DISCUSSION PAPER SERIES

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ABSTRACT

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In many European countries, wages are determined by collective bargaining agreements intended to improve wages and reduce inequality. We study the local and aggregate effects of collective bargaining in Italy and Germany. The two countries have similar geographical differences in firm productivity – with the North more productive than the South in Italy and the West more productive than the East in Germany – but have adopted different models of wage bargaining. Italy sets wages based on nationwide contracts that allow for limited local wage adjustments, while Germany has moved toward a more flexible system that allows for local bargaining. We find that, as a consequence, Italy exhibits limited geographical wage differences in nominal terms and almost no relationship between local productivity and local nominal wages, while Germany has larger geographic wage differences and a tighter link between local wages and local productivity. While the Italian system is successful at reducing nominal wage inequality, it also creates costly geographic imbalances. In Italy, low productivity provinces have significantly higher non-employment rates than high productivity provinces, because employers cannot lower wages, while in Germany the relationship between non-employment and productivity is significantly weaker. In Italy, the relationship between real wages and productivity is negative, with lower real wages in the North compared to the South, since the latter has low housing costs but similar nominal wages. Thus, conditional on having a job, Italian workers have higher purchasing power in the South, but the probability of having a job is higher in the North. We conclude that the Italian system has significant costs in terms of forgone aggregate earnings and employment because it generates a spatial equilibrium where workers queue for jobs in the South and remain unemployed while waiting. If Italy adopted the German system, aggregate employment and earnings would increase by 11.04% and 7.45%, respectively. Our findings are relevant for several other European countries with systems similar to Italy's.

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I Introduction

Wage inequality is large and rising in many countries. Different countries have different labor market institutions to try to mitigate labor market inequality, including minimum wages, subsidies for low wage workers like the Earned Income Tax Credit, and unions contracts.

In most European countries, collective bargaining agreements are common practice and cover the majority of workers. Typically, firms and unions belonging to a specific sector bargain over an occupation-specific wage schedule. This wage schedule applies to all workers in that sector, irrespective of their location and of whether or not they belong to a union.[1] The objective is to equalize salaries across employers and reduce inequality. Collective bargaining is prevalent in Austria, Belgium, Denmark, Finland, France Germany, Greece, Ireland, Iceland, Italy, Netherlands, Norway, Portugal, Slovenia, Spain and Sweden, although countries differ on how binding their national agreements are (European Central Bank, 2008).

In this paper, we investigate an important but under-researched feature of wage equalization systems. We argue that while national wage equalization may be successful at compressing wage inequality in a country, it can also create costly imbalances between cities and regions. In the presence of geographic differences in productivity across cities and regions, nominal wage equalization across localities can generate significant misallocations, leading to lower employment and earnings.

We study the local and aggregate effects of national wage bargaining systems in Italy and Germany. Italy and Germany represent two useful case studies. Both make extensive use of collective bargaining agreements, but the level of resulting wage flexibility is markedly different. Italian nationwide sectoral contracts are more binding and allow for only limited local wage adjustments. This means that within each sector, firms in high productivity and low productivity areas face largely the same wage schedule.[2] Germany previously had a similar wage setting system, but after reunification it made it more flexible. Due to concerns about lower productivity in the East, since 1996 Germany has adopted so-called "opening clauses" that allow firms to negotiate *locally* with unions, outside the nationwide agreements (Schnabel, 1998).

Our empirical analysis comprises two parts. In the first part, we study the relationship between local firm productivity and local wages, non-employment rates, and cost

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[1]As acknowledged by Card et al. (2004), there is de facto no distinction between union and nonunion sectors in these countries

[2]While firms can increase wages above the national contract schedule, they cannot lower them in most cases. We provide details on these institutions in the next Section.

of living. In the second part, we quantify the aggregate costs of spatial misallocation in Italy (compared to Germany) in terms of forgone employment and labor earnings. Our geographic unit of analysis is a local labor market, defined as an Italian "Province" (103 in total) or a German "Spatial Planning Region –"Raumordnungsregion" (96 in total).

Empirically, Italy and Germany have a similar cross-province standard deviation in mean firm productivity, as measured by firm value added. In Italy, firm value added is significantly higher in the North than in the South: in 2014, the gross value added per worker in an average firm of Milano, for example, was 71% above the value added in an average firm of Cosenza, in the southern region of Calabria. In Germany, productivity is significantly higher in the West than in the East: the value added per worker in an average firm in Munich is 83% above the value added in an average firm of North Thuringen in East Germany.[3] In Italy, the North-South productivity gap reflects long-lasting historical differences in transportation infrastructure, distance from European markets, efficiency of local governments and local policies, criminal activity, and cultural norms, while in Germany, the East-West gap likely reflects half a century of Communist rule in the East as well as other historical factors.[4]

While Italy and Germany have similar geographic distribution of firm productivity, they have important differences in the geographic distribution of nominal wages, likely reflecting wage bargaining differences in the two countries. In Italy, there is a much stronger degree of wage equalization across provinces than in Germany. For example, after controlling for worker characteristics the 90-10 percentile difference in mean wages across provinces is 42.9% in Germany, more than four times larger than the 10.3% difference in Italy. The mean wage difference between the North and the South in Italy is 4.2%, while the mean West-East difference in Germany is seven times larger: 28.2%, despite similar productivity differences.

Crucially, we find a marked difference in the relationship between local productivity and local nominal wages in the two countries. If wages can fully adjust, we should see a tight relationship between the two, with areas that enjoy higher firm productivity

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[3]Similar geographic differences exist in most countries. In the US, total factor productivity of firms in cities at the top of the TFP distribution is double that of cities at the bottom of the distribution (Hornbeck and Moretti, 2018).

[4]As we will show, the North-South productivity gap in Italy is remarkably similar to the West-East productivity gap in Germany. In 2014, the difference in mean value added between the Northern Italian and Southern Italian firms was 19.0%. The corresponding difference between West and East German firms was almost identical: 19.9%. In this paper, we will take these differences as given. Our analysis will focus on the effects of these differences, rather than their causes. The literature on regional productivity differences is immense. Examples for Italy include Banfield, 1958, Putnam et al., 1993, Ichino and Maggi, 2000, Guiso et al., 2004 and, more recently, Buonanno et al., 2015, Bigoni et al., 2016, Adda, 2018. An example for Germany is Burda and Hunt, 2001).

also having proportionally higher mean nominal wages. This is indeed the case in the US (Hornbeck and Moretti, 2018). By contrast, if wages are prevented from fully adjusting, we should see a weaker relationship. In the extreme case of fully-binding national contracts with complete nominal wage equalization, we should see no relationship at all. When we regress log mean nominal wage (adjusted for workers characteristics) on log value added across provinces, we find an elasticity of wages with respect to value added of 0.19 in Italy and 0.73–almost four times larger–in Germany. Thus, German firms appear to be significantly more able to adjust nominal wages to local productivity than Italian firms.

A simple spatial equilibrium model has several predictions for Italy and Germany, which appear consistent with our data. First, in Italy, where wages cannot fully adjust, provinces with low productivity should have higher non-employment rates. The reason is that firms in provinces where productivity is low need to pay wages above the local market-clearing level. This should be less true in Germany, where wages can adjust more to local productivity. Indeed, when we regress local non-employment rate on local value added we find that the elasticity of non-employment rates with respect to value added is negative in both countries–indicating that provinces with lower value added have higher non-employment rates–but the elasticity in Italy is -1.43 (0.03), almost six times larger (in absolute value) than Germany's -0.25 (0.02) elasticity. Our findings are not driven by the existence of an informal sector in Italy.

Second, the model indicates that since workers can move across regions, low productivity provinces should have lower housing prices, both in Italy and Germany. Empirically this is the case: we find a positive relationship between housing prices and local productivity.

Third, there are striking implications for real wages, defined as nominal wages deflated by the local cost of living. In Italy we find a *negative* relationship between real wages and local value added. Despite having higher productivity, provinces in the North have *lower* real wages than provinces in the South, since the South has low housing costs but similar nominal wages. By contrast, in Germany, we do not see that real wages in the West are lower than the East, since nominal wages are spatially more flexible.[5]

This means that employed Italians are better off working in the South in terms of purchasing power. However, the probability of having a job is higher in the North. One way to think about geographic differences in Italy is that national wage contracts have created a spatial equilibrium where workers queue for jobs in the South. If they find a

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[5]See Jappelli and Pistaferri (2010) for an analysis of how consumption inequality relates to income inequality in Italy.

job, they are better off than their colleagues in the North in terms of real wages, but while queued they remain not-employed.

Overall, the current wage-setting system in Italy appears inefficient. What would happen if nominal wages were allowed to reflect local productivity? Our model indicates that while nominal wages would decline in low productivity provinces, employment there would increase, resulting in an overall increase in employment in the country. Aggregate labor earnings would increase, but only if the elasticity of labor demand is larger than one. Intuitively, an elastic labor demand means that the increase in employment in low productivity areas more than offsets the decline in wages.[6]

In the last part of the paper, we quantify the aggregate costs stemming from spatial misallocation in Italy in terms of forgone aggregate earnings and employment. We consider what would happen if Italy adopted a system similar to Germany's. We provide estimates from a counterfactual scenario in which the Italian relationships between wages and value added and between non-employment and value added are the same as those observed in Germany. To be clear, we do not assume that wages or employment or value added are the same in the two countries; rather, we apply to Italy the elasticity of wages with respect to value added and the elasticity of non-employment with respect to value added that we estimate for Germany. Specifically, we set the counterfactual wages and the counterfactual employment in each Italian province based on the province observed value added and the elasticity of wages with respect to value added and employment with respect to value added that we estimate for Germany.

We find that average wages in Southern provinces would decrease by an average of 5.9% (or 53 cents an hour), while Southern employment would increase by 12.85 percentage points. On net, aggregate earnings in Southern provinces would increase on average by 16.6%, or 114 Euros a month. Nationwide, we estimate that aggregate employment would increase by 5.77 percentage points and aggregate earnings would increase by 7.45%. This amounts to around 600 euros per year for each working-age adult. We also consider an alternative counterfactual scenario where we allow for full adjustment of local wages to local productivity, and find similar estimates.

We conclude that in the aggregate, allowing union contracts some degree of local flexibility would improve the efficiency of labor allocation in Italy, resulting in increased employment and per capita labor income. There would also be distributional consequences, as currently-employed workers in the South would enjoy lower nominal and real wages.[7]

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[6]Labor demand—at least in the traded sector—is likely to be elastic in the case of an open economy like Italy, which is fully integrated in European product markets.

[7]We caution, however, that the welfare implications are unknown. A welfare analysis is outside the scope of this paper, as it would require, among other things, assessing the value of leisure for currently

Our findings are relevant to countries other than Italy and Germany, as the Italian and German system are by no means unique. Broadly speaking, France, Belgium, Portugal, Finland, Iceland, and Slovenia have a system similar to the Italian model, while Austria, Denmark, the Netherlands, Norway and Sweden are closer to the German model (OECD, 2017 and 2018). Countries like Greece, Portugal and Spain have recently moved from a bargaining system similar to Italy's to a "controlled decentralization" which is not unlike the German system. France has long debated the desirability of a more decentralized bargaining system, and such reform was initially part of the labor market reforms proposed by President Macron in 2017, though it was subsequently dropped due to strong union opposition. While the level of macroeconomic benefit from such reforms is likely to vary from country to country depending on the extent of productivity differences across regions, it is safe to conclude that countries with binding national contracts would improve efficiency if they moved toward the German wage-setting model.

This paper is part of a growing body of work that focuses on the causes and consequences of misallocation.[8] The US represents an interesting specular example of spatial misallocation. In the US case, little prevents nominal wages from adjusting.[9] However local employment is *de facto* constrained in many highly productivity cities, resulting in large spatial misallocation. Hsieh and Moretti (forthcoming) have found large efficiency losses in the form of forgone output and earnings caused by land use regulations that limit housing supply in the most productive cities, thereby constraining the flow of labor toward high-TFP locations. By contrast, in the Italian case nothing constrains local employment or mobility, but local wages cannot adjust to local labor demand conditions.[10]

Our paper is also part of the literature on centralized wage bargaining. While much research has been devoted to the effects of centralized wage bargaining in Italy, Germany and other European countries[11], the effects on the geography of employment and wages and their aggregate costs have not previously been studied.

The paper is organized as follows. In Section II we describe the institutional setting and wage determination mechanisms in Italy and Germany. Section III describes our theoretical model and its predictions. Section IV describes the data. Empirical evidence

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non-employers individuals.

[8]Restuccia and Rogerson (2017) provides a recent survey.

[9]The federal minimum wage in the US is not as binding as national contracts in Europe. It only apply to low-wage workers, while European national contracts define wage floors for all levels of employment, excluding top management. Moreover, in the US there is geographic variation in minimum wages, with state- and city-level minimum wages significantly more binding than the federal minimum wage.

[10]Other authors have used similar models to measure the effect of state taxes (Fajgelbaum et al., 2015), internal trade frictions (Redding, 2013), infrastructure (Ahlfeldt et al., 2015), and land misallocation (Duranton and Puga, 2014).

[11]For example, Calmfors and Horn (1986), Boeri et al. (2001), and Iversen (1996).

is presented and discussed in Section V. The aggregate costs of spatial wage rigidity are analyzed in Section VI. Section VII concludes.

II   Wage Setting Mechanisms in Italy, Germany and Other European Countries

We begin by describing the main features of the wage bargaining systems in Italy and Germany. We then discuss which among European countries have wage bargaining systems close to the Italian or German model. We stress that the specifics of a given country's labor market institutions are quite complex. We do not seek to provide a comprehensive description of all the features of the wage-setting systems in each European country, but instead seek to distill the key differences relevant in our analysis, abstracting from many less crucial details.

Italy.   Wage bargaining institutions in Italy have been historically designed to achieve strong nominal wage compression.[12]   Today, national agreements between unions and employers set wages for each industry and occupational level. Industries are defined narrowly: For instance, there are currently 34 contracts in the chemical industry, 31 in textiles, and 39 in food production. Overall, there are 346 national agreements, and they cover 97.7 per cent of dependent employment in the social security system and 99.3 per cent of firms.[13]

With limited exceptions, Italian firms cannot pay a salary below the level established at the national level, irrespective of their specific profitability and product demand conditions. Thus, despite large geographic differences in productivity, transportation infrastructure, geographic location, local public goods, and local government effectiveness across different areas of the country, firms in a given industry face the same wage floors.[14] In theory, the system does allow for some wage bargaining at a decentralized level, either at the firm level or within local industry clusters ("*distretti industriali*"). In practice, de-

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[12]Until 1992, it was mainly the centralized indexation of wages to inflation (*Scala Mobile*) that reduced nominal wage dispersion across sectors, regions and skill levels. The indexation imposed the same absolute (as opposed to proportional) salary increase to all employees, independent of their salary. As a result, wage increases in percent terms were large at the bottom and small at the top of the distribution, resulting in strong compression over time as described by Erickson and Ichino (1994), Checchi and Lucifora (2002), Manacorda (2004) and Garnero (2018)). This mechanism was abolished in 1992, and in 1993 the Italian government, the national trade unions, and the employer associations signed a new income policy agreement which is still in effect today.

[13]By definition, national agreements do not include the informal sector.

[14]In some exceptional circumstances of firms facing particularly severe difficulties, wages lower than those established at the national level may be allowed. These cases are limited by "opening", "hardship" or "inability to pay" clauses to exceptional circumstances such as severe macroeconomic or idiosyncratic shocks that make downsizing unavoidable. These provisions are rarely invoked before a firm is in severe distress.

centralized bargaining is limited because it is only allowed to increase wages above the levels set by the national agreements.[15]

In many cases, wages in national contracts are set close to the market clearing levels in Northern regions. One reason is that Southern employers are not well represented in employer associations. Northern regions have a much larger number of firms, especially in manufacturing, and dominate the process. Confindustria, the main employer association in manufacturing, collects almost 80 per cent of its revenues in the North and is typically led by a Northern president.[16] On the workers' side, unions are less transparent on their data, but their membership also seems to be dominated by workers from Northern and Central regions.[17] By contrast, Southern employers and workers do not often have the critical mass to have a strong voice in multi-employer bargaining. Empirically, most Northern provinces are generally close to full employment in a typical non-recession year, while unemployment is invariably much higher in the South.

In practice, private sector Italian firms do retain a limited degree of wage flexibility. National contracts allow limited geographic differentiation and some use of merit pay. In recent years, the diffusion of "Contratti di lavoro a tempo determinato" (fixed term contracts) has allowed to pay wages below national contracts to a limited number of employees per firm (Saggio et al., 2018). Firms can also pay employees under the table. Thus, while one should expect wage compression, one should not expect nominal wages to be uniformly identical in the private sector. Wages in the public sector (13.6% of employment in 2015), on the other hand, *are* nationally uniform; wages of teachers, doctors, nurses, social security workers, police, and military personnel are the same in every province for a given job description and level of seniority.[18]

Table 1 presents an actual example of an Italian wage agreement. This specific agree-

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[15]Decentralized bargaining is limited to a small number of large firms, since the wage floors imposed by the national contracts are typically high for small and medium size firms. In a 1995-96 survey of a representative sample of 8,000 firms with at least 10 employees in both the manufacturing and service sectors, only 10 per cent of the firms reported engaging in firm-level bargaining (IStat, 2000). Since then this share has declined (Casadio, 2003, 2008 and Brandolini et al., 2007).

[16]In terms of timing, employer organizations in the four strongest regions (Lombardia, Piemonte, Veneto, and Emilia, which are all in the North) typically sign the leading contracts in metalworking, textiles, chemicals and other manufacturing sectors.

[17]According to Il Fatto Quotidiano of April 29, 2017, the two main unions (CGIL and CISL) have about 50% of their members in the North, only one third in the South and the rest in the Center. The third main union (UIL) is only slightly more represented in the South (40%) because its members are mostly public sector employees.

[18]As a reaction to the strong nominal wage compression imposed by national agreements, the past few years witnessed an increasing number of so-called "pirate contracts" engineered by a small group of employers and a labor consultant, involving a "fake union" created ad-hoc with the purpose of signing the contract. This kind of agreement is, however, still very rare according to the National Council for Economy and Labor (CNEL, 2018).

ment applies to one occupational level ("Livello 1") in the construction sector ("*Contratto Collettivo Nazionale per i Lavoratori Edili*") in 2016. Entries are based on official figures released by the Italian Ministry of Labor and Social Affairs and show the degree of permitted labor cost differentiation across provinces for each specific component of labor costs. The table shows that the main components of labor costs – for example, the floor and the indexation to inflation – have no cross-province variation, while other components have limited cross-province variation. The bottom row shows that, overall, the standard deviation of total labor costs across provinces allowed by the agreement is only Eur 0.62.

Table 2 shows examples of geographic wage variations for two large private sector employers and one public sector employer. For confidentiality, we cannot reveal the names of the two private firms. The previous table referred to a wage agreement while this table reports wages actually observed in the labor market, but the picture is similar. The first row shows the median monthly salary at a large national bank. We report the median monthly salary of male bank tellers with 10 to 20 years of seniority and find limited geographic variability across North, Center and South Italy. For example, in the Northern city of Milan mean earnings are 1,659 euros per month, while in the Southern cities of Naples, Palermo and Bari they are 1,649, 1,677, and 1,670 euros, respectively. In the second row we show corresponding figures for a large national energy distribution company, inclusive of bonuses and merit pay. In both cases, we uncover limited geographic differences. If anything, wages in the energy company are slightly higher in the South, although for confidentiality reasons we cannot report wages for specific occupations. In the last row we show the salary for an elementary school teacher with 5 years of seniority. As in the rest of the public sector, there is no variation in the nominal wage across areas.

These are motivating examples based on three specific cases. In Section V we will present more systematic evidence on geographic wage heterogeneity for a representative sample of Italian workers based on labor survey data.

Germany. Germany offers an interesting case study to compare with Italy. Before the Unification of East and West Germany, the country had a wage-setting system not unlike Italy's today. The system was changed after Unification due to the large differences in productivity levels between East and West and the many firms' threats to walk out of employer associations. In particular, 'opening clauses" were enhanced to allow firm-level bargaining for wages lower than those established at the national level (see Dustmann et al. (2014) for a discussion of German labor market institutions and their reforms). Opening clauses enable company management and works council to conclude works agreements which deviate from the industry-level collective agreement within certain

limits. In the chemical industry, for instance, an opening clause allows companies to reduce the collectively agreed wage by up to 10 percent for a limited period of time in order to save jobs or improve competitiveness.[19]

More precisely, until the mid-1990s the German system was based on a two-tier bargaining structure. First, industry-wide collective bargaining negotiations between unions and employer associations took place at the regional ("*Lander*") level. One of the regions was typically pivotal for negotiations in other regions. Then plant-level bargaining took place, but wages could only increase relative to those established at the regional level. Since collective agreements were often settled uniformly for the whole industry (with only minor regional differences), wage differentiation between regions, sectors, and plants was only achievable if plants paid premiums above the contract wage (Schnabel, 1998, Dustmann et al., 2009).

After German unification, the scope for plant-level bargaining was significantly enhanced by allowing for opting-out and derogation clauses from the wage floors established by higher levels of bargaining. This development was caused by the concern that employers in the new Eastern regions might leave their respective associations in order to separately negotiate their labor contracts. The threat of large-scale association downsizing if less-productive firms in the East had to adopt Western wage floors was a factor in generating union support for "opening clauses". Another threat was the possible relocation of firms to neighboring Eastern European countries.

The decline in the importance of collective bargaining and the rise of opening clauses is quantified in Table 3. The ultimate effect of this reform was a significant increase in the decentralization of wage-setting in Germany. The decline in the importance of industry-level contracts in Germany after 1995 and the corresponding increase in the importance of firm-level wage-setting mechanisms have allowed a growing number of German firms to set wages in line with their productivity.

Other countries. An analysis of the Italian and German bargaining systems has implications not just for Italy and Germany, but also for other countries. While the specifics of each country labor market institutions are different, key aspects of the Italian and the German bargaining systems are present in many other European countries.

For our purposes, the key difference between the Italian and German systems is that the latter permits a much wider scope for decentralized bargaining than the former, allow-

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[19]Trade unions and employer associations retain the right to veto such deviating works agreements. Sectoral agreements also impose a number of conditions for derogations to apply: companies have to disclose their financial information allowing workers representatives to have enough time to scrutinize the financial status of the firm, and the derogation must be temporary.

ing wages to vary more as a function of local productivity. Within the OECD, countries with systems closer to Germany's tend to leave considerable room for firm-level bargaining and/or permit deviations or opt-outs from sectoral agreements under a broad set of circumstances. OECD (2018b) calls this system "organized decentralization". According to the OECD, the group of countries that had a system of organized decentralization in 2015 includes Austria, Denmark, the Netherlands, Norway, and Sweden along with Germany (OECD (2018b)).

By contrast, countries with systems closer to Italy's are countries where national industry-level agreements play a dominant role and deviations are either not possible or only allowed for wage *increases* relative to sectoral agreements.[20] According to the OECD, this group includes France, Iceland, Portugal, and Slovenia (OECD, 2018b).

In the wake of the Euro-area crisis, three countries–Spain, Portugal, and (to some extent) Greece–recently transitioned from a highly-centralized system towards a more decentralized, German-style model. A comparison of the Italian and German system can be informative on the possible effects of these reforms.

More generally, many European countries have a two-tier bargaining structure in which sector-level bargaining can, in principle, be accompanied by plant-level or local area bargaining. For example, in Denmark the proportion of firms carrying out two-tier bargaining more than doubled between 1989 to 1995 (Traxler et al., 2001; Andersen et al., 2003). Similarly, the number of Belgian firms involved in both industry and plant-level agreements increased tenfold from 1980 and the mid-1990s (Van Ruysseveldt and Visser (1996)). Two-tier bargaining structures are also present in Austria, Finland, the Netherlands, Norway, and Sweden (Boeri et al., 2001).

III   Theoretical Framework

Both Italy and Germany have large spatial productivity differences. In Italy, national contracts limit the ability of local wages to adjust to local productivity, while in Germany the past two decades of labor market reforms have allowed employers to adjust wages to local productivity.

In this section, we present a simplified spatial equilibrium model intended to provide intuition for the effects of the Italian and German wage-setting systems and to guide our empirical analysis. The model is a standard Rosen-Roback model and is kept deliberately simple. The main objective is to compare the spatial equilibria under two extreme cases: (1) local nominal wages can freely adjust to local productivity, and (2) local nomi-

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[20]Sometimes this principle extends beyond pay and includes employment features like hours and annual leave, which firms can only improve upon from the perspective of employees.

nal wages cannot adjust (due to institutional constraints) but workers and firms are free to relocate. Rosen-Roback models of spatial equilibria have traditionally focused on the case of market clearing. The case where the labor market does not clear has not received much attention.[21]

In interpreting the model, two points need to be clear. First, while the model provides useful benchmarks, it should be clear that neither Germany nor Italy is exactly described by either of these two extremes. While German firms have some flexibility to set nominal wages more in line with local productivity levels, union contracts ensure that this flexibility is not absolute. Similarly, while Italian firms have less flexibility in setting nominal wages, they nevertheless maintain some ability to adjust wages. Second, the focus is on geographic differences. Thus, we abstract from labor market institutions that affect all provinces equally. While both Germany and Italy have important labor market rigidities of this variety, their effects are clearly outside the scope of this paper.

III.A Setup

We consider two regions $r = \{n, s\}$ that produce a traded good with a price set on the international market. Production in each region is given by:

$$(1) \qquad Y_r = A_r K_r^{(1-\alpha)} E_r^\alpha$$

where A_r denotes Total Factor Productivity (TFP); E_r is employment and K_r is capital. The two regions are ex-ante identical with the exception of their level of TFP. We assume that n is more productive than s due to exogenous historical factors: $A_n \geq A_s$.

Population of each region is L_r, with the total population of the country $\bar{L} = L_n + L_s$ assumed fixed. The utility of a resident of region r is given by:

$$\Omega_r = \frac{w_r}{p_r^\sigma} (1 - u_r)^\delta$$

where w_r is the nominal wage level, p_r is the housing price in region r; σ is the weight of housing in the consumption basket; u_r is the non-employment rate in region r: $u_r = 1 - (E_r / L_r)$.[22] We assume that workers can freely move across regions and that they optimally choose where to live. Specifically, we assume zero mobility costs and no heterogeneity in taste for location. Thus, in equilibrium it needs to be the case that workers are indifferent across the two regions: $\Omega_n = \Omega_s$.[23]

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[21] Kline and Moretti (2013) model a case where unemployment arises from search frictions.

[22] For simplicity, we ignore local amenities and assume that workers are renters. Both assumptions can be relaxed.

[23] In the case of heterogeneity in taste for location, the marginal worker is indifferent between the two

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Firms optimally choose how many workers to hire and how much capital to use. As in the standard model, factor demand comes from the first order conditions implying that the price of each factor must be equal to its marginal product. Capital is supplied to firms in a region at an increasing price: $i_r = \mu \ln K_r$.

To close the model, we assume that each resident consumes one unit of housing and that the supply of housing is upward sloping: $\ln p_r = \gamma \ln L_r$. Put differently, housing costs are proportional to regional population.

Nominal wages, employment, capital, housing prices, population, and interest rates in each of the two regions – $w_n, w_s, E_n, E_s, K_n, K_s, p_n, p_s, L_n, L_s, i_n, i_s$ – are endogenous.

III.B Equilibrium When Wages Are Set by Market.

We first consider the standard free market case with flexible wages. The usual condition that a region's nominal wage equals the region's marginal product of labor follows from firms' first order conditions:

$$(2) \qquad\qquad w_r^* = \alpha A_r K_r^{*(1-\alpha)} E_r^{*-(1-\alpha)}$$

where the asterisk denotes an equilibrium variable in the free market case. Similarly, demand for capital in the two regions is determined by the marginal product of capital, obtained by differentiating Equation 1 with respect to K. In equilibrium, the marginal product of capital equals the rate of return. Given the additional condition that workers must be indifferent between the two regions, employment, population, capital and housing prices in the two regions are determined. The resulting equilibrium is the standard Rosen-Roback equilibrium, which is well understood in the literature. For our purposes, three features of this equilibrium are worth emphasizing.

First, equilibrium employment, capital and nominal wages are higher in n, which is the region with higher TFP. This can be seen explicitly by expressing equilibrium employment, capital and nominal wages as a function of the model exogenous parameters:

$$(3) \qquad\qquad \ln E_n^* - \ln E_s^* = \frac{(1+\mu)}{\sigma\gamma(\mu+\alpha) + \mu(1-\alpha)}(\ln A_n - \ln A_s) > 0$$

$$(4) \qquad\qquad \ln K_n^* - \ln K_s^* = \frac{(1+\sigma\gamma)}{\sigma\gamma(\mu+\alpha) + \mu(1-\alpha)}(\ln A_n - \ln A_s) > 0$$

locations, so results are qualitatively similar (See Moretti, 2011).

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(5)
$$\ln w_n^* - \ln w_s^* = \frac{(1+\mu)\sigma\gamma}{\sigma\gamma(\mu+\alpha)+\mu(1-\alpha)}(\ln A_n - \ln A_s) > 0$$

These three equations make intuitive sense. Since TFP is higher in n, profit-maximizing firms hire more workers and use more capital in that region. The differences in labor and capital inputs are proportional to the difference in TFP. The marginal product of labor is also higher in n, and hence the equilibrium nominal wage is higher, with the regional wage gap proportional to the gap in TFP.

Housing costs are higher in n because more workers live there in equilibrium:

(6)
$$\ln p_n^* - \ln p_s^* = \frac{(1+\mu)\gamma}{\sigma\gamma(\mu+\alpha)+\mu(1-\alpha)}(\ln A_n - \ln A_s) > 0$$

The difference in housing costs between the North and the South needs to be large enough to make workers indifferent between the two regions. This follows from the spatial equilibrium assumption. As a result, while nominal wages are higher in n in equilibrium, real wages are equalized in the two regions:

$$\frac{w_n^*}{p_n^{*\sigma}} = \frac{w_s^*}{p_s^{*\sigma}}$$

.

Finally, there is full employment in both regions, since there are no rigidities preventing the labor market to clear: $u_n^* = u_s^* = 0$.

III.C Equilibrium When Wages Are Set by National Contract.

We now turn to the case of wage rigidity due to collective bargaining. We assume that a national contract forces firms to pay the same nominal wage $\bar{w}$ in the two regions despite productivity differences. In particular, we focus for simplicity on the case where nominal wages are set equal to the market clearing wage in n, and thus above the market clearing wage in s:

(7)
$$\bar{w} = w_n^* > w_s^*$$

As discussed in Section II, this is consistent with the typical prescription of a union contract in Italy. Results are qualitatively similar when nominal wages are set between the market clearing wage in n and s: $w_n^* > \bar{w} > w_s^*$.

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After $\bar{w}$ is set by the national contract, employment, population, and housing prices adjust endogenously in the two regions. Non-employment also adjusts endogenously, since it depends on employment and population. The key difference relative to the free market case is that a national contract results in lower equilibrium employment, capital and output in s. While the wage in s is higher relative to the free market equilibrium, fewer workers are employed and total national employment declines. As a consequence, aggregate output and aggregate earnings are lower. By imposing a wage in s that exceeds s's productivity, the national contract generates spatial misallocation and causes a national economic loss.

To see this in more detail, consider how firms set employment in this context. The right-hand side of Equation (2) still represents the region's marginal product of labor, and therefore the labor demand function of firms in that region. But now the region's nominal wage is not endogenously determined by the market. Instead, it is exogenously set equal to $\bar{w}$. Firms in each region maximize profits by choosing employment and capital accordingly. It's clear that firms in s will hire fewer workers, simply because labor demand is downward sloping.

Just like in the free market case, residents reallocate between n and s until utility is equalized in the two regions. Thus in equilibrium:

$$\frac{\bar{w}(1 - u_n^{**})}{p_n^{**\sigma}} = \frac{\bar{w}(1 - u_s^{**})}{p_s^{**\sigma}}$$

where the double asterisk denotes an equilibrium variable in the collective bargaining case. A number of important features of this equilibrium are worth discussing. First, employment is lower in s. A comparison with Equation (3) indicates that the employment gap is larger than in the free market case:

$$(8) \qquad \ln E_n^{**} - \ln E_s^{**} = \frac{(1 + \mu)}{\mu(1 - \alpha)}(\ln A_n - \ln A_s) > 0$$

Unlike in the free market case, now s experiences equilibrium non-employment: $u_s^{**} > 0$. Intuitively, $\bar{w}$ is above the market clearing wage in s and non-employment results from the wedge between the wage and local productivity. In equilibrium, the level of non-employment in s is proportional to the productivity gap:

$$(9) \qquad u_s^{**} = \frac{(1 + \mu)\sigma\gamma}{\mu(1 - \alpha)(\sigma\gamma + \delta)}(\ln A_n - \ln A_s) > 0$$

By contrast, n enjoys full employment because $\bar{w}$ is assumed to be equal to its market

clearing wage.

As in the free market case, housing costs are higher in n since employment and population are higher there,[24] but unlike the free market case, real wages are now *lower* in n:

$$(10) \qquad \frac{\bar{w}}{p_n^{**\sigma}} - \frac{\bar{w}}{p_s^{**\sigma}} = -\frac{(1+\mu)\sigma\delta\gamma}{\mu(1-\alpha)(\sigma\gamma+\delta)}(\ln A_n - \ln A_s) < 0$$

Intuitively, this is due to the fact that housing costs are lower in s but nominal wages are the same. This has the interesting implication that conditional on employment, residents of s are better off than residents of n. Specifically, residents of the s queue to get a job and those who earn jobs are better off than their counterparts in n.

Finally, in equilibrium firms invest less in s than in n.[25]

III.D   Aggregate Effects

We have found that in the fixed wage equilibrium, a fraction of residents in s are not employed. They optimally choose to stay in s even if they are idle because if they were to find a job, the real wage would be higher. Therefore, relative to the free market equilibrium, the fixed wage equilibrium results in lower *aggregate* employment in the country. Moreover, since capital and labor are imperfect substitutes, the total stock of capital in s is also lower in the fixed wage equilibrium.[26] Thus, the fixed wage equilibrium results in lower aggregate output: $Y_n^* + Y_s^* > Y_n^{**} + Y_s^{**}$.[27]

If labor demand is elastic, the fixed wage equilibrium also results in lower labor income

$$(11) \qquad \frac{(w_n^* E_n^*) + (w_s^* E_s^*)}{\bar{L}} > \frac{(\bar{w} E_n^{**}) + (\bar{w} E_s^{**})}{\bar{L}}$$

To see why, notice that we can rewrite this inequality as

$$(12) \qquad (\bar{L} u_s^{**})\bar{w} > E_s^*(\bar{w} - w_s^*)$$

This expression can be see graphically in Figure 1, which shows the marginal product of labor (and therefore the labor demand) in s. Point 1 and 2 are the free market equi-

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[24]In particular: $\ln p_n^{**} - \ln p_s^{**} = \frac{(1+\mu)\delta\gamma}{\mu(1-\alpha)(\sigma\gamma+\delta)}(\ln A_n - \ln A_s) > 0.$

[25]The gap in the capital stock is $\ln K_n^{**} - \ln K_s^{**} = \frac{1}{\mu(1-\alpha)}(\ln A_n - \ln A_s) > 0.$

[26]The equilibrium amount of capital in s is $\ln K_s^{**} = \frac{\ln A_s + \ln(1-\alpha) + \alpha \ln E_s^{**}}{\mu + \alpha}$. Since $E_s^{**} < E_s^*$, it follows that $K_s^{**} < K_s^*$.

[27]Note that employment and capital are higher in n in the fixed wage equilibrium compared to free market equilibrium. But this only partially mitigates the aggregate losses.

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librium and the fixed wage equilibrium, respectively. The left-hand side of Equation 12 is the area of the rectangles A+C. The right-hand side is the area of the rectangles B + C. Labor income is larger under free market if A is larger than B.[28]

Intuitively, setting the wage above the market wage in s has two effects. On the one hand it raises the wage that employed workers receive by $(\bar{w} - w_s^*)$. On the other it lower employment by an amount defined in Equation (9). Labor income declines relative to the free market case if labor demand is sufficiently elastic, as represented in the Figure. For a small open economy, product demand and therefore labor demand are likely to be elastic.

Overall, the wage rigidity created by national union contracts has aggregate costs in terms of forgone aggregate employment, output and possibly labor income. In Section VI we will quantify these losses in the case of Italy.

IV   Data

Our empirical analysis is based on data for the labor and housing markets in Italy and Germany. Employment rates are obtained by the national statistical offices and are for individuals aged 15-64. Our wage data for Italy and Germany are from the National Italian Statistical Office (ISTAT) quarterly labor force statistics and the Institute for Employment Research (IAB)[29], respectively. They include all private and public employees for Italy (individual-level wage data for 2009 – 2013); and all private and public employees who are subject to social security contributions for Germany (individual-level wages for 1975 – 2014). For Italy, housing cost information comes from the Osservatorio Mobiliare Italiano and contains transaction-level data on residential real estate sales in Italy. German housing data are obtained from the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). Data on gross value added for all industries are from OECD (2018a).

Geographical Unit of Analysis. Choosing a geographic definition of local labor markets constitutes an important assumption in our study. Ideally, we would like to use a geographic unit akin to US Metropolitan Statistical Areas or Commuting Zones, which are small enough to encompass economically-meaningful units but large enough that most residents both live and work within a single region. Administrative boundaries of municipalities are likely to be too small; Italian and German workers easily commute across municipalities. For Italy, our definition of local labor markets is based on 103 provinces,

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[28]The term $(\bar{L}u_s^{**})$ on the left-hand side is the total number of non-employed. The employment loss $(\bar{L}u_s^{**})\bar{w}$ is smaller than the change in employment in s because under fixed wages employment in n is higher than under free market.

[29]This study uses the factually anonymous Sample of Integrated Labour Market Biographies (version 1975 - 2014). Data access was provided via a Scientific Use File supplied by the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB).

with average working-age population of 495,104. The minimum and maximum working-age population are 76,884 to 3,418,941. For Germany, we base our definition on 96 'Spatial Planning Regions" (Raumordnungsregion) with an average working age population of 737,448 and a range of 187,990 to 3,030,240.

In Italy, we define North and South by including in the North the following regions: Emilia-Romagna, Friuli Venezia Giulia, Liguria, Lombardia, Marche, Piemonte, Toscana, Trentino-Alto Adige, Umbria, Valle d'Aosta, Veneto. The South is the everything else. In Germany, we define West and East based on the historical Cold War division, with Berlin assigned to East.

Wages, Employment and Informal Sector. We seek to measure mean wages by province and year in Italy and Germany, controlling for differences in worker quality and industry mix across provinces. To estimate *conditional* average wages net of workers' characteristics and industry effects, we use worker-level data for Italy and Germany to regress

$$w_i = \alpha + Z_i \beta + u_i$$

where w_i is the hourly (Italy) or daily (Germany) wage of worker i and Z_i is a vector that includes worker i's gender, age, age squared, education, and industry. The regression is performed separately for Italy and Germany. We take the average residual $\hat{u}_i$ for every province-year pair, which we interpret as the average wage in that province and year holding constant worker observable characteristics and industry.[30] In the remainder of the paper, the term "wages" will refer to conditional mean wages.

In measuring employment in Italy, a potentially important issue is the existence of a large informal sector, which includes workers paid under the table to avoid taxes and Social Security contributions. Since the informal sector is widely understood to be larger in Southern provinces than in Northern provinces, this has the potential to lead us to underestimate employment rates in the South. Two points are worth noting. First, the employment rates that we use are computed using data that come from Istat Quarterly Labor Force Survey which is anonymous. In contrast to employment rates obtained from Social Security records, which are based on earnings reported by employers to the government and therefore miss the informal sector by construction, workers in the sample

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[30]To scale the average wage properly, we add to each province-year mean residual the mean national wage in 2010. This re-scaling simply means that our measures of conditional wages for Italy and Germany are scaled so that their averages equal the 2010 average wage in Italy and Germany, respectively. Due to data availability, for Italy, we use hourly wages net of taxes, while for Germany we use daily wages gross of taxes. We will present robustness checks to assess whether using wages net or gross of taxes in the two countries matters for our results.

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that we use to compute our employment rates have limited incentive to misreport their employment status. Second, we will present additional estimates that are based on *corrected* employment rates, obtained by adding to our baseline employment rates estimates of informal employment by province produced by the Italian National Statistical Institute (IStat, 2014).

Housing Costs and Local Cost of Living Indexes. We seek to measure mean cost of housing by province and year, controlling for differences in housing quality across provinces. For Italy, we follow the same approach that we use for wages. We regress

$$p_i = \alpha + X_i\beta + u_i$$

where p_i is the price per square meter of housing unit i and X_i is a vector that includes unit size, presence of a balcony, terrace or cellar, brightness, views, orientation, measures of quality of construction, distance to retail stores, distance to public transport, distance to public park or garden, parking, indicators for neighborhood type, and whether the municipality is located by the sea or in the mountains (these last two variables come from ISTAT). As with the wage residuals above, we then average the residuals from this regression by year and province.

The German housing data are rent prices collected by the regional planning authority BBSR from online or newspaper advertisements. To compute prices per square meter, the BBSR uses non-furnished flats of a size between 40 and 130 sqm in announcements listed for less than half a year. They filter out implausible prices and luxury flats. We compute weighted averages by Raumordnungsregion, using weights that reflect the stock of housing in the area.

The main source of geographical differences in local cost of living is represented by differences in cost of housing. An additional source is represented by differences in the price of non-tradable goods and services. The price of non-tradables tend to vary regionally with the price of housing. For example, a sandwich or haircut in Milan tend to cost more than a sandwich or haircut in Palermo. We build a local Consumer Price Index (Local CPI) following the methodology proposed by Moretti (2013) and using data on regional measures of CPI from the Italian and German statistical offices.[31]

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[31]Both countries' statistical offices provide regional measures of CPI that cannot be used for geographic comparisons as they are normalized to 1 in a given year. Nevertheless, they can be used in quantifying the relationship between prices of housing in an area and the price of other goods and services in that area. Specifically, we regress changes over time in CPI for a province on changes of its housing component. We run these regressions separately for Italy and Germany. Using these estimates, we then construct a Local CPI for Italy and one for Germany. The two Local CPI's measure differences in cost of living across provinces within each of the two countries. Local CPI_{pt} is defined as $CPI_{pt} = \omega HP_{pt} + (1 - \omega)NHP_{pt}$

Productivity. To our knowledge, the only measure of firm productivity available at a fine geographic level in Italy and Germany is gross value added. Gross value added is firm output valued at basic prices less intermediate inputs valued at purchaser prices. The basic price is the amount receivable by the producer from the purchaser for a unit of a product or service minus any tax on the product plus any subsidy on the product. Gross value added per worker in each province is obtained by dividing this measure by employment in that province. We obtain data on gross value added per worker for all industries at the local level from OECD (2018a).

Table A–1 shows summary statistics for 2010. Unsurprisingly, the non-employment rate is on average higher in Italy (42.5%) that in Germany (27.9%). This remains true when the Italian figure is corrected for the existence of informal work (34.0%). When considering mean wages, it should be noted that in our data wages are defined as hourly wages for Italy and daily wages for Germany. Mean value added per worker is slightly higher in Italy than in Germany. This likely reflect the fact that the available variable does not account for hours worked, which are not available at the detailed local level at which we run our analysis. Since the fraction of part time workers is on average higher in Germany (26.3%) than in Italy (15%), even if hourly value added is higher in Germany, value added per worker is higher in Italy. We do not expect this to be a major problem for our analysis, since we focus on differences between provinces within each of the two countries.[32]

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where HP_{pt} is housing price in province p and year t, NHP_{pt} is the price of non-housing or non-tradables, and (ω) is the housing weight. Some part of NHP varies with the housing price so that $NHP = \pi HP + \nu$. Therefore when we regress ΔCPI_{pt} on ΔHP_{pt}, $\beta = (\omega + (1-\omega)\pi)$. Then, we use ω to compute: $\pi = \frac{\beta - \omega_n}{1 - \omega_n}$. We then use the province specific housing prices obtained through our own calculations and construct the local CPI as:

$$CPI_{pt} = \omega HP_{pt} + (1-\omega)\left[\pi HP_{pt} + (1-\pi)NHP_t\right]$$

See Moretti (2013) for details. The housing weight in consumption ω for Germany is obtained from the German Federal Statistical Office (Destatis). For Italy we use consumption weights from Households consumption surveys for the years 2005-2011. See also Jappelli and Pistaferri (2000).

[32]More productive regions tend to have a higher share of part-time employment in both countries, but the dispersion of the fraction of part-time workers across local areas is similar in Germany and Italy, ranging, in 2010, between 20.2% and 32.1% among the 16 German regions and between 10.6% and 20.5% among the 20 Italian regions. If we regress the log part-time share per region on the log value added per worker of each region including year fixed effects (years 2005-2014). The coefficient of this regression in Germany is 0.60 while for Italy it is 0.69. This implies that the relationship between value added and part-time work across provinces is very similar in the two countries and that the incidence of part-time work is not likely to bias our results.

V Empirical Evidence

In this section, we first document the degree of productivity differences across provinces in Italy and Germany (subsection V.A). We then turn to wages, studying the relationship between nominal wages and local productivity (subsection V.B). Third, we study the relationship between non-employment rates and local productivity (subsections V.C) and the relationship between real wages and local productivity (subsection V.D).

V.A Value Added

The maps in the top panel of Figure 2 show value added per worker in Italy (left panel) and Germany (right panel) in 2010. Throughout the paper, all maps are in percent deviations from the unweighted national mean. The bottom panel in Figure 2 shows the spatial distribution of value added in the two countries across provinces in 2010.

Two features are important. First, the overall amount of geographical variation in productivity is similar in Italy and Germany, with the bulk of the distribution between -20% and 20% in both countries.[33] This level of geographic variation is not atypical among industrialized countries and it is not unlike what we see, for example, in the US (Hornbeck and Moretti, 2018).

Second, while there is some overlap, it is clear from the Figure that in Italy Northern provinces are vastly more productive than Southern provinces, and in Germany Western provinces are similarly more productive than Eastern provinces. Interestingly, the patterns are comparable in the two countries: the difference between the mean province in Northern and Southern Italy is 17.6%, while the difference between the mean province in West and East Germany is 22.7%.

We stress that in this paper, we take these differences as given; our analysis focuses on the *effects* of these differences rather than their *causes*. As we discuss above, in Italy, North-South differences probably reflect historical differences in many determinants of regional productivity, including transportation infrastructure, distance from European markets, efficiency of local governments and local policies, criminal activity, and cultural norms. These differences are long lasting and largely determined by historical factors. In Germany, East-West differences likely reflect half a century of Communist rule in the East as well as other historical factors. While it is in principle possible to model endogenous regional differences in the long run, such models are outside the scope of this paper.

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[33]The range, 90-10 percentile difference and 75-25 percentile difference are: 57.79%, 27.92% and 17.95% in Italy and 70.47.72%, 39.92% and 17.65% in Germany.

V.B Nominal Wages

The map in the top panel of Figure 3 shows geographical differences in nominal wages in the two countries, drawn using the same scale. The difference between Italy and Germany is seen even more clearly in the bottom panel of Figure 3, which shows the spatial distribution across provinces in the two countries.

The distribution is more compressed in Italy than in Germany, as one might expect based on the wage bargaining systems in the two countries. The mass of the distribution in Italy is between -10% and 10% of the country mean, while in Germany it is between -26% and 22%. The 75-25 percentile difference and 90-10 percentile difference were 5.8% and 10.3% in Italy and 13.1% and 42.9% in Germany. The amount of spatial wage dispersion in Germany is lower than what we see in the US, but not by much (Dauth et al., 2018). By contrast, the amount of spatial wage dispersion in Italy is much lower.

Wages are by no means completely uniform across Italian provinces, despite national wage contracts at the industry level, for the reasons discussed in Section II. Moreover, there are data limitations. National contracts specify a given wage for a given occupation and level of seniority in the firm. While we control for a worker work experience, as standard in wage regressions, we do not directly observe seniority. Our occupational categories are not as fine as those used in union contracts. There may also be measurement error in our data. While we use the largest available dataset, sample sizes in each province are finite.

Overall, while there is some geographical wage dispersion in Italy, it is clear from Figure 3 that wage dispersion is significantly wider in Germany. For our purposes, the empirical relationship between local productivity and local nominal wages is particularly important. If wages can fully adjust, our model indicates that we should see a tight relationship between the two, with provinces that enjoy higher productivity having higher nominal wages. This is indeed the case in the US (Hornbeck and Moretti, 2018). By contrast, if wages are prevented from fully adjusting, we should see a weaker relationship or none at all.

Figure 4 presents scatter plots that document the relation between the log conditional mean nominal wage by province on the y-axis and log mean value added on the x-axis in 2010. The Figure shows that while in Germany there is a positive relationship between local nominal wages and local productivity, in Italy the relationship is significantly weaker. Thus, German firms appear significantly more able to adjust nominal wages to local productivity than Italian firms. Indeed, the graph for Italy suggests almost no relationship between wages and productivity, presumably due to constraint imposed by nationwide contracts.

Table 4 shows the corresponding regression coefficients.[34] Columns 1 and 3 show that in a regression of log conditional mean nominal wage on log mean value added the elasticity of nominal wages with respect to local value added is 0.19 and 0.73 in Italy and Germany, respectively. In other words, the elasticity is almost four times larger in Germany than in Italy. In columns 2 and 4 we condition on region fixed effects, where regions are North and South in Italy, and East and West in Germany. These models absorb North-South and East-West differences in the determinants of wages, and are identified by variation in value added *within a region*. In these models, the elasticity for Italy drops to 0.13, while in Germany is 0.37, or three times larger.[35]

Overall, we find that despite large productivity differences across provinces, Italy's wage-setting mechanism results in nominal wages that are generally compressed across space. Crucially, there is little or no correlation between mean productivity in a province and mean nominal wages. By contrast, Germany has more nominal wage dispersion. Although Germany has the same amount of productivity difference across provinces, the absence of binding national wage contracts allows wages to better adjust to local labor market conditions.

V.C Probability of Non-Employment and Informal Employment

Our model predicts that in Italy, where wages cannot adjust fully, provinces with low productivity should have higher non-employment rates. This should be less true in Germany, where wages can adjust more to local productivity.

The maps in the top panel of Figure 5 show rates of non-employment in Italy and Germany, by province. This difference between the two countries is more clear in the bottom panel of Figure 5, which shows the spatial distribution of non-employment rates in the two countries. In Italy there is almost no overlap between the North and the South in non-employment rates. While the North is at or close to full employment, the South has much higher rates of non-employment. Germany is different. Despite equally large spatial productivity differences, the East-West differences in non-employment rates are much smaller. Indeed, the distributions for West Germany and East Germany overlap almost completely.

Figure 6 shows more explicitly the relation between non-employment rate and log

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[34]The sample includes years 2000-2014 for Germany and 2009-2013 for Italy.

[35]A similar point is made in Appendix Table A–2. In the first row, we regress individual level log wages on workers characteristics: sex, age, age squared, education and the industry. Entries in the table refer to the R^2. In the second row, we add province fixed effects. In Italy, the R^2 increases only marginally, from 0.35 to 0.36. By contrast, in Germany the R^2 increases significantly more, from 0.39 to 0.46. This suggests that despite large productivity differences across provinces, local factors play a minimal role in explaining individual level wage variation in Italy, and a larger role in Germany.

mean value added in 2010. Unsurprisingly, the elasticity of non-employment with respect to value added appears negative in both countries, indicating that provinces with lower value added have higher non-employment. But it is clear that the elasticity is significantly more negative for Italy than Germany. In Italy, areas with low mean value added have much higher non-employment rates than areas with high mean value added; in Germany, where nominal wages can adjust to local value added, the difference in non-employment rates is significantly smaller.

Column 1 and 5 in Table 5 show the corresponding regression coefficients. The elasticity in Italy is -1.43, almost six times larger in absolute value than the elasticity in Germany. In columns 2 and 6 we show estimates from models that include region fixed effects. These models controls for North-South and East-West differences in factors that affect non-employment rates, and are identified by variation in value added within each region. Both elasticities drop significantly, but the one for Italy remains 5 times larger than the one for Germany.

Of course, provinces within Italy and Germany differ in many respects, including infrastructures, efficiency of the public administration, crime rates, distance to European markets, etc. Our analysis assumes that these differences affect non-employment only through differences in mean value added per worker. For example, if Southern Italian provinces have worse transportation infrastructure than Northern Italian provinces, or they are further away from European markets, we assume that these differences in infrastructure and market distance are fully reflected in lower value added per worker in Southern provinces compared to Northern provinces. Put differently, we assume that conditional on local mean value added, there is no additional direct effect of quality of transportation infrastructure or distance from European markets on local non-employment rates.

It is in principle possible that the presence of an informal sector in Italy could explain some of the differences with Germany documented in Figure 6 and in columns 1 and 2 of Table 5. If employers in less productive provinces in Italy are forced to pay wages above the equilibrium wage by binding national contracts, they may react by paying workers under the table. If informal jobs are not included in employment measures, our estimates would be biased. Specifically, failure to include informal employment in Italy would lead us to estimate an elasticity of non-employment with respect to value added that is more negative than the true elasticity. We don't expect this bias to be very large in our setting because the employment data that we use should in principle include workers both in the formal and informal sector. As mentioned in Section IV, our data are based on an anonymous survey of individuals – not tax data or social security data – and there is no

a priori reason to think that workers in our sample have an incentive to misreport their employment status.

Nevertheless, we probe the robustness of our findings in columns 3 and 4 of Table 5 using an alternative measure of employment. This measure is based on estimates of the share of informal employment among all full-time equivalent units of work published by the Italian National Statistical Institute ISTAT taken from its Regional Accounts (IStat, 2014). Appendix Figure A–1 shows the fraction of employment in the informal sector, as estimated by ISTAT. We use this measure to inflate the employment rate in each province proportionally to the estimated informal sector.[36]

We find that models based non-employment rates inflated by ISTAT regional estimates of informal sector yield elasticities not very different from the baseline models. A comparison of Figure 7 with Figure 6 shows that after correcting for informality, there still is a strong negative correlation of non-employment rates with value added. Table 5 shows that the coefficients based on corrected non-employment rates (columns 3 and 4) are slightly smaller than those in columns 1 and 2, but remain much larger than the corresponding coefficients for Germany.[37]

The effect of nominal wage rigidity on the size of the local informal sector is interesting in itself. A larger informal sector implies less taxes and social security contributions being collected. In Table 6 we show results of a model where we regress the share of informal employment in a province on mean value added. We find a clear negative correlation, suggesting that informal sector is smaller in provinces where value added is higher. In column 1 we find a coefficient of -2.48. When we include region fixed effects, the coefficient drops to -0.96 but remains economically and statistically significant.

Overall, we draw three conclusions. First, and most importantly, in Italy non-employment rates are much higher in low productivity provinces than in high productivity provinces. While in Germany there is also a difference between high and low productivity provinces, the difference is significantly smaller in Germany than in Italy, presumably because employers in Germany have more flexibility in setting wages. Second, estimates are robust to including employment in the informal sector. Third, the informal sector in Italy is larger in provinces with low productivity. The higher non-employment rates and higher share of informal sector in low productivity provinces are potentially important unintended consequences of collective bargaining in Italy.

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[36]In particular, we inflate the official employment rate by a factor $\frac{1}{1-e_{inf}}$ where e_{inf} is the estimated share of employment in the informal sector.

[37]For completeness, Appendix Figure A–2 replicates Figure 5 using corrected non-employment rates.

V.D Cost of Living and Real Wages

Appendix Figures A–3 and A–4 show the spatial distribution of housing prices and overall cost of living (local CPI) in the two countries. Housing prices and cost of living are higher in Northern Italy and West Germany, with the geographic differences slightly more pronounced in Italy. Housing prices and overall cost of living are very highly correlated in both countries.

Figure 8 shows real wages, defined as nominal wages deflated by the index of local cost of living, Local CPI. Real wages in a province measure worker purchasing power. For a given nominal wage, real wages are higher the lower the local cost of living index.

For Italy, the comparison between nominal wages in Figure 3 and real wages in Figure 8 is striking. It indicates that real wages in many provinces of the South are significantly *higher* than the country mean, despite having low productivity. In Germany the same inversion does not occur. This is consistent with the predictions of our model.

Table 7 quantifies the North-South and West-East differences in nominal and real wages. Columns 1 and 3 show the nominal wage difference between North-South (column 1) and West-East (column 3). Despite the fact that productivity differences are similar in the two countries, conditional on worker characteristics the wage difference between the North and the South in Italy is only 4.2%, while the West-East difference in Germany is seven times larger at 28.2%. This disparity between the two countries is plausibly due to the fact that wages cannot fully adjust in Italy. Columns 2 and 4 show the corresponding real wage difference, which becomes negative in Italy. Thus, Southern Italian provinces are characterized by lower nominal wages than Northern provinces but higher real wages as a result of relatively low housing prices and cost of living. In Germany instead real wages are higher in more productive provinces.[38]

Figure 9 presents the province-level relationship between log real wages and log value added. Consistent with our model, in Italy, there is a negative relationship, indicating that the most productive provinces tend to have the lowest real wage. In Germany, the relationship is positive.

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[38]One difference between the two countries in terms of data is that the wages we use for Italy are net of taxes. Given a progressive tax scheme, taxes could compress wages and thus exaggerate the patterns we are pointing to in this paper. To adjust for this we use the mean wage of all full time workers in social security records (INPS) gross and net of taxes (from 2015) to generate a net/gross ratio for every province. We then construct the net/gross corrected wages dividing the net ISTAT wage of every province by the net/gross ratio for every province. The results base based on corrected wages are in the Appendix Table A–3. The correction does not change our findings.

VI   Aggregate Costs of Spatial Misallocation

In this Section we estimate the aggregate costs stemming from spatial misallocation in Italy. Misallocation arises because under the current wage setting system, firms in provinces where productivity is low are forced to pay wages above the local market-clearing level. As a consequence, output and employment in those provinces, many of which are in the South, are below what they could be if wages were flexible.

In this respect, the findings in the previous Section are striking. Workers in the South were found to enjoy higher real wages than workers in the North, because nominal wages are similar, but cost of living is lower in the South. However, non-employment is much higher in the South. One way to think about the spatial equilibrium in Italy is that Southern jobs are essentially rationed, with residents queuing to get one. If they succeed, their real wage is higher than in the North. But the higher non-employment means that many residents remain idle in the meantime. This implies an inefficient spatial allocation of resources and possibly large economic costs in terms of forgone earnings and forgone employment. In Germany the spatial equilibrium is different. Because nominal wages are more flexible, there are smaller differences in non-employment rates across regions.

If Italy adopted a collective bargaining system in which nominal wages were allowed to reflect local productivity, output and employment in low-productivity provinces would likely increase, resulting in an overall increase in national aggregate output and aggregate employment. This could happen if, for example, union contracts were negotiated at the provincial level instead of the national level.

Aggregate labor income might increase as well. Our model indicates that total labor income would increase if the elasticity of labor demand is larger than one. Intuitively, in low-productivity provinces wages would decrease relative to the current status quo. But an elastic labor demand implies that the increase in local employment would be proportionally larger than the decline in wages, insuring a positive effect on aggregate labor income. Labor demand is likely to be elastic in the case of a small open economy like a province.

If nominal wages were allowed to reflect local productivity, there would also be some distributional consequences, in the sense that there would be winners and losers relative to the status quo. The main losers would be currently-employed workers in the South, as they would earn lower wages.

To quantify the magnitude of these effects, we provide estimates from two counterfactual exercises. The two exercises are similar in that they both relax wage rigidity in Italy by allowing local wages and local employment to depend on local productivity. They differ in how tight the link with local productivity is allowed to be.

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In the first counterfactual scenario (partial adjustment), we seek to estimate what would happen to wages and employment if Italy adopted a version of collective bargaining as flexible as the one that exists in Germany. In practice, we apply to Italy the German elasticity of wages with respect to value added and the elasticity of employment with respect to value added. We set the counterfactual wages and the counterfactual employment in each Italian province based on the province observed value added and the elasticity of wages with respect to value added and employment with respect to value added that we estimated for Germany.

In the second counterfactual scenario (full adjustment), we set counterfactual wages and employment in each province assuming that wages fully adjust to local value added and the employment rate reaches Northern levels, as it would be the case in the standard market-clearing case with no frictions (see the first order conditions in equation 2).

In both scenarios, we compute counterfactual wages and employment for Italy's South and assume that the North is in full employment. As discussed in Section II, the current Italian nationwide contracts can be thought of as setting wages approximately equal to the market-clearing level in the North.

We caution that while the empirical results in the previous section were estimated exclusively from data, the quantification of aggregate losses naturally relies on some assumptions. The estimated effects should therefore be considered as an attempt to assess an order of magnitude, rather than exact figures.

VI.A   Assumptions

Counterfactual 1: partial adjustment. To compute counterfactual mean nominal wage in a province in the South, we take value added in the province as given and we predict local mean wage using the elasticity of wages with respect to value added that we have estimated for Germany. In particular, we use the elasticity reported in column 3 of Table 4, which is equal to .74. To be clear: we do not assume that the average wages or employment or productivity in Italy are the same as in Germany. Instead, we assume that if in Germany a 10% productivity difference is associated with a 7.4% wage difference, the same is true in Italy.

Thus, counterfactual wage in a province c in the South with value added A_c is defined as $[1 - 0.74 * \frac{(A_n - A_c)}{A_n}] * W_n$ where A_n and W_n are value added and wage of the median province in the North. Counterfactual wages and employment in the North are set equal to those observed in the data. Consider, for example, a Southern province with value added 10% below the median province in the North. The counterfactual wage is this province is set 7.4% lower than the wage that we observe in the data in the median

province in the North.

We compute counterfactual employment in a similar way. We assume that the relationship between non-employment and value added in the south is the same as the relationship between non-employment and value added that we estimated for Germany. We use the coefficient in column 5 of Table 5, which is equal to .25.

Counterfactual employment rate in a province c in the South is defined as $[1 - 0.25 * \frac{(A_n - A_c)}{A_n}] * E_n$ where E_n is employment rate in the median province in the North. For example, counterfactual employment in a province in the South with productivity 10% below the median province in the North is 2.5% lower than observed employment in the median province in the North.

In the data, the employment rate (corrected for informal employment) in the median province in the North is 71.23% and the median wage is 8.7 Euros per hour. To probe the robustness of our findings, we also estimate variants of these counterfactuals where the benchmark province is not the median province in the North but it is the median province among the top 5, 10 or 20 provinces in the North in terms of value added.

Counterfactual 2: full adjustment. In the second counterfactual scenario, we assume that wages in each province fully adjust to local productivity. That is, we assume that if one province is 10% more productive than another, then its wages are 10% higher. This is indeed the case in the standard market-clearing case, as evident in the first order conditions in equation 2.

The counterfactual wage in a province c in the South are defined as $[1 - \frac{(A_n - A_c)}{A_n}] * W_n$ and the counterfactual labor market clears at $E_c = E_n$. Counterfactual wages and employment in the North are set equal to those observed in the data, as described above.

VI.B   Results

Figures 10 shows how nominal wages and employment would change in Counterfactual 1 (partial adjustment). In particular, it shows the percent difference in wages and employment in each province relative to the status quo. Wages in most Southern provinces would decline, while their employment rate would increase. By assumption, there are no changes in the North. Figures 11 shows how nominal wages and employment would change in Counterfactual 2 (full adjustment). The changes in the two counterfactual scenarios appear very correlated.

Table 8 quantifies the wage and employment changes. Column 1 and 2 report observed and counterfactual wages, employment and aggregate labor income in the South. Columns 3 and 4 are for the North, which does not change by assumption; and columns 5 to 7 are for the nation.

The entry in column 1, first row, for example, indicates that the 2010 mean hourly wage in the South is Eur 8.6 in our data. The entry in the second row shows that the mean wage in Southern provinces in Counterfactual 1 would be 7.8, a decrease of on average 5.9% compared to status quo. Column 5 indicates that the average wage decrease across Italian provinces would be 2.6%.

The fourth row indicates that the status quo average Southern employment rate is 57.3%, after adjusting for informal employment. The fifth row shows that in Counterfactual 1, the employment rate in the Southern provinces would increase by 12.85 percentage points on average. The employment rate across Italian provinces would increase by 5.7 percentage points, an 11.0% increase. We see this an economically large effect.

Since average wage declines but employment increases, it is unclear what happens to labor income. The bottom panel reports Aggregate Labor Income, scaled in Euros per month per resident. Aggregate labor income is the product of monthly earnings times the employment rate. Monthly earnings are defined as the hourly wage multiplied by 160, under the assumption that workers work 160 hours a month. It is Eur 766 in the status quo in the South. In counterfactual 1 it increases by 114 Euros per month (16.6% on average) in the South and 7.45% across the country.

The changes under Counterfactual 2 are somewhat larger than the changes under Counterfactual 1, as one might expect, but quantitatively not very different. Letting nominal wages in each province fully adjust to local productivity would reduce hourly wage by 80 cents and increase employment by 13.9 percentage points in the South, raising income for the average Southern worker, whether employed or not, by about 95 Euros a month. For the country as a whole this increase would amount to a 6.25 percentage point increase in employment, corresponding to about 2.5 million additional jobs in the Southern provinces and to an average increase of about 500 euros of yearly income per working-age person in Italy.

Appendix Tables A–4, A–5 and A–6 repeat the counterfactual calculations for the case in which we use the median of the top 5, 10 and 20 provinces in the North as our status quo productivity baseline. Results are not very sensitive.[39]

With all their obvious limits due to the coarse assumptions on which they are based, these counterfactual exercises highlight the existence of potentially large gains in term of equity and efficiency deriving from a liberalization of wage bargaining across different

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[39]For example, in Appendix Table A–4 average hourly wages in Southern provinces would decrease by 0.98 to 1.45 Euros, depending on the scenario, while Southern employment would increase by on average 12.85 or 14.63 percentage points. Aggregate earnings in the South would increase by 28 to 61 Euros a month, and nationwide aggregate employment would increase by on average 6.21 – 7.34 percentage points and aggregate earnings would increase by 0.69% – 3.35%.

localities. The costs originating from spatial misallocation in Italy appear to be substantial.

VII   Conclusions

Centralized wage bargaining systems are common in Europe and have traditionally received substantial attention in the economic literature. But their effects on the geography of employment and wages and their aggregate costs have not previously been studied. In this paper, we study the local and aggregate effects of national wage bargaining systems by comparing the spatial distribution of wages, non-employment rates, cost of housing, and real wages in Italy and Germany. The two countries have a similar spatial distribution of firm productivity, but have adopted different models of wage bargaining. Italy sets wages based on nationwide sectoral contracts that allow for minimal local wage adjustments, while Germany has moved toward a more flexible system that allows for local bargaining.

We find that, as a consequence, the spatial distribution of nominal wages is very compressed in Italy, and the relationship between local productivity and local nominal wages is weak or possibly zero. By contrast, Germany has significantly more spatially-dispersed wages and a much tighter link between wages and local productivity.

These wage rigidities generate economically costly inefficiencies in Italy. We find that provinces with low productivity have significantly higher non-employment rates than provinces with high productivity, because employers in low productivity provinces cannot lower wages and end up hiring fewer workers. We also uncover a *negative* relationship between real wages and local value added in Italy. Despite having higher productivity, the North has *lower* real wages than the South, since the latter has low housing costs but similar nominal wages. This means that, conditional on having a job, an Italian worker is better off in the South in terms of purchasing power. However, the probability of having a job is higher in the North. Thus, national wage contracts have created a spatial equilibrium where workers queue for jobs in the South and remain unemployed while waiting. By contrast, in Germany real wages in the West are not significantly lower than in the East, since nominal wages are spatially more flexible.

From a macro-economic point of view, we find that the Italian wage bargaining system generates significant economic costs in terms of forgone aggregate earnings and employment. If nominal wages were allowed to reflect local productivity, aggregate employment and aggregate earnings would significantly increase in Italy. Based on reasonable assumptions, we estimate that aggregate Southern employment would increase by 12.85 – 13.92 percentage points. Aggregate earnings in the South would increase by 94 – 114

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Euros a month. Nationwide, we estimate that aggregate employment would increase by 5.77 to 6.25 percentage points or about 2.5 million jobs, and aggregate earnings would increase by 6.22% to 7.45%. In per capita terms, this amounts to around 500-600 euros per capita per year across all working-age adults, not just the employed. This could happen if Italy adopted a system similar to Germany's, where union contracts can be fully negotiated at the firm or provincial level instead of the national level.

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Table 1: Example of a collective bargaining contract in Italy: Construction sector, 2016

Cost component	Mean	Min	Max	SD
Minimum/Floor	4.86	4.86	4.86	0.00
Indexation to inflation	2.96	2.96	2.96	0.00
Cost of living allowance	0.06	0.06	0.06	0.00
Variable component of pay	0.15	0.04	0.50	0.09
Sectoral allowance	1.11	0.91	1.26	0.07
Total : Hourly components of pay	9.02	8.79	9.37	0.09
Remuneration for national holidays	0.61	0.60	0.62	0.00
Compensation for yearly vacation	0.47	0.46	0.48	0.01
Contribution to mutual sectoral fund	1.77	1.73	1.80	0.01
Transport allowance	0.29	0.05	1.40	0.20
Compensation for training	0.18	0.18	0.18	0.00
Contribution to mutual fund for injury	0.21	0.20	0.21	0.00
Total : Additional costs	3.46	3.19	4.64	0.21
Contribution to social security	4.38	4.23	4.78	0.09
Contribution to accident insurance	1.62	1.57	1.77	0.03
Contribution to special contruction worker fund	0.78	0.39	1.16	0.15
Total : Social security and accident insurance	6.78	6.34	7.57	0.23
Allowance for meals	0.60	0.12	1.75	0.26
Severance	0.98	0.92	1.39	0.05
Mobility allowance, complemenatary allowances	3.20	3.13	3.25	0.02
Contribution to pension fund	0.06	0.06	0.06	0.00
Total average hourly cost of labor	24.08	22.98	26.04	0.62

Note: The table shows the various components that are used to set compensation for workers in "Level 1" of the bargaining agreement for the May 2016 Construction sector ("Contratto Collettivo Nazionale per i Lavoratori Edili"). Monetary figures are in Euros. Entries show the degree of permitted labor cost differentiation across provinces for each specific component of labor costs.

Table 2: Median monthly wages at three employers

	Median North	Median Center	Median South
Private sector: Bank teller	1,666	1,667	1,664
Private sector: Energy company	2,736	2,923	2,931
Public sector: Elementary school teacher	1,305	1,305	1,305

Note: In the first row, we show the median monthly wage for a male bank teller with 10-20 years of experience in a large Italian bank, at occupational level 6 ("Inquadramento unico: impiegato"). The data come from years 1993-1995 and sample sizes are 423, 140, and 105 for the North, Center, and South respectively. The second row shows median monthly wages in a large company in the energy sector operating in almost all Italian provinces in 2016. We include men with less than 10 years of experience and with a permanent full-time contract. The sample size is 91, 64 and 130 individuals for the North, Center, and South respectively. In the third row we show the wage of an elementary school teacher with 5 years of seniority in 2014.

Table 3: Percentage of workers covered by collective bargaining and opening clauses in Germany

Year	% workers under industry contract		% workers subject to opening clauses	
	(1)	(2)	(3)	(4)
	West	East	West	East
1996	69.22	56.30	.	.
1998	67.77	50.46	.	.
2001	63.11	44.60	.	.
2003	62.08	42.58	.	.
2005	58.74	41.89	33.36	23.69
2007	56.18	40.57	38.30	28.19
2009	55.46	38.35	.	.
2011	53.70	37.44	47.27	40.01
2013	52.03	35.13	.	.

Note: This table shows the coverage of union contracts and opening clauses ("exceptions to union contracts on wage or hours"). The data are obtained from the German Institute for Employment Research (IAB).[40] The figures in this table show the fraction of workers working for an employer in the West and in the East who states to apply industry contracts or to use opening clauses respectively.

Table 4: Regression of mean nominal wages on mean value added

	Italy		Germany	
	(1)	(2)	(3)	(4)
Log value added	0.195	0.137	0.736	0.379
	(0.013)	(0.019)	(0.013)	(0.008)
Region FE:	No	Yes	No	Yes
Provinces:	103	103	96	96

Note: Entries are the coefficients of log mean value added in a regression of log mean nominal wage on log value added of each province pooling years 2000-2014 for Germany and 2009-2013 for Italy. All regressions include year fixed effects. Regressions in columns 2 and 4 include fixed effects for the North in Italy and the West in Germany. Standard errors in parentheses.

Table 5: Regression of non-employment rate on mean value added

	Italy				Germany	
	Uncorrected		Corrected			
	(1)	(2)	(3)	(4)	(5)	(6)
Log value added	-1.434	-0.534	-1.259	-0.403	-0.252	-0.110
	(0.030)	(0.031)	(0.042)	(0.050)	(0.024)	(0.031)
Region FE:	No	Yes	No	Yes	No	Yes
Provinces:	103	103	103	103	96	96

Note: Entries are the coefficients of log mean value added in a regression of the log non-employment rate among 15-64-year-olds on log mean value added of each province pooling years 2001-2015 for Germany, 2004-2015 for Italy in columns 1 and 2, and 2004-2011 for Italy in columns 3 and 4. Columns 1 and 2 (uncorrected) do not account for irregular employment in Italy, while columns 3 and 4 use estimates from IStat, 2014 to account for irregular employment. All regressions include year fixed effects. Regressions in columns 2, 4 and 6 include fixed effects for the North in Italy and the West in Germany. Standard errors in parentheses.

Table 6: Regression of the share of informal employment on mean value added

	(1)	(2)
Log value added	-2.487	-0.962
	(0.058)	(0.065)
Region FE:	No	Yes
Provinces:	103	103

Note: Entries are the coefficients of log mean value added in a regression of the log share of total work provided informally on log mean value added for each province pooling years 2001-2011. All regressions include year fixed effects. Regression in column 2 include fixed effects for the North. Standard errors in parentheses.

Table 7: Average wage differences between macro regions

	North - South in Italy		West - East in Germany	
	(1)	(2)	(3)	(4)
	Nominal	Real	Nominal	Real
% Difference	0.0425	-0.0921	0.282	0.176
	(0.003)	(0.017)	(0.003)	(0.007)
Provinces:	103	103	96	96

Note: This table reports the coefficients of regressions of log mean conditional wages of all local areas on an indicator of North/West. We pool all available years. For nominal wages: 2000-2014 (Germany) and 2009-2013 (Italy). For real wages: 2004-2014 (Germany) and 2009-2011 (Italy). All specifications control for year fixed effects. Standard errors in parentheses.

Table 8: Counterfactuals exercises for Italy

| | South | | North | | Italy | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
	Level	Change	Level	Change	Level	Change	Change %
Average hourly wage: *in Euros*							
Status quo	8.36		8.68		8.54		
Counterfactual 1	7.84	-0.53	8.68	0.00	8.30	-0.24	-2.65
Counterfactual 2	7.56	-0.80	8.68	0.00	8.18	-0.36	-4.13
Employment rate: *in % corrected for informal work*							
Status quo	57.32		71.00		64.86		
Counterfactual 1	70.17	12.85	71.00	0.00	70.63	5.77	11.04
Counterfactual 2	71.24	13.92	71.00	0.00	71.11	6.25	11.95
Aggregate labor income per capita: *in Euros per month*							
Status quo	766.63		986.68		887.89		
Counterfactual 1	881.00	114.37	986.68	0.00	939.24	51.34	7.45
Counterfactual 2	861.44	94.81	986.68	0.00	930.46	42.56	6.22

Note: In each panel the first row corresponds to the status quo in 2010. The second row corresponds to the first counterfactual scenario (partial adjustment), while the third row is for the second counterfactual scenario (full adjustment). Entries in columns (1), (3) and (5) are averages of hourly nominal wages, employment rates and aggregate labor income levels per capita across provinces of the South, of the North or of Italy as a whole, respectively. Entries in columns (2), (4) and (6) are the average changes corresponding to each counterfactual scenario. Column (7) shows the average percentage change across all Italian provinces, corresponding to each counterfactual scenario. Aggregate labor income in a province is the product of the average monthly earnings times the employment rate. Monthly earnings are the product of the hourly wage times 160 (which implies assuming 160 working hours per month).
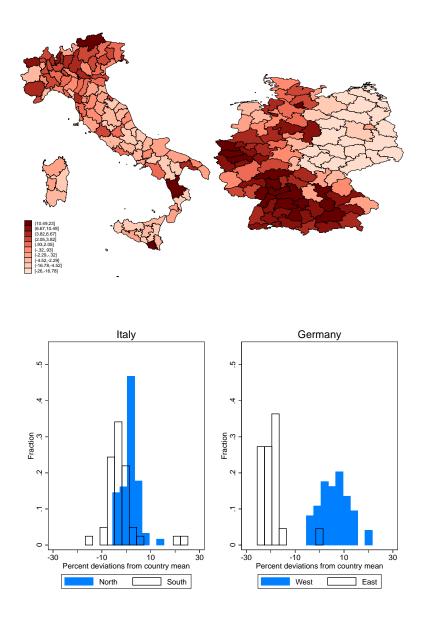
Figure 1: Labor demand

Note: Point 1 and 2 are the free market equilibrium and the fixed wage equilibrium, respectively. Setting the wage above the market wage raises the wage that employed workers receive but lowers employment. Aggregate labor income is larger if the negative effect of employment losses (the area of A) exceeds the positive effect from the higher wage (the area of B).
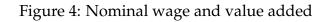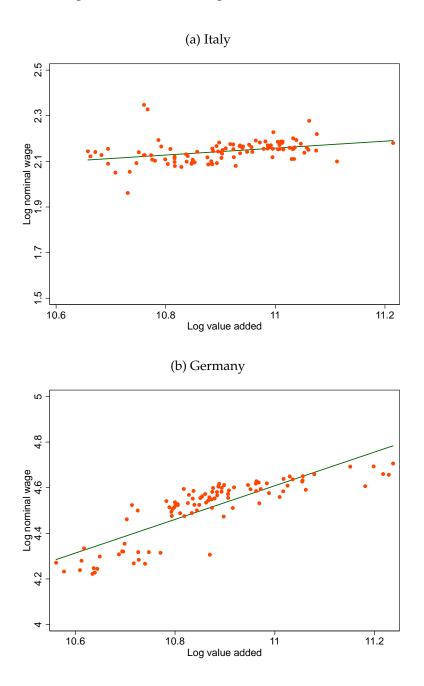
Figure 2: Mean value added per worker

(15.99,44]
(10.33,15.99]
(7.26,10.33]
(2.16,7.26]
(-.8,2.16]
(-3.4,-.8]
(-7.22,-3.4]
(-12.09,-7.22]
(-16.59,-12.09]
[-28,-16.59]

Italy

Germany

Note: This figure plots deviations from the country mean of the gross value added per worker of each province in 2010. Means across local areas are not weighted by population.
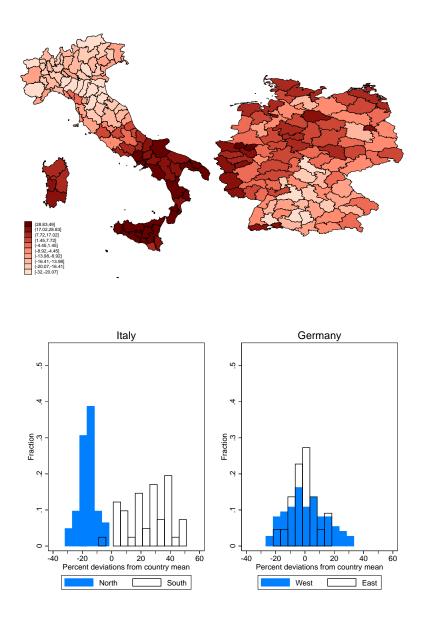
Figure 3: Nominal wages

Note: This figure plots deviations from the country mean of the nominal wages in euros (corrected for work force composition) of each province in 2010. Means are not weighted by population.

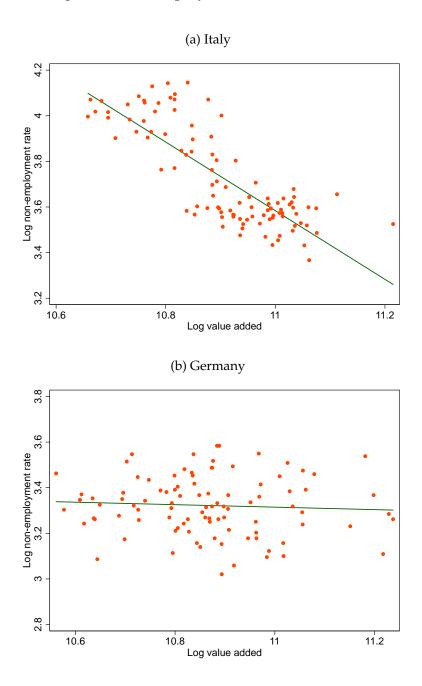# Figure 4: Nominal wage and value added

(a) Italy

(b) Germany

Note: This figure shows the relationship between log mean conditional nominal wages and log value added in 2010, across provinces. Each province is represented by a dot.
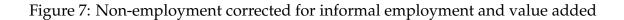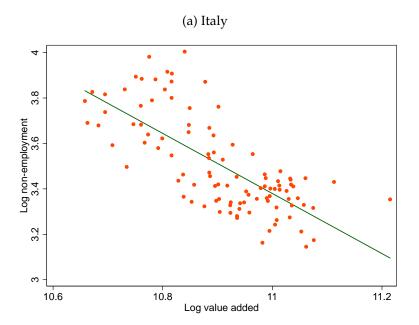
Figure 5: Non-employment rate

Note: This figure plots deviations from the country mean of the non-employment rate of 15-64-year-olds for each province in 2010. Means are not weighted by population.

Figure 6: Non-employment and value added
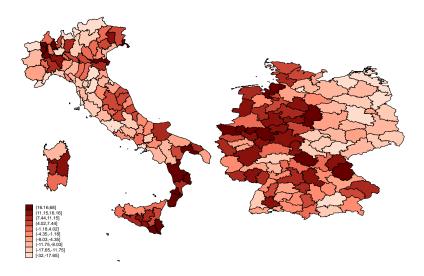
(a) Italy

(b) Germany

Note: This figure shows the relationship between the log non-employment rate among 15-64-year-olds and log value added across provinces in 2010. Each province is represented by a dot.

Figure 7: Non-employment corrected for informal employment and value added
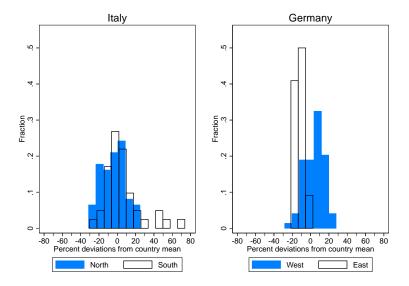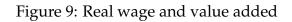
(a) Italy

Note: This figure shows the relationship between the log non-employment rate among 15-64-year-olds taking into account informal work, and log value added across provinces in 2010. Each province is represented by a dot.
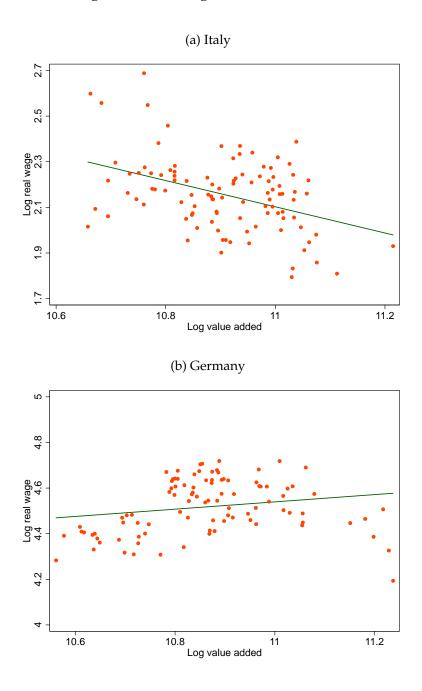
Figure 8: Real wages

Note: Deviations from the country mean of the mean conditional real wages in euros (conditional nominal wages adjusted for consumer prices, as explained in Section IV) of each province in 2010. Means are not weighted by population.

Figure 9: Real wage and value added

(a) Italy

(b) Germany

Note: This figure shows the relationship between log mean conditional real wages (log conditional nominal wages adjusted for consumer prices, as explained in Section IV) and log mean value added across provinces in 2010. Each province is represented by a dot.
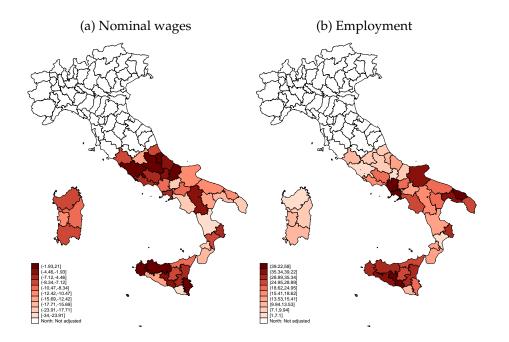
Figure 10: Change in wages and employment by province in counterfactual 1

(a) Nominal wages   (b) Employment

Note: The maps show the percent change in mean wage and employment rate in each province under counterfactual 1. For nominal wages, a lighter color indicates a larger in size negative adjustment. For employment a darker color indicates a larger in size positive adjustment. There is no change in the North by assumption.

Figure 11: Changes in wages and employment by province in counterfactual 2

(a) Nominal wages   (b) Employment

Note: The maps show the percent change in mean wage and employment rate in each province under counterfactual 2. For nominal wages, a lighter color indicates a larger in size negative adjustment. For employment a darker color indicates a larger in size positive adjustment. There is no change in the North by assumption.
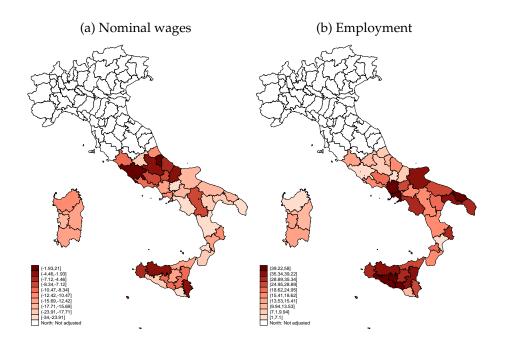
Table A–1: Summary statistics - 2010

Italy	Mean	SD	N
Value added per worker	54837	6227	103
Local CPI	100.0	16.19	103
Local housing price	100.0	25.17	103
Nominal wage - hourly	8.5	0.44	103
Real wage - hourly	8.8	1.47	103
Non-empl rate	42.5	9.58	103
Non-empl rate corrected	34.0	7.55	103
Germany			
Value added per worker	52901	8134	96
Local CPI	100.0	14.18	96
Local housing price	100.0	18.53	96
Nominal wage - daily	91.6	11.25	96
Real wage - daily	92.3	10.76	96
Non-empl rate	27.9	3.59	96

Note: Value-added is computed across all industries in each geographic area, as calculated by the OECD (Germany) and ISTAT (Italy), and it is divided by employment in the corresponding area. Housing prices are average prices for a square meter with similar characteristics in each area. The Local CPI is constructed using those housing prices according to the method describes in Section IV. Nominal wages are obtained after controlling for individual characteristics such as age, education, gender, and industry, as explained in Section IV. Note that for Italy we have "hourly" wages net of taxes, while for Germany we have "daily" wages gross of taxes. Real wages are deflated using Local CPI. Non-employment refers to the number of people age 15-64 out of employment over the total population of that age group. For Italy, we also report non-employment corrected for the presence of informal work

Table A–2: R^2 from a regression of individual wages on worker characteristics, industry and year fixed effects

	(1)	(2)
	Italy	Germany
Without province FE	.352	.389
With province FE	.36	.463
Difference	.008	.074

Note: the first row of this table reports the R^2 of regressions of individual wages on worker characteristics (gender, age, age squared and education), industry and year fixed effects, for Italy and Germany respectively. The second row reports the R^2 of the same regressions when province fixed effects are added to the specification. The third row reports the change in the R^2 deriving from the inclusion of province fixed effects. Data refer to 2009-2013 for Italy and to 1992-2014 for Germany.

Table A–3: Nominal and real wages corrected for taxes

	North - South			
	Uncorrected		Corrected	
	(1)	(2)	(3)	(4)
	nominal	real	nominal - corr	real - corr
% Difference	0.0425	-0.0921	0.0717	-0.0629
	(0.003)	(0.017)	(0.004)	(0.017)
Year FE:	Yes	Yes	Yes	Yes
Provinces:	103	103	103	103

Note: This table reports North-South differences in mean conditional wages obtained from regressions of log mean conditional wages on a dummy for the North. Columns 1 and 2 report, for convenience, the same estimates of Table 7 for Italy, based on wages net of taxes. Columns 3 and 4 are based instead on estimated wages gross of taxes. Wages used for Italy in the first two columns are from Istat and are net of taxes. To generate the corrected wages used in the remaining columns, we take the mean gross and net wages of all full-time workers from the Italian social security agency (INPS) to generate a net/gross ratio for every province. We then correct the Istat wages dividing the net wage of each province by the corresponding net/gross ratio derived from INPS. For nominal wages the data are for years 2009-2013 while for real wages they are for years 2009-2011. All specifications control for year fixed effects. Standard errors are in parentheses

Table A–4: Counterfactual scenarios - Variant 2 – top 5 provinces

	South		North		Italy		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Level	Change	Level	Change	Level	Change	Change %
Average hourly wage: *in Euros*							
Status quo	8.36		8.68		8.54		
Counterfactual 1	7.38	-0.98	8.39	-0.30	7.94	-0.60	-6.99
Counterfactual 2	6.92	-1.45	8.23	-0.46	7.64	-0.90	-10.50
Employment rate: *in % corrected for informal work*							
Status quo	57.32		71.00		64.86		
Counterfactual 1	70.17	12.85	71.80	0.79	71.07	6.21	11.80
Counterfactual 2	71.95	14.63	72.41	1.41	72.20	7.34	13.74
Aggregate labor income per capita: *in Euros per month*							
Status quo	766.63		986.68		887.89		
Counterfactual 1	828.53	61.90	963.96	-22.72	903.16	15.27	3.35
Counterfactual 2	795.03	28.40	953.35	-33.33	882.28	-5.61	0.69

Note: This table is like Table 8, but the reference group used to calculate A_n, E_n and W_n is the median of the top five provinces in terms of value added, rather than the median of all Northern provinces.

Table A–5: Counterfactual scenarios - Variant 3: top 10 provinces

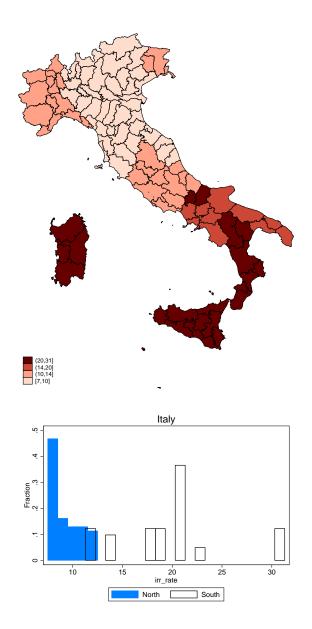|	South		North		Italy		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Level	Change	Level	Change	Level	Change	Change %
Average hourly wage: *in Euros*							
Status quo	8.36		8.68		8.54		
Counterfactual 1	7.37	-0.99	8.38	-0.30	7.93	-0.61	-7.09
Counterfactual 2	6.93	-1.43	8.25	-0.43	7.66	-0.88	-10.28
Employment rate: *in % corrected for informal work*							
Status quo	57.32		71.00		64.86		
Counterfactual 1	69.66	12.35	71.32	0.32	70.58	5.72	11.01
Counterfactual 2	71.34	14.03	71.82	0.82	71.61	6.75	12.78
Aggregate labor income per capita: *in Euros per month*							
Status quo	766.63		986.68		887.89		
Counterfactual 1	821.33	54.70	956.94	-29.73	896.06	8.17	2.50
Counterfactual 2	790.23	23.60	948.41	-38.27	877.40	-10.50	0.11

Note: This table is like Table 8, but the reference group used to calculate A_n, E_n and W_n is the median of the top ten provinces in terms of value added, rather than the median of all Northern provinces.

Table A–6: Counterfactual scenarios - Variant 4: top 20 provinces

	South		North		Italy		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Level	Change	Level	Change	Level	Change	Change %
Average hourly wage: *in Euros*							
Status quo	8.36		8.68		8.54		
Counterfactual 1	7.42	-0.94	8.43	-0.26	7.97	-0.57	-6.55
Counterfactual 2	7.02	-1.34	8.34	-0.35	7.75	-0.79	-9.27
Employment rate: *in % corrected for informal work*							
Status quo	57.32		71.00		64.86		
Counterfactual 1	69.00	11.69	70.60	-0.40	69.89	5.03	9.89
Counterfactual 2	70.53	13.21	70.94	-0.06	70.76	5.90	11.41
Aggregate labor income per capita: *in Euros per month*							
Status quo	766.63		986.68		887.89		
Counterfactual 1	819.10	52.47	952.57	-34.10	892.65	4.76	2.10
Counterfactual 2	791.41	24.78	946.83	-39.84	877.06	-10.83	0.08

Note: This table is like Table 8, but the reference group used to calculate A_n, E_n and W_n is the median of the top twenty provinces in terms of value added, rather than the median of all Northern provinces.

Figure A–1: Share of informal employment

Note: This figure plots deviations from the country mean of the share of irregular employment out of total employment of each province in 2010. Means are not weighted by population. The share of irregular employment is provided by IStat, 2014.
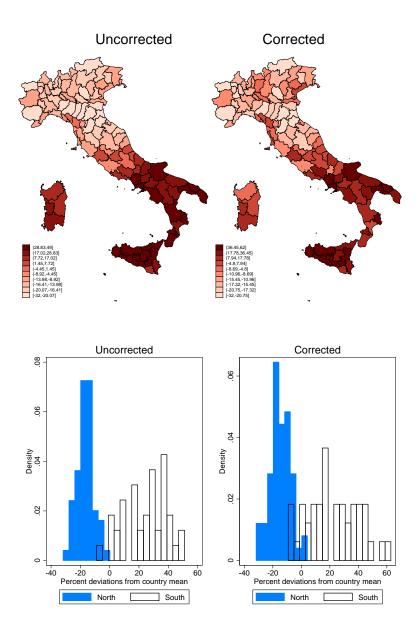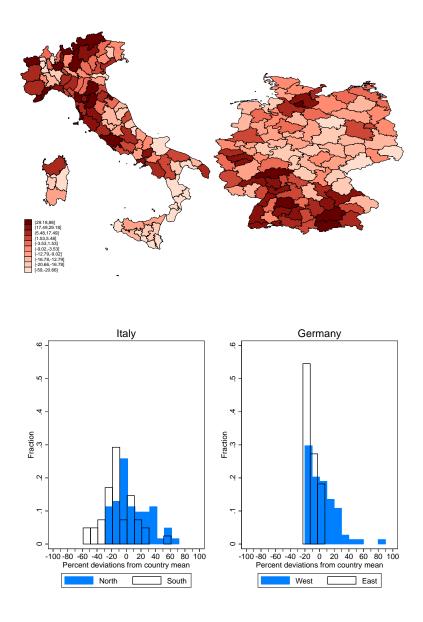
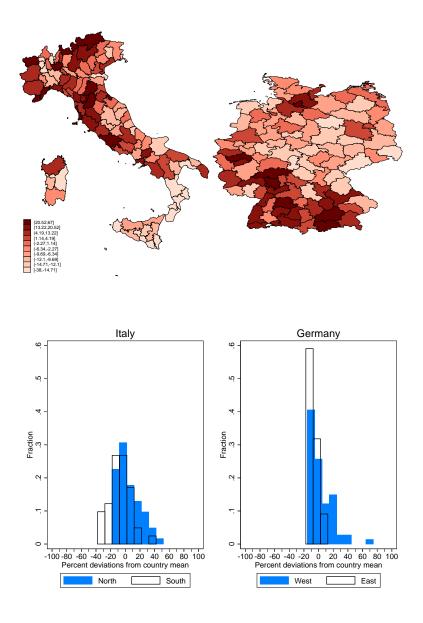# Figure A–2: Non-employment rate corrected for informal employment

Note: To account for employment in the informal sector in Italy we compute an "informal labor market - corrected" employment rate by adjusting our employment rate to the fact that we only observe a proportion $1 - e_{inf}$ (1-rate of informal employment) of actual employment. We thus inflate the official employment rate by a factor $\frac{1}{1-e_{inf}}$. This figure plots deviations from the country mean of the non-employment rate of each province in 2010, comparing the corrected and uncorrected figures. Means are not weighted by population. The share of irregular employment is provided by IStat, 2014.

Figure A–3: Housing costs

Note: This figure plots deviations from the country mean of the housing price index of each province in 2010. Means are not weighted by population.

Figure A–4: Local cost of living index

Note: This figure plots deviations from the country mean of the consumer price index of each province in 2010. Means are not weighted by population.