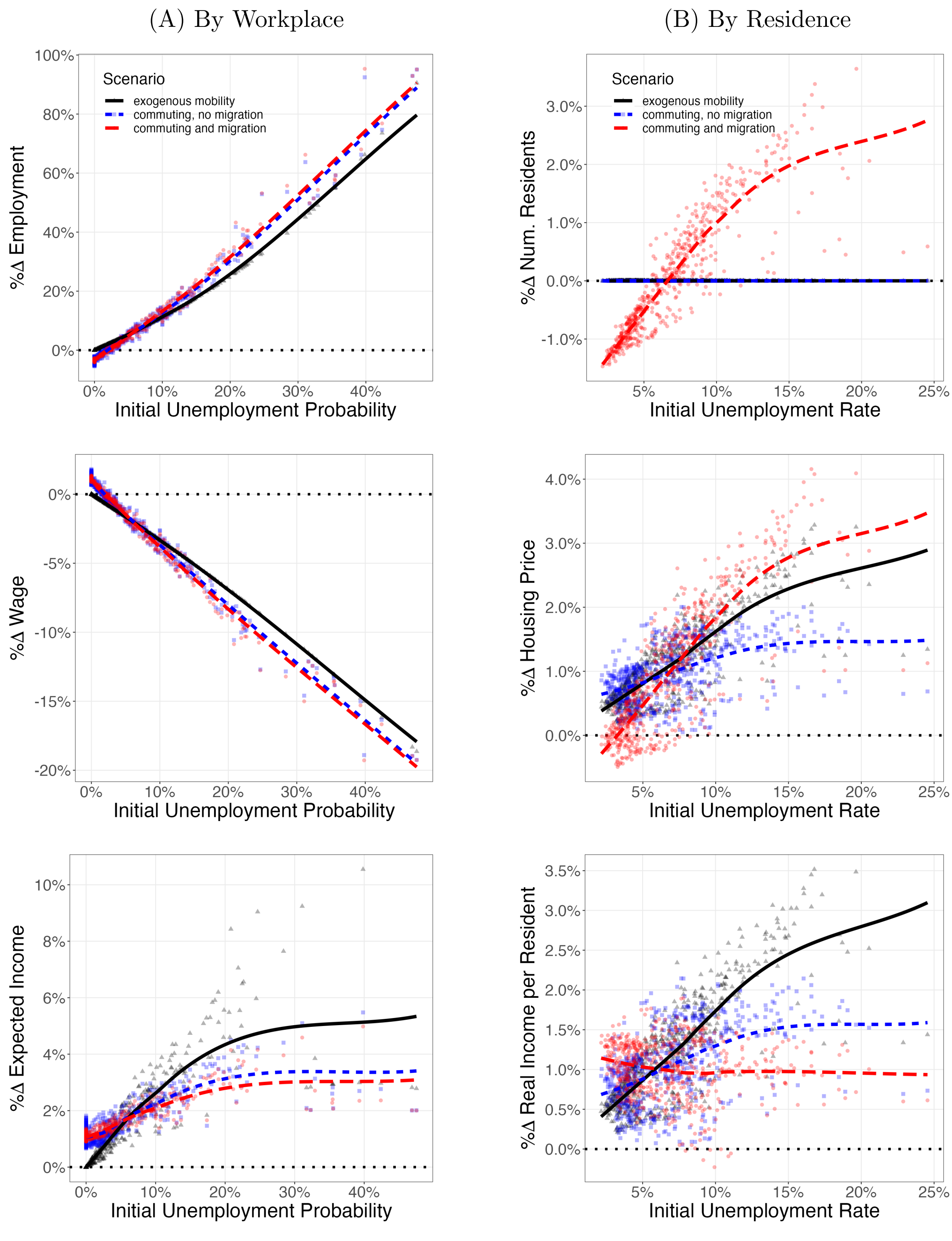

Figure 5: Local Effects

Note: The figure shows the effect of eliminating unemployment across municipalities. Column A: effects by workplace, initial unemployment probability ($u^W_{j(0)}$) on the horizontal axis. Column B: effects by residence, initial residential unemployment rate ($u^R_{i(0)}$) on the horizontal axis. The counterfactual scenarios are: Exogenous Mobility (black solid line): workers cannot change their residence and workplace choices. Commuting, No Migration (blue dashed line): workers can change their workplace choices but cannot migrate. Commuting and Migration (red dashed line): workers can change both their residence and workplace choices. Fitting lines are obtained by local regression.

The effect on local housing prices is shown in the right middle panel of Figure 5. In the benchmark scenario workers are not allowed to change their location choices, hence the positive effect on housing prices is entirely due to the increase in nominal income per resident (equation 20), which in turn is determined by the change in expected income. This is shown in the figure, where the solid black line for housing prices tracks that for expected income (in the bottom left panel). In this case housing prices increase by about 0.5% at the lowest and 3% at the highest. When workers are instead allowed to change only their workplace, the increase in expected income in high initial unemployment locations is smaller, and similarly for nominal income per resident. Consequently, the effect on housing prices is more uniform across residential locations than in the benchmark scenario. If in addition workers are allowed to change residence, then housing prices respond also to changes in the residential population. In this case the dashed red line for housing prices tracks almost perfectly the migratory response in the top right panel, accentuating the variability of effects across municipalities compared to the benchmark scenario.

Lastly, the bottom right panel displays the effect on real income per resident, which is a proxy for the welfare of the average resident. In the first two scenarios, when workers cannot adjust their choices of residence, the change in real income per resident is similar to that in housing prices. Intuitively, this is due to the fact that both the change in housing prices and real income per resident are mostly driven by the change in nominal income per resident.[36] However, since in this scenario the change in housing prices is always lower than the change in nominal income, the effect on real income is positive. Finally in the third scenario, as workers migrate to locations with a higher initial unemployment rate, the ensuing increase in housing prices erodes most of the real gains stemming from higher nominal income per resident. Similarly to the equalizing effect of workplace adjustments on expected income (bottom left panel), residence adjustments equalize the effect on real income per resident across locations. Thus, while in the benchmark scenario the effect on real income ranges from 0.5% to 3%, the increase in real income in the full mobility scenario is about 1% across all municipalities.

Summing up, the importance of labor mobility depends on whether we examine outcomes by location of workplace or residence. By workplace, commuting proves to be a sufficient insurance mechanism against shocks to nominal income, making migration redundant.[37] However, when we account for the general equilibrium effects passing through the housing market, migration becomes an important mechanism for workers to benefit

[36]This can be seen from equation 20 by setting $\hat{L}_i^R = 1$ and rewriting $\hat{Q}_i = (\hat{v}_i^R)^{\frac{1}{1+\gamma}} \leq \hat{v}_i^R$ and $\hat{v}_i^R / \hat{Q}_i^\beta = (\hat{v}_i^R)^{\frac{1+\gamma-\beta}{1+\gamma}} \leq \hat{v}_i^R$.

[37]Typically insurance is intended to protect agents against adverse shocks. Here the shock generates an increase in expected income, however this is not always the case. We refer the reader to Section 5.1 below for the opposite case.

from the higher increase in real income occurring in other locations. Finally, the degree of labor mobility also determines the main beneficiaries of the elimination of wage rigidities and unemployment. Without adjustments, the largest positive effects on real income per resident occur in the most disadvantaged locations, that is, those with higher initial unemployment. However, when workers can adjust their location choices, these larger gains are completely dissipated by the new inflow of workers from locations with lower initial unemployment. In other words, the residents of locations with higher initial unemployment would be better off if workers were not able to adjust their location choices.

4.3.2 Aggregate Effects

The previous section has revealed how local effects depends on the initial level of unemployment by municipality. As shown in Figure 1, unemployment is highly clustered by region, hence we would expect pronounced differences in the aggregate effects as well. Table 3 presents the average effects by region in the first three columns and at the national level in the last.

Starting from the top, the first panel shows the change in the resident population, which is held constant in the first two scenarios. When migration is allowed, the model predicts an outflow of workers from Flanders to the other two regions. This is the result of the higher initial concentration of unemployment in Brussels and Wallonia (Figure 1B), and the fact that locations with higher initial unemployment become relatively more attractive after the shock, as shown in the top right panel of Figure 5. Nevertheless, the magnitude of these inter-regional movements is small, around 1%.

The next two panels show the effect on employment measured respectively at the region of residence and of workplace, where the difference between the two is dictated by commuting and migration. The largest effect would occur in Brussels, with an increase in the number of employed residents by about 17%, whereas the effect in Wallonia and Flanders would be lower, about 12% and 5% respectively. In comparison, workplace employment in Brussels would increase by about 20%, as the city would attract a significant number of commuters from Flanders. The average wage would instead drop by 8% in Brussels and 5% in Wallonia, whereas in Flanders it would decrease by less than 1.5%. Combining the decrease in wages and the increase in residential employment, the net impact on aggregate labor income would be positive, by about 7% in Brussels, 6% in Wallonia, and 2.5% in Flanders.

The last two panels show the effect on average housing prices and real income per resident. The increase in housing prices would be larger in Wallonia, about 1.5% across scenarios, due to the combined strong employment effect and the modest drop in wages. On the contrary, in Flanders housing prices would increase by less than 1% in the exogenous mobility scenario, while dropping to about 0.2% in the case with full mobility, as some workers would migrate to the other two regions. The effect on housing prices in Brussels would also depend on the mobility scenario: in the first, housing prices would increase the most by 1.2%, due to restoring full employment from a high initial level of unemployment; in the second, as more workers would commute to Brussels, the drop in the wages of residents would lower the impact on housing prices to 0.6%; and in the third, due to the migration of workers from Flanders, the effect would increase again to about 1%. Similarly, the effects on real income per resident would be modest. As discussed before in the context of Figure 5, the largest real income effects would occur in the locations with highest initial unemployment, when workers are not allowed to change their location choices. Here, Wallonia and Brussels would experience respectively an increase by 1.9% and 1.3% in real income, compared to 0.8% in Flanders. Instead, when migration is allowed, the increase in housing prices in Wallonia and Brussels would attenuate the real income effect to 1% and 0.6%, while the lower increase in housing prices in Flanders would mildly raise the effect to about 1 percentage point on average.

In the fifth column of Table 3 we display the effects at the national level. While population is assumed to be constant, the employment rate would increase by 8%, the average wage would drop by 4%, and aggregate labor income per capita would increase by 4%.[38] To put our results in perspective, we can compare with those in Boeri et al. (2021). Assuming that wages fully reflected local productivity, the authors find that in Italy the employment rate would increase by 12%, the average wage would drop by 4%, and aggregate labor income per capita would increase by 6%. Although our quantitative approach is substantially different and notwithstanding the different economy under study, the results are remarkably similar in magnitude. In particular, the aggregate elasticities are almost identical: we find that the wage and labor income elasticities to employment are $0.04/0.08 = 0.50$ in absolute value, compared to $0.04/0.12 = 0.33$ and $0.06/0.12 = 0.50$ in Boeri et al. (2021). We find, though, a smaller effect on employment. This could partially stem from the use of a different measure of misallocation: while we focus on the unemployment rate and hold the total labor force constant, Boeri et al. (2021) use the non-employment rate, which includes both unemployed and inactive workers. Indeed, had we added a labor force participation margin in our analysis, the increase in expected income would have pushed some inactive workers into the labor force, thus increasing employment further. However, the additional inflow of workers would have also accentuated the negative effect on wages, hence the net effect is a priori ambiguous.

Finally, our framework allows us to assess the average effect on welfare, as measured by

[38]Since at the national level the total population is held constant, the percentage change in the employment rate is equivalent to that in employment, while the percentage change in per capita and aggregate labor income are the same.

Table 3: Aggregate Effects

	Brussels	Flanders	Wallonia	Belgium
%Δ *Num. Residents*				
Exogenous mobility	0.00	0.00	0.00	0.00
Commuting, no migration	0.00	0.00	0.00	0.00
Commuting and migration	0.47	-0.66	1.18	0.00
%Δ *Num. Employed Residents*				
Exogenous mobility	16.59	5.10	11.65	7.99
Commuting, no migration	16.59	5.10	11.65	7.99
Commuting and migration	17.14	4.40	12.96	7.99
%Δ *Employment*				
Exogenous mobility	19.29	3.47	11.11	7.99
Commuting, no migration	20.18	2.80	12.05	7.99
Commuting and migration	20.26	2.35	12.99	7.99
%Δ *Average Wage*				
Exogenous mobility	-8.21	-1.40	-4.34	-3.52
Commuting, no migration	-8.78	-1.34	-4.94	-3.78
Commuting and migration	-8.79	-1.20	-5.21	-3.79
%Δ *Aggregate Labor Income*				
Exogenous mobility	7.55	2.72	6.41	4.19
Commuting, no migration	6.78	2.65	5.80	3.91
Commuting and migration	7.25	2.11	6.77	3.89
%Δ *Average Housing Price*				
Exogenous mobility	1.21	0.72	1.66	1.00
Commuting, no migration	0.64	0.67	1.26	0.81
Commuting and migration	1.03	0.26	1.73	0.61
%Δ *Real Income per Resident*				
Exogenous mobility	1.28	0.79	1.90	1.17
Commuting, no migration	0.68	0.73	1.41	0.94
Commuting and migration	0.57	0.97	1.01	0.95

Note: The table presents the aggregate effects of eliminating unemployment. The counterfactual scenarios are: Exogenous Mobility: workers cannot change their residence and workplace choices; Commuting, No Migration: workers can change their workplace choices but cannot migrate; Commuting and Migration: workers can change both their residence and workplace choices. The average wage is calculated by weighting by employment. Aggregate labor income is the sum of the wages earned by employed residents. The average housing price is calculated by weighting by the number of residents. Real income per resident is calculated as the weighted average of the real income earned by each resident, whether employed or unemployed in the initial equilibrium, and using the number of residents as weights.

real income per capita: were wages free to clear the labor markets, welfare would increase by about 1 percentage point. Given the large size of the shock, the welfare effect is small, with an elasticity to employment of $0.01/0.08 = 0.125$. While part of this small effect is explained by the increase in housing prices, most of it is due to the limited increase in expected income, as shown in Figure 5. The effect on expected income is influenced by the generosity of unemployment insurance, which if too high, could limit the gains of eliminating the risk of unemployment. Moreover, we have also abstracted from how unemployment insurance is financed, and the potential positive effect of reducing social security contributions when unemployment is eliminated. We expand further on these policy considerations in Section 5.

5 Policy Considerations

5.1 The Generosity of Unemployment Insurance

In Section 4.1 we have pointed out that the sign of the percentage change in expected income depends on the level of unemployment benefits (ζ). When benefits are low, the elimination of the unemployment risk dominates the wage drop, hence causing expected income to increase. On the contrary, when benefits are high, the wage drop may be large enough to cause expected income to fall. Despite Belgium being one of the countries with the most generous unemployment insurance (OECD, 2023b), in the main analysis we have found that the average unemployment allowance of €870 per month, corresponding to 56% of the lower bound of the recovered wage distribution, is sufficiently low to trigger an increase in expected income even when wages decrease substantially. Therefore, we can safely anticipate that, had benefits been lower, for example in the context of a different country, we would have obtained similar results. However, with higher benefits, the impact on local labor markets could have been markedly different. In addition, even if the results with lower benefits were comparable, the magnitude of the effects could be more pronounced. These considerations motivate us to first investigate how local labor markets behave with higher unemployment benefits, and, second, to assess whether the welfare effects would had been significantly stronger if benefits had been set to a lower value.

We start by replicating the analysis with a higher value of unemployment benefits set to €1,400 per month, approximately equivalent to the maximum amount available in Belgium in 2012 (Nevejan and Van Camp, 2013), or about 90% and 62% of the lowest and median recovered wages respectively. We first re-calculate the initial value of expected income and income per resident given the new benefit amount, and then simulate again the counterfactuals. Given the differences with the main analysis, we provide the results for the local effects here in Figure 6, while the corresponding aggregate effects are reported in Table C.1 in the Appendix.

With a higher level of unemployment benefits the effect on expected income would indeed be negative, and even more so in labor markets with a higher initial unemployment probability (bottom left panel of Figure 6). This negative effect causes workers to adjust their workplace location choices in favour of less affected labor markets, hence attenuating the impact on both employment and wages (top and middle left panels). As in the main analysis (Figure 5), the effect on outcome variables measured at the workplace (Column A) is almost identical between the scenarios with and without migration, whereas differences emerge across residential locations (Column B). In the benchmark scenario, when workers are not allowed to change their location choices, housing prices drop as a consequence of the negative effect on expected income (black solid line in the middle right panel). Instead, if workers were allowed to change workplace, then they would be fully insured against the drop in nominal income, and the ensuing change in housing prices would be negligible (blue dashed line in the middle right panel). In absence of residential location adjustments, the change in nominal income per resident would translate into a similar effect on both housing prices and real income per resident (black solid and blue dashed lines in the middle and bottom right panels). However, once allowed to change residence, workers would migrate from high to low unemployment locations (top right panel), causing an analogous response in housing prices (red dashed line in the middle right panel) and an opposite effect on real income per resident (red dashed line in the bottom right panel). In this case, residents of locations with high initial unemployment would benefit from the outflow of some of them towards locations with low initial unemployment, while, on the contrary, residents in more advantaged locations would experience a mild loss in real income due to the corresponding inflow. Nevertheless, notice that, for the most part, the magnitude of the changes in real income per resident would be negligible, 0.2% on average (Table C.1).

Summing up, in comparison to the main analysis the relocation choices of workers are completely reversed when unemployment benefits are sufficiently high.[39] This effect stems from the fact that in the initial equilibrium the unemployment risk is already largely insured. The direct effect of eliminating unemployment on expected income is then smaller than the indirect effect passing through wages, thus inducing workers to relocate where the decrease in wages is smaller, that is, where unemployment was initially lower. To put it in another way, in these simulations the initial spatial distribution rationalizes an equilibrium in which relatively more workers originally chose to locate in high unemployment locations because of the generous unemployment insurance. Had insurance not been so generous, fewer workers would have chosen to live and work in high unemployment locations to begin with. Eliminating unemployment risk therefore reverses this initial distortion.[40]

What if instead unemployment benefits had been lower? We perform the same exercise by setting a lower value of unemployment benefits equal to €630 per month, close to the minimum amount available in Belgium in 2012 (Nevejan and Van Camp, 2013), or approximately 40% of the lowest recovered wage. This is about 28% lower than the value used in the baseline calibration, which is comparable to the gap in net replacement rates between the OECD average and Belgium (OECD, 2023b). We report the local and aggregate effects in the Appendix, in Figure C.2 and in Table C.1 respectively. While the

[39]Experimenting with different values of ζ, we find that in practice the percentage change in expected income begins turning negative with a benefit amount of about €1,000 per month, or about 65% and 44% of the lowest and median wages respectively.

[40]This result echoes the findings in Notowidigdo (2020), who shows that more generous public transfers tend to incentivize workers to remain in local labor markets affected by negative employment shocks.

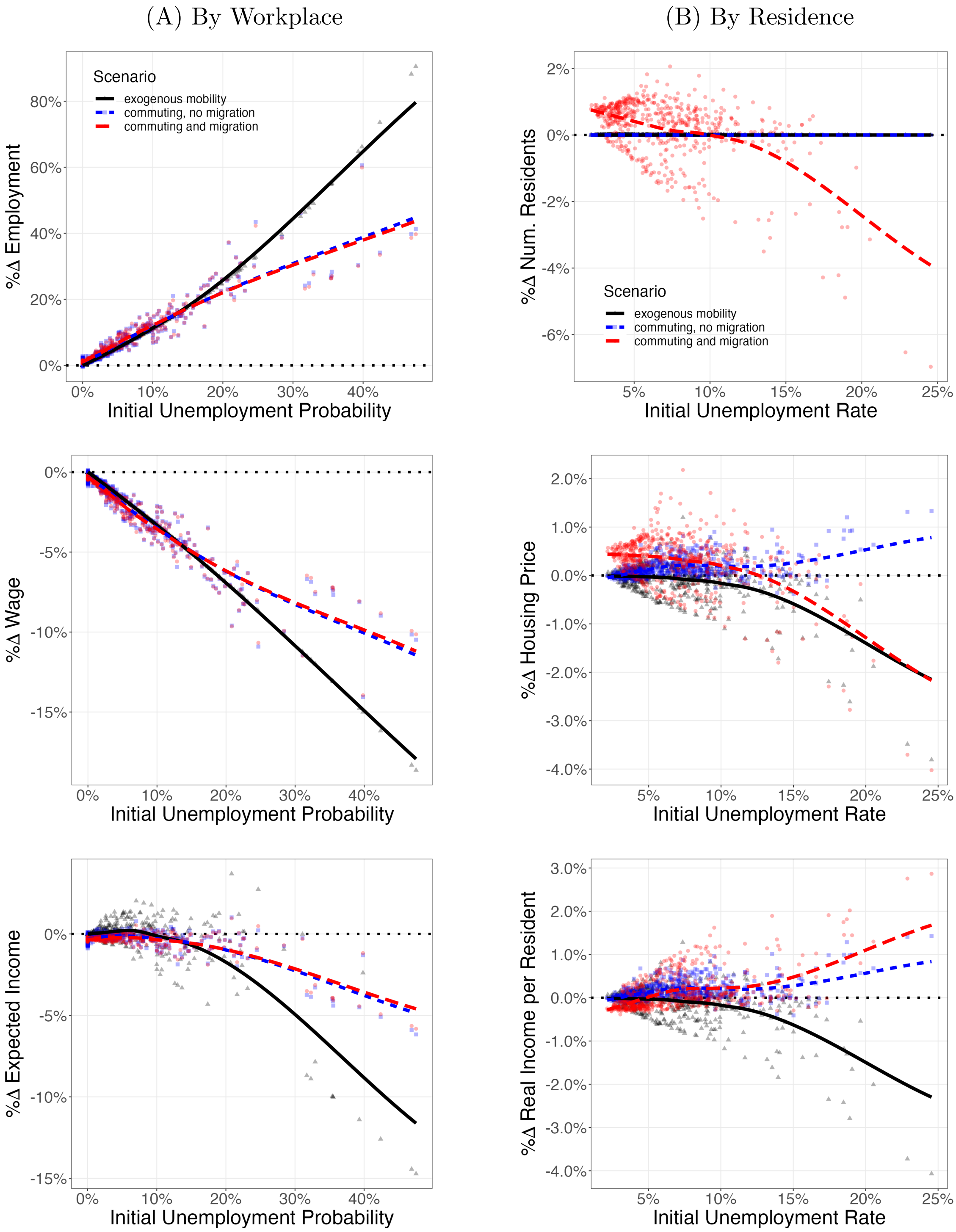

Figure 6: Local Effects with High Unemployment Benefits

Note: The figure shows the effect of eliminating unemployment across municipalities when unemployment benefits are high ($\zeta = 1,400$). Column A: effects by workplace, initial unemployment probability ($u^W_{j(0)}$) on the horizontal axis. Column B: effects by residence, initial residential unemployment rate ($u^R_{i(0)}$) on the horizontal axis. The counterfactual scenarios are: Exogenous Mobility (black solid line): workers cannot change their residence and workplace choices. Commuting, No Migration (blue dashed line): workers can change their workplace choices but cannot migrate. Commuting and Migration (red dashed line): workers can change both their residence and workplace choices. Fitting lines are obtained by local regression.

local effects are similar to those in the main analysis, the aggregate effects are larger. In particular, in the full mobility scenario the migration outflow from Flanders is twice as large and mostly directed towards Brussels. However, while in this case the welfare effect in Wallonia and Flanders would moderately increase compared to the main analysis, in Brussels it would turn negative (-0.3%) due to the relatively larger increase in housing prices (2%). Nevertheless, the overall welfare effect in Belgium would be marginally larger than in the main analysis, by just 0.3 percentage points.

In conclusion, this exercise has shown that, first, while high unemployment benefits could lead to perverse effects such as a reduction in expected income when the unemployment risk is removed, the welfare effects would be negligible in magnitude. Second, even a substantially lower level of benefits would generate only a modest increase in welfare. Overall, in our model the welfare effects are not very sensitive to large changes in the generosity of unemployment insurance.

5.2 Endogenous Social Security Contributions

So far we have abstracted from the endogenous response of the social security system. However, if unemployment disappears, the government no longer needs to collect taxes to finance unemployment benefits. Thus, by reducing payroll taxes, all local labor demands would shift outwards and generate a positive effect on wages. What would be the welfare effect in this case?

Assume that now the labor cost faced by the firms includes social security contributions such that the labor demand becomes:

$$E_j = \left(\frac{\alpha A_j}{(1+\tau) w_j} \right)^{\frac{1}{1-\alpha}}, \tag{28}$$

where τ is the contribution rate chosen to balance the budget constraint of the social security system:

$$\sum_{j \in \mathbb{N}} \tau w_j E_j = \sum_{j \in \mathbb{N}} \zeta u_j^W L_j. \tag{29}$$

In the counterfactuals, since unemployment is set to zero everywhere, the social security contribution rate would also drop to zero ($\tau_{(1)} = 0$). Then, accounting for the change in the social security contribution rate $\widehat{(1+\tau)} = (1+\tau_{(1)})/(1+\tau_{(0)}) = 1/(1+\tau_{(0)})$, the hat algebra form of the inverse labor demand in equation 19 becomes:

$$\hat{w}_j = (1+\tau_{(0)}) \hat{E}_j^{\alpha-1}. \tag{30}$$

Compared to the scenario with a fixed social security contribution rate, and assuming for now the same change in labor allocations ($\hat{\lambda}_{ij}$), the change in the wage would be inflated by a factor $(1+\tau_{(0)})$. The change in expected income would also increase by the same factor (equation 23), the housing price by $(1+\tau_{(0)})^{\frac{1}{1+\gamma}}$ (equations 20 and 22), and real expected income by $(1+\tau_{(0)})^{\frac{1+\gamma-\beta}{1+\gamma}}$. Finally, to complete the argument, notice that in equation 26 any proportional change in real expected income common across all residence-workplace pairs does not affect $\hat{\lambda}_{ij}$, as the relative attractiveness of each pair of locations would remain constant. Thus, the change in the social security contribution rate is neutral with respect to labor allocations and increases welfare by the same factor everywhere.[41]

To calculate the additional welfare effect due to the elimination of payroll taxes, we recover the initial value of the contribution rate from the social security budget constraint in equation 29. Given an implied social security contribution rate equal to $\tau_{(0)} = 0.032$, we find that the endogenous reduction in social contributions would *additionally* increase wages by 3.2%, housing prices by 2.5%, and welfare by 2.6%.

Thus, this exercise suggests that, while the welfare effects originating from the pure reallocation of workers across local labor markets may be modest on average, a significantly larger effect could be obtained by reducing payroll taxes.

6 Conclusion

The wage rigidities ensuing from the collective wage bargaining systems adopted by many European countries are thought to be the cause of substantial employment losses. These losses can be more pronounced in less productive regions and can have consequences for the spatial distribution of real income per capita. In this paper we set up a quantitative spatial equilibrium model to assess the local and aggregate effects of removing such wage rigidities, and to study to which extent these effects depend on the degree of geographical labor mobility.

We analyze the case of Belgium, which exhibits a wide regional gap in productivity and unemployment. Wages are strictly regulated and are weakly related to local productivity. Housing prices are higher in the most productive region, and, because of that, real income per capita is actually higher in the least productive one. We find however little labor mobility. The majority of workers do not change residence over a one-year horizon, and, if they do, they relocate within the same district. On the other hand, a significant share of commutes occur across districts.

We simulate the model assuming the economy would achieve full employment in absence of wage rigidities. In practice, in our model this is equivalent to eliminating unemployment risk in all local labor markets, and, as such, the exercise can also be interpreted

[41]Note that, since the economy already achieves full employment regardless of the change in social contributions, output will not increase further. The increase in welfare is therefore due to the redistribution of resources that would otherwise be collected by the government.

as an evaluation of the local and aggregate cost of unemployment. To assess the importance of labor mobility, we provide three counterfactuals in which workers are allowed to either adapt both their residence and workplace, only their workplace, or none. Across scenarios, we find no quantitative differences in the effects of eliminating unemployment on local wages and employment once workers can change their workplaces, which highlights the importance of commuting as insurance. Instead, the local welfare effects mostly depend on the migratory response of workers. When workers cannot relocate, we find positive welfare effects ranging between 0.5% and 2%, increasing in the initial unemployment rate of the municipality. However, once allowing for migration, the welfare effects are equalized across municipalities at about 1%. At the national level, we find similar effects across mobility scenarios: employment would increase by 8%, the average wage would drop by 4%, and aggregate labor income would increase by 4%. The average welfare effect, on the other hand, would be small, about 1 percentage point. Finally, the endogenous reduction in social security contributions would generate welfare effects three times larger than those ensuing from the pure reallocation of workers across local labor markets.

The analysis in this paper could be extended along several dimensions. First, while collective wage bargaining systems typically affect all workers, not all of them face the same unemployment risk. Low-skill workers and those employed in declining sectors are more likely to become unemployed and tend to remain in unemployment for longer periods. Thus, accounting for the heterogeneity across sectors and skills could reveal stronger welfare effects than those found in this paper. These features could be incorporated in a quantitative spatial model, for example, along the lines of the multi-sector model of Caliendo et al. (2017) and Caliendo et al. (2019), or as in the canonical spatial model with skill heterogeneity (e.g., Diamond, 2016; Notowidigdo, 2020).

Second, if the welfare effects of eliminating wage rigidities were indeed as small as presented in this paper, one may then ask whether this would be a desirable policy objective to pursue. In our framework, we calculated the welfare effects of transitioning from an economy characterized by local labor markets with high wage rigidities and unemployment to an economy in competitive equilibrium and at full employment. However, depending on the degree of monopsony power in the labor market, the welfare effects could be larger if wage rigidities were not eliminated altogether, but simply reduced. For instance, Ahlfeldt et al. (2023) find that the introduction of a sufficiently low national minimum wage could significantly increase welfare at a small loss in employment. While employment losses rapidly increase at higher levels of the national minimum wage, the authors show that the adoption of region-specific minimum wages could substantially mitigate this trade-off. As such, accounting for local productivity differences in the optimal design of wage regulation constitutes an active and promising line of investigation.

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Appendix

A Data

In this section we provide the additional information on the data sources and the construction of the relevant variables.

Gross Value Added per Worker – GVA per worker is calculated from the Regional Accounts of the National Bank of Belgium using information on GVA and total employment by district.

Unemployment Rate – The local unemployment rates are obtained from the *Institute Wallone de l'Evaluation, de la Prospective et de la Statistique* (IWEPS), a public scientific institution providing data on economic, social, political, and environmental subjects. In the paper we use the unemployment rate for all individuals of age 15-64.

Wages – The wage data used in Section 2.2 are obtained from the 2010-2019 Structure of Earnings Survey (SES) provided by Statbel, the Belgian institute of statistics. The survey is conducted in most EU countries and is harmonized by Eurostat. It comprises a large sample of employees working in private enterprises with at least 10 employees. The survey contains information on the characteristics of workers (sex, age, occupation, tenure, education, hours of work, gross earnings, etc.) and those of their employer (economic activity, size, and location of the enterprise). We calculate the hourly wage from the gross earnings per paid hours over the reference period of work, typically a month.

Housing Prices – Average housing prices are calculated from aggregate data on the sales of land and housing units publicly provided by Statbel. We calculate the average housing price by dividing the total selling value of houses, flats, and manors by the total number of transactions. In total there are 7 / 581 municipalities with missing housing prices in 2010. For 5 / 581 municipalities we imputed the missing values by averaging the housing prices observed in 2009 and 2011 in those municipalities, and for the other 2 / 581 cases, for which this was not doable, we imputed the housing price by the median across the municipalities in the same district.

Average Income per Resident – Average income per resident is calculated starting from publicly available data on total professional income by municipality provided by Statbel. Professional income is the sum of wage income, self-employment income, unemployment benefits, and pension benefits. In this paper we focus only on workers, therefore we construct a measure of total residential income by netting out pension benefits. Since the decomposition of professional income is not available, we impute local pension benefits using data on total pension benefits from the Public Finance Accounts of the National Bank of Belgium and data on the age composition of the population from Statbel. We first calculate the national average pension benefit by dividing total pensions by the total population aged 65 and older, and second we calculate the amount of pension benefits by municipality as the product of the national average pension benefit and the local number of individuals aged 65 or more. Deducing local pension benefits from professional income gives our measure of residential income. To obtain a suitable measure for the number of residents we sum up the total number of employed and unemployed residents. We calculate the number of employed residents by municipality by summing along each row of the commuting matrix constructed by Statbel from the 2011 Census of the population. For consistency, we recover the number of unemployed resident by multiplying the obtained number of employed by $\frac{u_i^R}{1-u_i^R}$, where u_i^R is the unemployment rate obtained from IWEPS. Finally, average income per resident is calculated by dividing the constructed measures of residential income and residential population.

Average Labor Income – In Section 4.2, to recover our measure of wages we use data on average labor income by municipality. This measure is constructed similarly to average income per resident. We start from the professional income data and we net out both pension benefits and unemployment benefits. We obtain the total unemployment benefits by municipality by multiplying the local number of unemployed residents by the national average unemployment benefit obtained from Office National de l'Emploi (2012), which amounts to about €870 per month. We calculate average labor income by dividing total labor income by the number of employed residents.

Migration and Commuting Shares – The migration shares are calculated on the microdata from the 2011 Census of the population provided by Statbel. We select all individuals either employed or unemployed of age 20-59. For the commuting shares and distance, since Statbel does not provide microdata disaggregated by municipality of residence and workplace, we use the commuting matrix directly available from Statbel's open-data portal. The commuting matrix covers all individuals holding a job during the 2011 Census. We removed from the matrix all entries for individuals working in a foreign country (2% of the sample) or with missing municipality of work (1%).

Labor Income Share – To calculate the labor income share we use data from the National Accounts of the National Bank of Belgium, which include information on gross value added, total employment, number of employees, and compensation of employees. We calculate the labor income share as the ratio of labor income to GVA, where labor income is obtained by first calculating the average employee compensation and then multiplying by total employment (i.e., inclusive of self-employment) as suggested by Gollin (2002).

Housing Expenditure Share – To calculate the housing expenditure share we use data the National Accounts of the National Bank of Belgium, which include aggregate data on the final consumption of households by category of expenditure. Housing expenditure includes expenditure on housing, water, electricity, gas and other fuels.

B Model Derivation

B.1 Worker's Allocation Problem

Each worker has preferences for locations of residence and workplace and can either be employed or unemployed. Each worker chooses where to live and work, and the quantity of final good consumption and housing.

The timing of the decision process is the following: First, the worker chooses a pair of residence and workplace locations to maximize her expected utility, taking as given the choices of all the other agents in the economy and the resulting equilibrium quantities. Second, the worker can either find a job or become unemployed, depending on the economic conditions prevailing in the chosen workplace location. Nevertheless, since the model is static, the worker will not be stuck forever in neither employment nor unemployment. Instead, she will indefinitely transition across states, where the fraction of time spent in each state is determined by the unemployment rate in the chosen workplace location. Given the employment status, the worker chooses consumption of the final good and housing. Finally, the worker cannot save to smooth consumption across states, however income losses are partially insured via unemployment benefits provided by the social security system.

Formally, a worker ω, living in location i, commuting to workplace j, and being in labor market status $z \in \{E, U\}$, has preferences over consumption of the final good $c_{ij}^z(\omega)$ and housing $h_{ij}^z(\omega)$:

$$U_{ij}^z(\omega) = \frac{b_{ij}(\omega)}{\kappa_{ij}} \left(\frac{c_{ij}^z(\omega)}{1-\beta} \right)^{1-\beta} \left(\frac{h_{ij}^z(\omega)}{\beta} \right)^{\beta}, \tag{31}$$

where $b_{ij}(\omega)$ is the worker's idiosyncratic preference for a given residence-workplace pair, and $\kappa_{ij} \in [1, \infty)$ is the iceberg commuting cost which does not vary across workers or employment status. The worker's labor income depends on her employment status: if employed ($z = E$), the worker receives the wage, w_j, while if unemployed ($z = U$), she receives a fixed unemployment insurance amount ζ.

The optimal allocation of consumption and housing yields indirect utility:

$$V_{ij}^{z}(\omega) = \frac{b_{ij}(\omega)}{\kappa_{ij}} \frac{y_j^z}{Q_i^{\beta}}, \tag{32}$$

where Q_i denotes the rental price for one unit of housing. Since all workers are identical from the local firm's perspective, there is no heterogeneity in wages and unemployment probability. Therefore, the expected state of a worker commuting to workplace location j is equal to the local unemployment rate u_j^W prevailing in that specific labor market. Under risk-neutrality, the worker's expected indirect utility $V_{ij}(\omega)$ conditional on residence and workplace is linear in the expected income y_j:

$$V_{ij}(\omega) = \frac{b_{ij}(\omega)}{\kappa_{ij}} \frac{y_j}{Q_i^{\beta}}, \tag{33}$$

where:

$$y_j = (1 - u_j^W) w_j + u_j^W \zeta. \tag{34}$$

B.2 Derivation of the Commuting Probabilities

In this section, we derive the commuting probabilities and the expected utility. The derivations are adapted from those available in the Appendix of Monte et al. (2018) and Heblich et al. (2020).

Since the expected indirect utility $V_{ij}(\omega)$ is monotonically increasing in the preferences parameter $b_{ij}(\omega)$, its distribution follows directly from that of $b_{ij}(\omega)$:

$$\begin{aligned}
\Pr\left(V_{ij}(\omega) \leq V\right) = & \quad \Pr\left(\frac{b_{ij}(\omega)}{\kappa_{ij}} \frac{y_j}{Q_i^{\beta}} \leq V\right) \\
= & \quad \Pr\left(b_{ij}(\omega) \leq \kappa_{ij} q_i^{\beta} y_j^{-1} V\right) \\
= & \quad e^{-B_{ij}\left(\kappa_{ij} Q_i^{\beta}\right)^{-\epsilon} y_j^{\epsilon} V^{-\epsilon}} \\
= & \quad e^{-\Psi_{ij} V^{-\epsilon}} \\
= & \quad F_{ij}\left(V \; ; \; \Psi_{ij}, \epsilon\right),
\end{aligned}$$

where $\Psi_{ij} = B_{ij}\left(\kappa_{ij} Q_i^{\beta}\right)^{-\epsilon} y_j^{\epsilon}$ and in the third equation we substituted the Fréchet distribution of $b_{ij}(\omega)$, $F_{ij}\left(V \; ; B_{ij}, \epsilon\right) = e^{-B_{ij} b^{-\epsilon}}$. Each worker selects the residence-workplace pair yielding the maximum utility, which is also Fréchet distributed:

$$
\begin{aligned}
\Pr\left(\max_{ij} V_{ij}(\omega) \leq V\right) &= \Pr\Big(V_{ij}(\omega) \leq V,\ \forall\, i, j\Big) \\
&= \prod_{ij} \Pr\big(V_{ij}(\omega) \leq V\big) \\
&= \prod_{ij} e^{-\Psi_{ij} V^{-\epsilon}} \\
&= e^{-\left(\sum_{ij} \Psi_{ij}\right) V^{-\epsilon}} \\
&= F\big(V\ ;\ \Psi, \epsilon\big),
\end{aligned}
$$

where $\Psi = \sum_{ij} \Psi_{ij}$. Finally, given the distribution of the expected indirect utility and that of its maximum, the joint commuting probabilities λ_{ij} can be obtained by noting that the indirect expected utility for the (i, j) pair must be greater than the maximum among all the other possible pairs:

$$
\begin{aligned}
\lambda_{ij} &= \Pr\left(V_{ij}(\omega) \geq \max_{(r,s)\neq(i,j)} V_{rs}(\omega)\right) \\
&= \int_0^\infty \Pr\left(\max_{(r,s)\neq(i,j)} V_{rs}(\omega) \leq v \;\middle|\; V_{ij}(\omega) = v\right) f_{ij}\big(v\ ;\ \Psi_{ij},\ \epsilon\big)\ \mathrm{d}v \\
&= \int_0^\infty e^{-\sum_{(r,s)\neq(n,i)} \Psi_{rs} v^{-\epsilon}} \epsilon \Psi_{ij} v^{-(\epsilon+1)} e^{\Psi_{ij} v^{-\epsilon}}\ \mathrm{d}v \\
&= \int_0^\infty \epsilon \Psi_{ij} v^{-(\epsilon+1)} e^{-\Psi v^{\epsilon}}\ \mathrm{d}v \\
&= \frac{\Psi_{ij}}{\Psi} \int_0^\infty \epsilon \Psi v^{-(\epsilon+1)} e^{-\Psi v^{\epsilon}}\ \mathrm{d}v \\
&= \frac{\Psi_{ij}}{\Psi} \int_0^\infty f\big(v\ ;\ \Psi,\ \epsilon\big)\ \mathrm{d}v \\
&= \frac{\Psi_{ij}}{\Psi},
\end{aligned}
$$

where in the third equation we substituted the density of $V_{ij}(\omega)$, $f\big(v\ ;\ \Psi_{ij},\ \epsilon\big) = \epsilon \Psi_{ij} v^{-(\epsilon+1)} e^{\Psi_{ij} v^{-\epsilon}}$, and the integral in the sixth equation is the area under a Fréchet distribution with scale Ψ and shape ϵ. Substituting Ψ_{ij} and Ψ we obtain the final expression:

$$
\lambda_{ij} = \frac{B_{ij}\big(\kappa_{ij} Q_i^{\beta}\big)^{-\epsilon} y_j^{\epsilon}}{\sum_{r,s\in\mathbb{N}} B_{rs}\big(\kappa_{rs} Q_r^{\beta}\big)^{-\epsilon} y_s^{\epsilon}}.
$$

As shown above, the maximum of the indirect utility $V_{ij\omega}$ is distributed as a Fréchet random variable with scale Ψ and shape ϵ. We can therefore calculate the expected utility across the entire population of workers:

$$
\begin{aligned}
E\Big[\max_{ij} V_{ij}(\omega)\Big] &= \int_0^\infty \epsilon\Psi v^{-\epsilon} e^{-\Psi v^{-\epsilon}}\ \mathrm{d}v \\
&= -\int_\infty^0 \Psi^{\frac{1}{\epsilon}} x^{-\frac{1}{\epsilon}} e^{-x}\ \mathrm{d}x \\
&= \Psi^{\frac{1}{\epsilon}} \int_0^\infty x^{-\frac{1}{\epsilon}} e^{-x}\ \mathrm{d}x \\
&= \Gamma\left(\frac{\epsilon-1}{\epsilon}\right)\Psi^{\frac{1}{\epsilon}} \\
&= \Gamma\left(\frac{\epsilon-1}{\epsilon}\right)\left[\sum_{s,r\in\mathbb{N}} B_{rs}\Big(\kappa_{rs} Q_r^{\beta}\Big)^{-\epsilon} y_{rs}^{\epsilon}\right]^{\frac{1}{\epsilon}}
\end{aligned}
$$

where in the second equation we used the change of variable $x = \Psi v^{-\epsilon}$ with $\mathrm{d}x = -\epsilon\Psi v^{-(\epsilon+1)}\mathrm{d}v$, and $\Gamma(\cdot)$ is the gamma function.

C Additional Figures and Tables

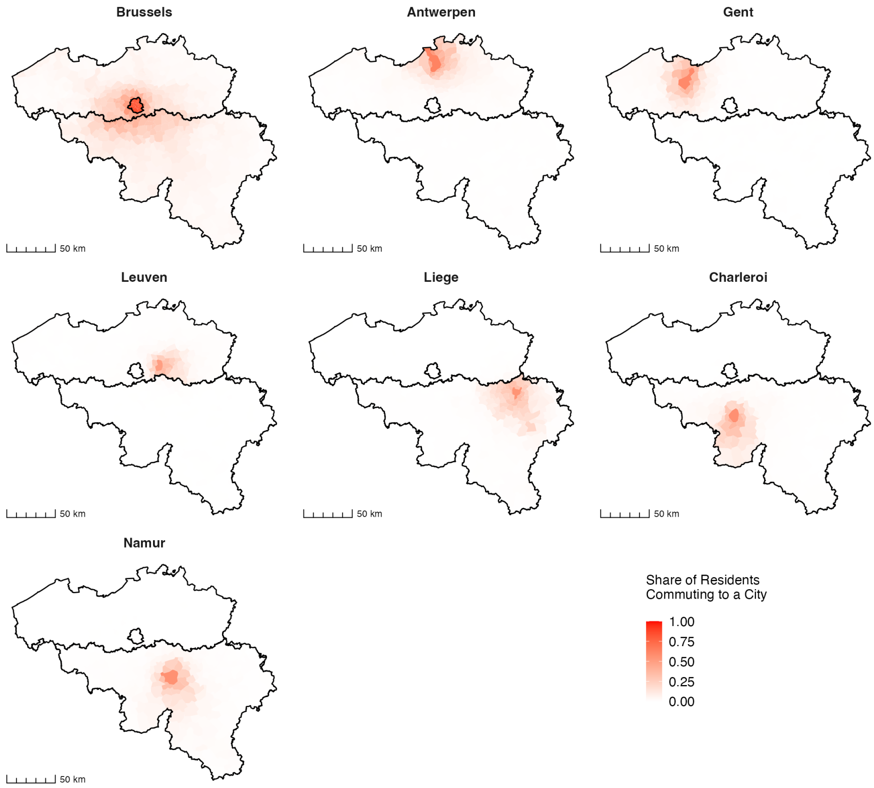

Figure C.1: Share of Outflowing Commuters to Major City

Note: Share of residents commuting to a municipality different from that of residence. Each panel displays the map for a different commuting destination. Authors' elaborations based on the 2011 commuting matrix provided by Statbel.

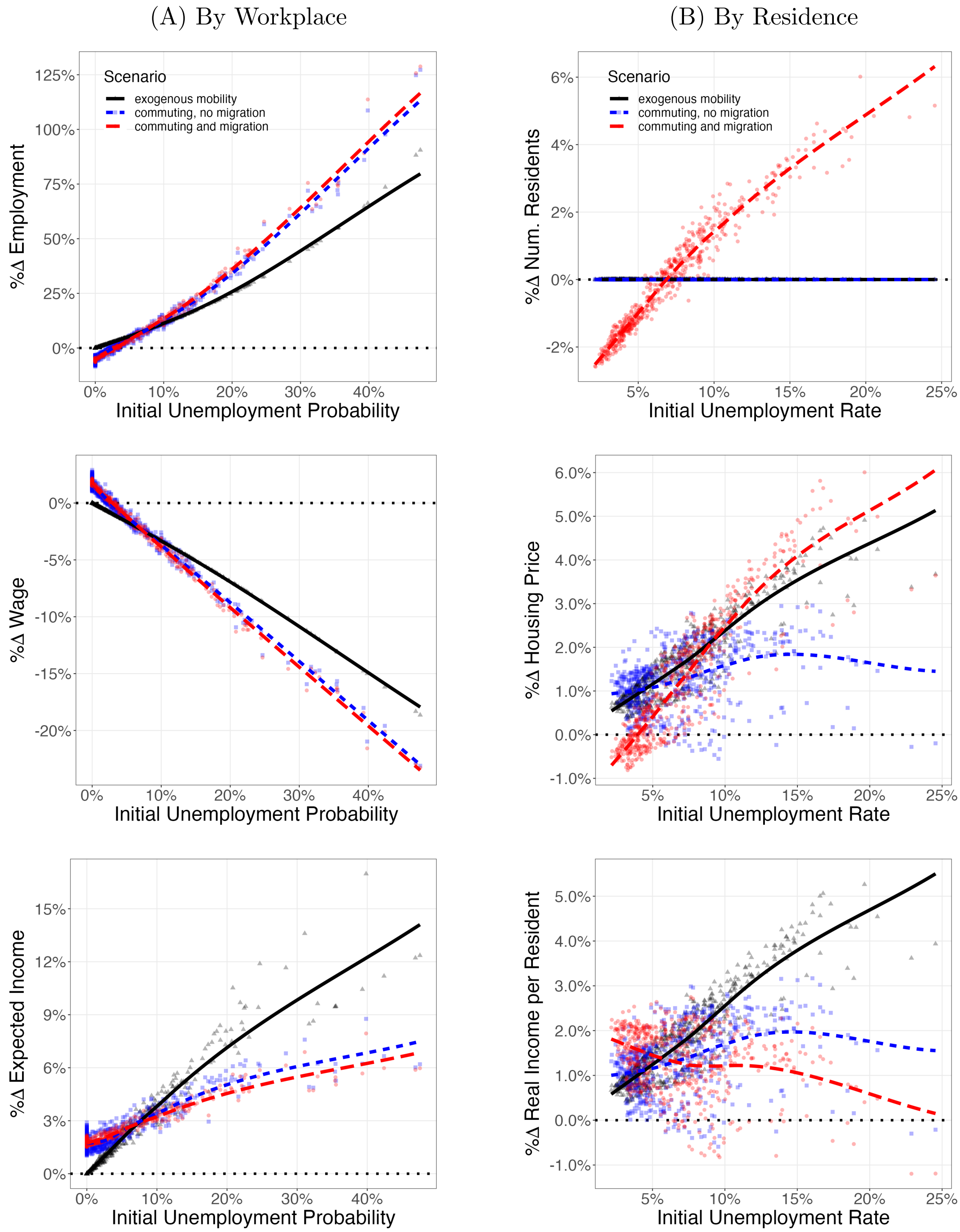

Figure C.2: Local Effects with Low Unemployment Benefits

Note: The figure shows the effect of eliminating unemployment across municipalities when unemployment benefits are high ($\zeta = 630$). Column A: effects by workplace, initial unemployment probability ($u^W_{j(0)}$) on the horizontal axis. Column B: effects by residence, initial residential unemployment rate ($u^R_{i(0)}$) on the horizontal axis. The counterfactual scenarios are: Exogenous Mobility (black solid line): workers cannot change their residence and workplace choices. Commuting, No Migration (blue dashed line): workers can change their workplace choices but cannot migrate. Commuting and Migration (red dashed line): workers can change both their residence and workplace choices. Fitting lines are obtained by local regression.

Table C.1: Aggregate Effects - Sensitivity to ζ

	Low Benefits $\zeta = 630$				Medium Benefits $\zeta = 870$ (baseline)				High Benefits $\zeta = 1{,}400$			
	BR	FL	WL	BEL	BR	FL	WL	BEL	BR	FL	WL	BEL
%Δ *Num. Residents*												
Exogenous mobility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting, no migration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting and migration	2.62	-1.22	1.65	0.00	0.47	-0.66	1.18	0.00	-2.92	0.37	0.12	0.00
%Δ *Num. Employed Residents*												
Exogenous mobility	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting, no migration	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting and migration	19.65	3.82	13.49	7.99	17.14	4.40	12.96	7.99	13.19	5.49	11.79	7.99
%Δ *Employment*												
Exogenous mobility	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99
Commuting, no migration	24.24	1.81	11.79	7.99	20.18	2.80	12.05	7.99	13.48	4.53	12.27	7.99
Commuting and migration	24.98	0.97	13.17	7.99	20.26	2.35	12.99	7.99	12.56	4.78	12.26	7.99
%Δ *Average Wage*												
Exogenous mobility	-8.21	-1.40	-4.34	-3.52	-8.21	-1.40	-4.34	-3.52	-8.21	-1.40	-4.34	-3.52
Commuting, no migration	-10.87	-1.15	-5.19	-4.20	-8.78	-1.34	-4.94	-3.78	-5.14	-1.64	-4.38	-3.06
Commuting and migration	-11.02	-0.86	-5.59	-4.22	-8.79	-1.20	-5.21	-3.79	-4.90	-1.75	-4.39	-3.06
%Δ *Aggregate Labor Income*												
Exogenous mobility	7.55	2.72	6.41	4.19	7.55	2.72	6.41	4.19	7.55	2.72	6.41	4.19
Commuting, no migration	4.71	2.43	5.27	3.45	6.78	2.65	5.80	3.91	10.39	2.96	6.80	4.68
Commuting and migration	7.16	1.46	6.59	3.43	7.25	2.11	6.77	3.89	7.54	3.25	6.94	4.68
%Δ *Average Housing Price*												
Exogenous mobility	2.41	1.09	2.47	1.56	1.21	0.72	1.66	1.00	-1.31	-0.08	-0.06	-0.21
Commuting, no migration	0.35	0.87	1.67	1.01	0.64	0.67	1.26	0.81	0.60	0.11	0.23	0.19
Commuting and migration	2.00	0.16	2.35	0.80	1.03	0.26	1.73	0.61	-1.03	0.28	0.30	0.10
%Δ *Real Income per Resident*												
Exogenous mobility	2.60	1.18	2.82	1.81	1.28	0.79	1.90	1.17	-1.52	-0.08	-0.08	-0.20
Commuting, no migration	0.34	0.96	1.90	1.21	0.68	0.73	1.41	0.94	0.67	0.11	0.22	0.19
Commuting and migration	-0.32	1.40	1.32	1.22	0.57	0.97	1.01	0.95	1.43	-0.02	0.21	0.19

Note: The table presents the aggregate effects of eliminating unemployment for alternative values of the unemployment benefits (ζ). The counterfactual scenarios are: Exogenous Mobility: workers cannot change their residence and workplace choices; Commuting, No Migration: workers can change their workplace choices but cannot migrate; Commuting and Migration: workers can change both their residence and workplace choices. The average wage is calculated by weighting by employment. Aggregate labor income is the sum of the wages earned by employed residents. The average housing price is calculated by weighting by the number of residents. Real income per resident is calculated as the weighted average of the real income earned by each resident, whether employed or unemployed in the initial equilibrium, and using the number of residents as weights. BR is Brussels, FL is Flanders, WL is Wallonia, and BEL is Belgium.

D Sensitivity Analysis

We check the robustness of our results to alternative values of the three main parameters of the model: α, which determines the elasticity of the labor demand; ϵ, which determines the elasticity of the labor supply; and γ, the price elasticity of the housing supply. Testing the sensitivity to these parameters allows us also to study alternative specifications of our model, for example, including capital in production and risk aversion. The results are reported in Tables D.2, D.3, and D.4. Overall, the results are robust to large variations in the values of the parameters.

Choice of α – In our model we derive a downward-sloping labor demand by bundling all non-labor factors of production into the exogenous productivity level (A_j). However, as mentioned in Section 3, the production function could be augmented with capital and land. Assume that the technology is constant return to scale in labor (E_j), capital (K_j), and commercial land (T_j), such that $Y_j = \tilde{A}_j E_j^{\alpha_E} K_j^{\alpha_K} T_j^{\alpha_T}$ with $\alpha_E + \alpha_K + \alpha_T = 1$, and that the rental rate of capital is the same across locations, as would be the case if it were determined in the international capital market. Then, the corresponding labor demand would be $E_j \propto w_j^{-\frac{\alpha_E+\alpha_T}{\alpha_T}}$. Following Hsieh and Moretti (2019) we set the income share of commercial land to $\alpha_T = 0.10$ and we keep the labor income share as in our baseline parameterization, that is, $\alpha_E = 0.68$. The resulting elasticity of the labor demand would be $\frac{\alpha_E+\alpha_T}{\alpha_T} = 7.8$, more than twice our initial value $\frac{1}{1-\alpha} = 3.125$. This specification would be equivalent to setting $\alpha = \frac{\alpha_E}{\alpha_E+\alpha_T} = 0.87$ in our model. We can also probe our results to a lower value of α. For example, if we measured the labor income share by omitting the self-employed we would obtain $\alpha = 0.57$.

Choice of ϵ – In the baseline model workers are risk neutral, however, were they averse to risk, we would expect a stronger response to the elimination of unemployment. For example, consider the isoelastic utility function in consumption $\mathcal{U}(c) = \frac{c^{1-\sigma}}{1-\sigma}$ with $\sigma \geq 0$, and assume for simplicity that unemployment benefits are a constant fraction ρ of the wage such that $\zeta = \rho w$. The indirect utility would be $V = u\mathcal{U}(\rho w) + (1-u)\mathcal{U}(w) = \mathcal{U}(w)[u\rho^{1-\sigma} + (1-u)]$, instead of being linear in expected income as in equation 3. The percentage change in the indirect utility when unemployment drops to zero would be $\frac{\mathcal{U}(w)-V}{|V|} = 1 - \frac{\mathcal{U}(w)}{V} = 1 - \frac{1}{u\rho^{1-\sigma}+(1-u)}$, compared to the percentage change in expected income $\frac{w-y}{y} = \frac{w}{y} - 1 = \frac{1}{u\rho+(1-u)} - 1$. Using a canonical value of $\sigma = 2$ and the official replacement rate $\rho = 0.60$ (Office National de l'Emploi, 2012), the corresponding elasticity evaluated at the national unemployment rate $u^R = 0.083$ would be $\frac{\mathcal{U}(w)-V}{|V|} / \frac{w-y}{y} = 1.53$, that is, about 50% higher than the linear case used in the baseline. This specification can be approximated in our model by increasing the sensitivity of the location choice probabilities to real expected income, that is, by increasing ϵ from 6 to 9. We also explore the case with $\epsilon = 3$, a value towards the lower end of the range of the estimates of the commuting elasticity found in the literature.

Choice of γ – Lastly, we explore the sensitivity with respect to the housing supply elasticity. As shown in Caldera and Johansson (2013), most of the OECD countries have a long-run housing supply elasticity below one. Thus, to cover the range of parameters for the case of many developed economies, we replicate the simulations by setting $\gamma = 0$ and $\gamma = 1$.

Table D.2: Aggregate Effects - Sensitivity to α

	$\alpha = 0.57$				$\alpha = 0.68$ (baseline)				$\alpha = 0.87$			
	BR	FL	WL	BEL	BR	FL	WL	BEL	BR	FL	WL	BEL
%Δ *Num. Residents*												
Exogenous mobility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting, no migration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting and migration	-0.73	-0.19	0.59	0.00	0.47	-0.66	1.18	0.00	5.08	-2.19	2.85	0.00
%Δ *Num. Employed Residents*												
Exogenous mobility	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting, no migration	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting and migration	15.74	4.90	12.31	7.99	17.14	4.40	12.96	7.99	22.52	2.80	14.83	7.99
%Δ *Employment*												
Exogenous mobility	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99
Commuting, no migration	17.84	3.48	11.94	7.99	20.18	2.80	12.05	7.99	28.92	0.60	11.65	7.99
Commuting and migration	17.62	3.36	12.34	7.99	20.26	2.35	12.99	7.99	30.88	-1.22	14.44	7.99
%Δ *Average Wage*												
Exogenous mobility	-9.65	-1.72	-5.30	-4.19	-8.21	-1.40	-4.34	-3.52	-5.54	-0.83	-2.64	-2.32
Commuting, no migration	-8.90	-1.77	-5.68	-4.17	-8.78	-1.34	-4.94	-3.78	-9.60	-1.10	-4.17	-3.85
Commuting and migration	-8.82	-1.72	-5.83	-4.17	-8.79	-1.20	-5.21	-3.79	-9.73	-0.78	-4.54	-3.91
%Δ *Aggregate Labor Income*												
Exogenous mobility	6.19	2.25	5.31	3.47	7.55	2.72	6.41	4.19	10.04	3.53	8.36	5.48
Commuting, no migration	6.76	2.32	5.08	3.49	6.78	2.65	5.80	3.91	5.28	2.46	6.34	3.83
Commuting and migration	6.10	2.17	5.56	3.48	7.25	2.11	6.77	3.89	10.25	0.48	8.99	3.77
%Δ *Average Housing Price*												
Exogenous mobility	0.23	0.38	0.89	0.49	1.21	0.72	1.66	1.00	2.99	1.33	3.03	1.92
Commuting, no migration	0.61	0.43	0.75	0.52	0.64	0.67	1.26	0.81	-0.42	0.50	1.55	0.66
Commuting and migration	0.27	0.30	0.98	0.40	1.03	0.26	1.73	0.61	2.95	-0.92	2.97	0.31
%Δ *Real Income per Resident*												
Exogenous mobility	0.20	0.41	1.01	0.58	1.28	0.79	1.90	1.17	3.23	1.45	3.46	2.22
Commuting, no migration	0.67	0.46	0.83	0.59	0.68	0.73	1.41	0.94	-0.47	0.60	1.87	0.91
Commuting and migration	0.87	0.54	0.62	0.60	0.57	0.97	1.01	0.95	-1.58	1.21	1.12	0.91

Note: The table presents the aggregate effects of eliminating unemployment for alternative values of the labor income share (α). The counterfactual scenarios are: Exogenous Mobility: workers cannot change their residence and workplace choices; Commuting, No Migration: workers can change their workplace choices but cannot migrate; Commuting and Migration: workers can change both their residence and workplace choices. The average wage is calculated by weighting by employment. Aggregate labor income is the sum of the wages earned by employed residents. The average housing price is calculated by weighting by the number of residents. Real income per resident is calculated as the weighted average of the real income earned by each resident, whether employed or unemployed in the initial equilibrium, and using the number of residents as weights. BR is Brussels, FL is Flanders, WL is Wallonia, and BEL is Belgium.

Table D.3: Aggregate Effects - Sensitivity to ϵ

	$\epsilon = 3$				$\epsilon = 6$ (baseline)				$\epsilon = 9$			
	BR	FL	WL	BEL	BR	FL	WL	BEL	BR	FL	WL	BEL
%Δ *Num. Residents*												
Exogenous mobility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting, no migration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting and migration	0.39	-0.55	0.97	0.00	0.47	-0.66	1.18	0.00	0.50	-0.69	1.23	0.00
%Δ *Num. Employed Residents*												
Exogenous mobility	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting, no migration	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting and migration	17.05	4.53	12.73	7.99	17.14	4.40	12.96	7.99	17.17	4.37	13.02	7.99
%Δ *Employment*												
Exogenous mobility	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99
Commuting, no migration	19.94	3.06	11.63	7.99	20.18	2.80	12.05	7.99	20.30	2.62	12.38	7.99
Commuting and migration	19.99	2.63	12.52	7.99	20.26	2.35	12.99	7.99	20.39	2.19	13.25	7.99
%Δ *Average Wage*												
Exogenous mobility	-8.21	-1.40	-4.34	-3.52	-8.21	-1.40	-4.34	-3.52	-8.21	-1.40	-4.34	-3.52
Commuting, no migration	-8.62	-1.38	-4.73	-3.70	-8.78	-1.34	-4.94	-3.78	-8.85	-1.31	-5.08	-3.82
Commuting and migration	-8.63	-1.24	-4.99	-3.72	-8.79	-1.20	-5.21	-3.79	-8.87	-1.17	-5.33	-3.83
%Δ *Aggregate Labor Income*												
Exogenous mobility	7.55	2.72	6.41	4.19	7.55	2.72	6.41	4.19	7.55	2.72	6.41	4.19
Commuting, no migration	6.98	2.65	6.01	3.99	6.78	2.65	5.80	3.91	6.68	2.65	5.67	3.86
Commuting and migration	7.38	2.22	6.78	3.97	7.25	2.11	6.77	3.89	7.17	2.08	6.71	3.85
%Δ *Average Housing Price*												
Exogenous mobility	1.21	0.72	1.66	1.00	1.21	0.72	1.66	1.00	1.21	0.72	1.66	1.00
Commuting, no migration	0.79	0.67	1.39	0.86	0.64	0.67	1.26	0.81	0.56	0.67	1.17	0.78
Commuting and migration	1.11	0.33	1.75	0.69	1.03	0.26	1.73	0.61	0.98	0.25	1.70	0.58
%Δ *Real Income per Resident*												
Exogenous mobility	1.28	0.79	1.90	1.17	1.28	0.79	1.90	1.17	1.28	0.79	1.90	1.17
Commuting, no migration	0.84	0.74	1.57	1.01	0.68	0.73	1.41	0.94	0.61	0.74	1.30	0.90
Commuting and migration	0.75	0.94	1.22	1.02	0.57	0.97	1.01	0.95	0.48	0.98	0.90	0.92

Note: The table presents the aggregate effects of eliminating unemployment for alternative values of the commuting elasticity (ϵ). The counterfactual scenarios are: Exogenous Mobility: workers cannot change their residence and workplace choices; Commuting, No Migration: workers can change their workplace choices but cannot migrate; Commuting and Migration: workers can change both their residence and workplace choices. The average wage is calculated by weighting by employment. Aggregate labor income is the sum of the wages earned by employed residents. The average housing price is calculated by weighting by the number of residents. Real income per resident is calculated as the weighted average of the real income earned by each resident, whether employed or unemployed in the initial equilibrium, and using the number of residents as weights. BR is Brussels, FL is Flanders, WL is Wallonia, and BEL is Belgium.

Table D.4: Aggregate Effects - Sensitivity to γ

	$\gamma = 0$				$\gamma = 0.3$ (baseline)				$\gamma = 1$			
	BR	FL	WL	BEL	BR	FL	WL	BEL	BR	FL	WL	BEL
%Δ *Num. Residents*												
Exogenous mobility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting, no migration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commuting and migration	0.45	-0.59	1.03	0.00	0.47	-0.66	1.18	0.00	0.52	-0.78	1.39	0.00
%Δ *Num. Employed Residents*												
Exogenous mobility	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting, no migration	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99	16.59	5.10	11.65	7.99
Commuting and migration	17.11	4.49	12.80	7.99	17.14	4.40	12.96	7.99	17.19	4.29	13.20	7.99
%Δ *Employment*												
Exogenous mobility	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99	19.29	3.47	11.11	7.99
Commuting, no migration	20.18	2.80	12.05	7.99	20.18	2.80	12.05	7.99	20.18	2.80	12.05	7.99
Commuting and migration	20.27	2.40	12.87	7.99	20.26	2.35	12.99	7.99	20.24	2.27	13.16	7.99
%Δ *Average Wage*												
Exogenous mobility	-8.21	-1.40	-4.34	-3.52	-8.21	-1.40	-4.34	-3.52	-8.21	-1.40	-4.34	-3.52
Commuting, no migration	-8.78	-1.34	-4.94	-3.78	-8.78	-1.34	-4.94	-3.78	-8.78	-1.34	-4.94	-3.78
Commuting and migration	-8.79	-1.21	-5.18	-3.79	-8.79	-1.20	-5.21	-3.79	-8.78	-1.18	-5.27	-3.80
%Δ *Aggregate Labor Income*												
Exogenous mobility	7.55	2.72	6.41	4.19	7.55	2.72	6.41	4.19	7.55	2.72	6.41	4.19
Commuting, no migration	6.78	2.65	5.80	3.91	6.78	2.65	5.80	3.91	6.78	2.65	5.80	3.91
Commuting and migration	7.23	2.17	6.65	3.90	7.25	2.11	6.77	3.89	7.30	2.01	6.95	3.89
%Δ *Average Housing Price*												
Exogenous mobility	1.57	0.94	2.17	1.30	1.21	0.72	1.66	1.00	0.78	0.47	1.08	0.65
Commuting, no migration	0.83	0.87	1.64	1.05	0.64	0.67	1.26	0.81	0.42	0.43	0.81	0.52
Commuting and migration	1.30	0.41	2.23	0.87	1.03	0.26	1.73	0.61	0.70	0.11	1.10	0.31
%Δ *Real Income per Resident*												
Exogenous mobility	1.19	0.74	1.77	1.10	1.28	0.79	1.90	1.17	1.37	0.85	2.04	1.26
Commuting, no migration	0.64	0.68	1.31	0.88	0.68	0.73	1.41	0.94	0.74	0.79	1.51	1.01
Commuting and migration	0.51	0.92	0.92	0.89	0.57	0.97	1.01	0.95	0.65	1.02	1.11	1.03

Note: The table presents the aggregate effects of eliminating unemployment for alternative values of the price elasticity of the housing supply (γ). The counterfactual scenarios are: Exogenous Mobility: workers cannot change their residence and workplace choices; Commuting, No Migration: workers can change their workplace choices but cannot migrate; Commuting and Migration: workers can change both their residence and workplace choices. The average wage is calculated by weighting by employment. Aggregate labor income is the sum of the wages earned by employed residents. The average housing price is calculated by weighting by the number of residents. Real income per resident is calculated as the weighted average of the real income earned by each resident, whether employed or unemployed in the initial equilibrium, and using the number of residents as weights. BR is Brussels, FL is Flanders, WL is Wallonia, and BEL is Belgium.