Sun, regulation and local social networks*

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Abstract

The aim of this paper is to explain over-regulation and local social capital as barriers to immigration. The interest of social networks is that conflict resolution is independent of the law. Hence, if local individuals develop local social capital and regulation, foreigners without social networks are disadvantaged and can less easily migrate. We develop a two-country search-theoretic model where we endogenize the choice of procedural formalism (PF) and the network size. This model features two different equilibria: a Mediterranean equilibrium with PF and dense local social network and a Scandinavian and Anglo-Saxon equilibrium without PF and local social networks.

Keywords: Housing market regulation; local social capital; mobility, climate amenities; social networks

J.E.L classification : R38

1 Introduction

The aim of this paper is to explain over-regulation and local social capital as barriers to immigration. Regions or countries richly endowed in geographic amenities tend to attract foreign people. Though the process may create wealth for all, it also fosters competition for scarce resources. One way to mitigate the problem for local people is to promote market regulation and induced procedural formalism in judicial conflicts, while investing in local social networks. Procedural formalism lengthens trial duration and makes their outcome more uncertain. Those who are well inserted in a local social network trade and exchange within this network. This allows them to avoid going to courts and solve their disputes within the network. Meanwhile foreigners cannot use this possibility and disputes involving them always end in courts. This reduces their competitive position, thereby lowering incentive to migrate and reducing the market pressure on scarce resources.

We illustrate this idea in a particular case, i.e., procedural formalism in the rental market, and in a particular geographical area, i.e., Europe. The rental market offers a good application to our general idea because space is limited and rents constitute a substantial share of household income (typically

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30% in France). Though a relatively small continent, Europe is characterized by climate and rental market regulation heterogeneity. Mediterranean countries enjoy more sun and regulate more the rental market. Immigration in such countries should be large because the sunshine capital is attractive (see, e.g., Rodríguez-Pose and Ketterer, 2012 or Michaelides, 2009). Such immigration would increase the demand for dwellings in the rental market tightness, leading to higher prices and lower probability of finding a rental for all. To reduce such potential immigration from countries where climate amenities are low, individuals living in countries with high climate amenities erect barriers to entry involving procedural formalism and social capital.

We proceed in three steps. In Section 2, we present empirical evidence motivating our analysis. Firstly, we explain that the sunshine influences the well-being and the migratory behaviors of individuals. The statistical identification of sunshine effects is not obvious because it is difficult to separate such effects from those of the regulation. We start by exposing medical arguments whereby sunshine is good for health. We then study migratory flows for sub-populations less exposed to endogeneity problems. We especially focus on retirees and student who are free from constraints on the rental and labor markets. Secondly, we show that typical measures of sunshine, local social capital and regulation are positively correlated. Lastly, we use micro data from the World Value Survey and the European Community Household Panel and show that social capital and family ties are both more developed in mediterranean countries than in the rest of Europe.

In Section 3, we develop a two-country model where procedural formalism drives landlords to favor local applicants who benefit from extended local social networks. We then study the social demand for procedural formalism and social networks due to the migratory pressure generated by the amenity differential between countries. The framework involves coordination frictions. Individuals apply for a dwelling, whereas landlords may receive several applications and choose the best one. When setting procedural formalism, individuals leaving in the southern country are confronted to the following trade-off. On the one hand, procedural formalism and social networks increase their probability of getting a lease at the expense of foreigners. On the other hand, developing a social network is costly and procedural formalism involves paying higher rents out of social networks. When the increase in probability of getting a lease is sufficiently large compared with the costs of procedural formalism in terms of rents and the cost of social network formation, then the southern country chooses to regulate its rental market and individuals invest in their social network.

In Section 4, we calibrate the model and show that the optimal level of social network increases with the climate amenity differential between the northern and the southern countries. Moreover, the comparison between the *laissez-faire* equilibrium and the regulated equilibrium highlights that the number of foreigners decreases with regulation.

Put in the grand perspective of the role of the State and the market in modern societies, our paper predicts that openness to the rest of the world does not necessarily lead to the end of the family and other local arrangements as ways to provide the basic needs to individuals. Instead, openness may well promote market regulation and foster investment in local social networks. In turn, this may explain why emancipation values fail to spread in southern European countries.

This paper belongs to the growing strand of literature on the positive analysis of market regulation.

This literature aims at understanding the degree of regulation of various markets in different countries. Decreuse and van Ypersele (2011) argue that the social demand for job protection increases with procedural formalism in the housing market. Alesina et al (2015) demonstrate that individuals with strong family ties rationally choose regulated labor markets to avoid moving and limiting the monopsony power of firms. Closer to this paper, Bonleu (2015) highlights that individuals with strong social networks prefer regulated rental markets. We present a complementary approach where procedural formalism and local social networks form barriers to immigration.

Though focusing on the rental market, the arguments of this paper easily extend to the labor market. On the (disputable) ground that jobs can be considered as a fixed resource, employment protection legislation can repulse employers from hiring foreigners, thereby improving labor market prospects for local workers. The two sets of regulation can also be seen as complementary. Procedural formalism in the rental market reduces worker mobility. Following Alesina et al (2015), this lack of mobility provides employers with market power. Labor regulation is then a way to mitigate such market power. These different mechanisms lead to a Mediterranean equilibrium with high climate amenities, large local social capital, low mobility and strong regulation on the rental and labor markets. A contrario, the northern countries with low climate amenities are not attractive to southern Europeans[1]. Therefore individuals do not promote procedural formalism and do not need to invest in local social networks.

Our paper also renews the analysis of local social ties. There is an established literature stressing the complementarity between investment in local social ties, including friends and family, and lack of geographical mobility (see, e.g., David et al, 2010, and Alesina et al, 2015). Individuals with local social capital are less mobile. Though our model does not say much about worker mobility, we highlight the role played by climate amenities in these reasoning.

There is body of literature linking climate amenities and economic performance. In a hedonic general-equilibrium framework, Albouy et al (2013) measure the willingness to pay of Canadians and Americans for climate amenities. In this setting, households and firms in areas with less advantageous amenities are compensated by more advantageous local prices. Typically, households in areas with lower quality of life are compensated through higher nominal wages or lower costs of living. In this spirit, we show that the climate amenity differential can be balanced by a regulation differential in the rental market.

Lastly, there is a considerable literature assessing the importance of geography and institutions to explain differences in long-term growth between countries. The institutional theory (Acemoglu et al, 2001) attributes economic growth to the legal and economic institutions already established within a country, whereas the geographic theory (Sachs, 2001) asserts that geography is the dominant factor behind growth. These theories have motivated a body of papers studying the relative role of each set of factors (see, e.g., Rodrik et al, 2004, Veiseh, 2010, Arbia, 2010). Though our purpose is more modest, we highlight a market situation where institutions are strongly determined by the geography and, in turn, affect the performance of the rental market.

[1] A survey realized by Eurobarometers in 2011 has interrogated European on the different barriers in EU countries preventing Europeans to studying and working in another EU country. Portuguese claim that the difficulty in terms of climate and lifestyle in northern Europe are barriers to live there.

2 Empirical evidence

This section presents empirical evidence motivating our analysis. We first discuss the sunshine attractiveness. Then we show various correlations between sunshine, social capital, mobility, employment protection legislation and housing market regulation.

2.1 Sunshine is an attractive amenity

The aim of this subsection is to prove that sunshine influences the well-being and the migratory behaviors of individuals. However, the sunshine's effect is difficult to isolate from other characteristics like the legislation and the economic environment. Indeed, the analysis may suffer problems of endogeneity and missing variables. For example, in our theory migratory behaviors and rental market regulation are necessarily correlated. We first document medical arguments according to which sunshine is good for health. Secondly, we study heliotropism on two subsamples where problems of endogeneity and missing variables are less significant. We thus study the sunshine effect on migration behaviors within France because the regulation is fixed at national level and there is a strong north / south divide in terms of geographic amenities. We finally study the migration behaviors of students and retirees in northern Europe because these persons are not submitted to constraints specific to the labor and rental markets. Indeed, students can find a room on the university campus and Huete and Mantecon (2012) show that retirees who migrate to southern Europe are mostly owners.

Sunshine is good for health.—Several medical papers show that sunshine is vital for health (see, e.g., Vyssoki et al, 2014, and Saraff and Shaw, 2015). Exposure of the skin to solar ultraviolet B radiation is the major source of vitamin D; in addition sunshine could reduce the suicide probability. A survey carried out by Eurobarometers in 2011 in 15 European countries shows that the weather is a substantial factor for people's well-being. Respondents in seven countries (Denmark, the Czech Republic, France, Portugal, the Netherlands, the younger group in Estonia and the higher social status group, education, and rural group in the UK) claim that snow, bad weather and the darkness of winter days influence well-being negatively and that the absence of light causes depression in Denmark. Finally, a survey carried out by Uswitch in Great Britain examines claims that the UK and Ireland are the worst places in Europe to live, whereas Spain and France are the best. Here again, one of the determinant factors is the sunshine. With, respectively, an average of 1500 and 1400 hours of sunshine per year the Great Britain and Ireland are countries where the hours of sunshine are the lowest, while with respectively 2600 and 2000 hours of sunshine per year, Spain and France are countries where the hours of sunshine are the larger. As a result, more than one in ten Britons say they are seriously considering emigrating[2].

Heliotropism in France.—Baccaïni (2007) uses data from the 1990s and argues that the western and southern France are attractive. The net migration in these regions is positive, whereas it is negative in the northern France and Ile de France. The most attractive region is Languedoc-Roussillon while Ile de France is the most repulsive one. The migration from northern to southern and western France is mainly due to the attractiveness of the climate and the attractiveness of an idyllic rural way of life and does not

[2]See the Guardian for see details about this survey: https://www.theguardian.com/money/2011/sep/29/uk-worst-quality-of-life-europe

depend on socioeconomic characteristics. Indeed, in Languedoc-Roussillon, the unemployment is strong and the wage of managers and entrepreneurs are low when compared to Ile de France.

Heliotropism for retirees and student.—A large literature (Casado-Diaz, 2012, 2004 and 2001, Benson and O'Reilly, 2009, Huete and Mantecon, 2012, Bell and Ward, 2000, Rodriguez, 2001, Truly, 2002, Williams et al, 2000) on lifestyle migration shows a preference of northern Europeans to live in southern Europe and enjoy the mild of Mediterranean climate. However, they only come to live permanently in southern Europe when retired, i.e., when they escape the barriers to entry in the rental and labor markets. Furthermore, Spain, France, Italy and Portugal are respectively the first, the second, the fifth and the eight host countries of Erasmus students (Campus France, 2011). Baldoni et al (2003) who study intra-European migration from the 1950s to 1990s, show that the number of northern Europeans in southern Europe has sizably increased. In Spain, from 1993 to 2001, the German presence increased by 190%. The growth of British residents was slightly less spectacular, but still took place at a very high rate. In eight years, Britons have increased by 85%. This phenomenon also exists in France where Britons and Germans have considerably expanded. Britons have increased by 150% and Germans by 140%. Furthermore the authors note that Italy is the country that attracts the largest spectrum of Europeans and that there is a preponderance of Britons living in Greece and Portugal.

To conclude, the behavior of students and retirees reveal strong heliotropism, whereas the behavior of other people is more ambiguous with respect to such climate amenities. These individuals are exposed to the various constraints set on the labor and rental markets, suggesting that the regulation could well be a barrier to migration.

2.2 Correlations with sunshine

In this subsection we document a nexus of correlations justifying the mechanisms described in our model, namely there are strong complementarities between sunshine, the size of local social networks and the magnitude of procedural formalism in the rental market. Furthermore, we describe also correlations justifying our explanations in the last section, i.e., local social networks and procedural formalism are associated to lack of mobility and strongly protected jobs[3].

Microeconomic evidence.—At the micro level, we show that southern Europeans have stronger social networks, are less mobile and support stronger levels of regulation than northern Europeans. As for sunshine, we use the average time of sunshine per year as given by the website climatedata.eu[4]. There are 18 European countries: Austria, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Switzerland, the United Kingdom, Germany, Belgium, Denmark, Finland, Norway, Iceland, Sweden and Luxembourg.

[3] At micro level, David et al (2010) use the ECHP and show that agents with strong local social capital are less mobile. Alesina et al (2013) use the WVS and find that individuals who inherit stronger family ties are less mobile and support more stringent labor market regulations. At macro level, Rupert and Wasmer (2012) show that the housing market regulation is negatively correlated with mobility rates in a cross-section of European countries. Decreuse and van Ypersele (2012) show a positive correlation between employment protection legislation and housing market regulation. Finally, Bonleu (2015) shows a positive correlation between procedural formalism in the rental market and measures of local social capital.

[4] The average number of hours of sunshine is computed for each capital city. We make an exception for France where there is a very large sunshine differential between the northern part and the southern parts of country. Thus we use the average hours of sunshine in Lyon.

The sunshine variable is a dummy variable equal to 1 if the individual lives in a country where the hours of sunshine are higher than 2000 hours per year. The sunny countries are France, Greece, Italy, Portugal and Spain.

The mobility variable is obtained from the European Community Household Panel (hereafter ECHP) and takes the value 1 if the individual has moved from another area in the two years before the survey. The job security variable is obtained from the World Values Survey (hereafter WVS) and takes the value 1 if the respondent claims that it is important to have good job security.

We measure the size of social networks from a wide range of indicators. On the one hand, we follow David et al (2010) and use the *friendship ties* and *neighborhood ties* variables in the ECHP. Individuals are asked about i) the frequency of relationships with neighbors, ii) the frequency of contacts with friends and relatives outside the household. The answers are as follows: 1. On most days; 2. Once or twice a week; 3. Once or twice a month; 4. Less often than once a month; 5. Never. As David et al (2010), we consider the following index:

$$Z_{i,t} = I\left[X_{i,t} = 1\right] + I\left[X_{i,t} = 2\right]\frac{2}{7} + I\left[X_{i,t} = 3\right]\frac{2}{30} + I\left[X_{i,t} = 4\right]\frac{1}{60} + I\left[X_{i,t} = 5\right]0, \tag{1}$$

where $Z_{i,t}$ is the index value for individual i at time t, $X_{i,t}$ is the answer to the question and answers have been transformed to daily frequency. $I[.]$ is an indicator function that takes value 1 if the expression in brackets is true and 0 if it is not. On the other hand, we also measure the strength of family ties from a wide range of indicator in the WVS as in Alesina et al (2013). We use four measures:

i) *Teach independence*: the question informs about the cultural importance of the family: "Would you consider important to teach your children to leave your home?". The answer to the question is yes, coded 1, or no, coded 0.

ii) *Living with parents*: the question asks whether the individual lives with his/her parents. The answer to the question is yes, coded 1, or no, coded 0.

iii) *Family important*: respondents indicate the importance of the family in their life. The answer can take values from 1 to 4, with 1 being very important and 4 not important at all.

iv) *Parents' responsibility*: the respondents inform if they agree with one of the following two statements (taking the value of 1 and 2 respectively): 1) It is the parents' duty to do their best for their children even at the expense of their own well being, 2) Parents have a life on their own.

We recode the last two questions so that a higher number implies a stronger attachment to the family.

Table 1 provides descriptive statistics for the different variables.

	mean	s.d
Sunny country	0.37	0.48
Teach independence	0.46	0.5
Living with parents	0.2	0.4
Family important	3.82	0.47
Parents responsibility	1.78	0.41
Neighborhood ties	0.57	0.41
Friendship ties	0.51	0.4
Mobility	0.14	0.34
Job security	0.59	049

Table 1: Descriptive statistics

We run the following OLS or probit (depending on the nature of the left-hand side variable) regressions:

$$Y_i = \alpha_0 + \alpha_1 Sunny\_country + \alpha_2 X_i + \delta_t + \varepsilon_i, \tag{2}$$

where X_i are individual controls. When using the ECHP, we control for age group (-18, 18 to 30, 31 to 60, 60+), education, income and a gender dummy. When using the WVS, we control for age, education, income, a gender dummy and religious denomination. Lastly, δ_t is a year fixed effect.

	(1) Teach independence	(2) Living with parents	(3) Family important	(4) Parents responsibility	(5) Neighborhood ties	(6) Friendship ties
Estimation	Probit	Probit	OLS	OLS	OLS	OLS
Sunny country	-0.216^{***}	0.075^{***}	0.0271^{***}	0.0809^{***}	0.096^{***}	0.007^{*}
	(-33.43)	(22.59)	(4.68)	(15.045)	(30.06)	(2.36)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.06	0.33	0.03	0.02	0.02	0.03
Observations	27706	13282	27813	25269	71466	80640

Table 2: Sun and local social capital. t statistics in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Marginal effects are reported for probit estimation. Columns (1)-(4): Regressions control for age, education, income, a gender dummy and religious denomination. Source: WVS. Column (5)-(6): Regressions control for age category (-18, 18 to 30, 31 to 60, 60+), education, income and a gender dummy. Source: ECHP.

Table 2 shows that individuals living in a southern country have stronger family ties and local social capital than individuals living in a northern country. The probability that parents teach independence to their children decreases by 21% when the individual lives in a country with strong climate amenities. Moreover, the probability of living with parents is increased by 7% in such circumstances.

	(1) Mobility	(2) Job security
Estimation	Probit	Probit
Sunny country	-0.085^{***}	0.066^{***}
	(-11.86)	(7.12)
Year fixed effect	Yes	Yes
R^2	0.03	0.02
Observations	15118	13170

Table 3: Sun, mobility and the demand for job security. t statistics in parentheses. * p<0.05, ** p<0.01, *** p<0.001. Marginal effects are reported for probit estimation. (1): Regressions control for age category (-18, 18 to 30, 31 to 60, 60+), education, income and a gender dummy. Source: ECHP. (2): Regressions control for age, education, income and a gender dummy.

Table 3 shows that individuals who live in a sunny country are less mobile and want more secure jobs. Living in a country with strong climate amenities decreases the probability of being mobile by 9% and increases the probability of asking job protection by 7%.

Macroeconomic evidence.—At macro level, we plot the number of average hours of sunshine by country as provided by climatedata.eu against the variables measuring the size of local social networks, procedural formalism in the rental market and an index of job protection. The social networks variables are the family ties, neighborhood ties and friendship ties indices. They are computed from David et al (2010) and are averaged by country. The job protection index is provided by Allard (2005). It covers a variety of regulations affecting workers' dismissals like procedural requirements, notice and severance pay requirements, regulations to the use of temporary work and short-term contracts, penalties for unfair dismissals and specific regulations applying to collective dismissals. The procedural formalism index is provided by Djankov et al (2003). This is a composite index based on the difficulty to evict a tenant, reflecting the complexity and the length of the procedure at various stages (pretrial, process of trial, execution of the court decision).

Figures 1 to 3 show a positive correlation between sunshine and the social networks variables.

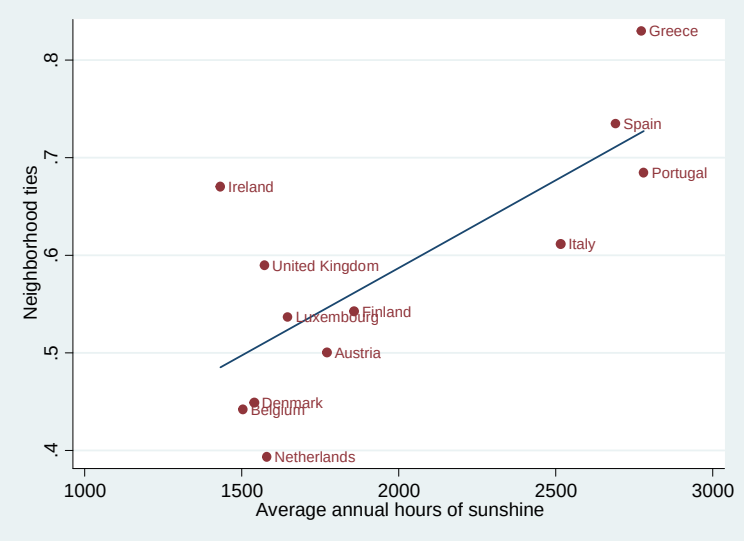

Figure 1: Neighborhood ties and sunshine: the figure displays the correlation between two measures of social capital by country and average time of sunshine. Data base: ECHP. The average time of sunshine is given by the website climatedata.eu. The sample period is 1994-2001.

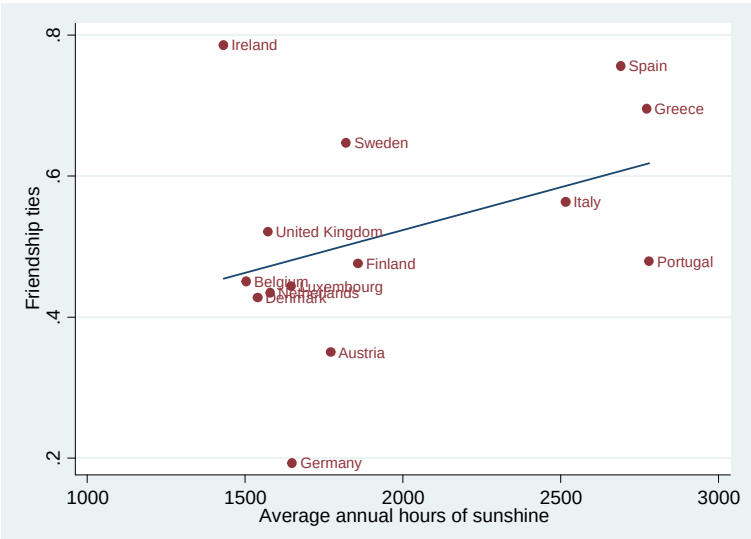

Figure 2: Friendship ties and sunshine. The figure displays the correlation in the cross-section of countries between a measure of social capital and the average time of sunshine. Source: ECHP. The average time of sunshine is given by the website climatedata.eu. The sample period is 1994-2001.

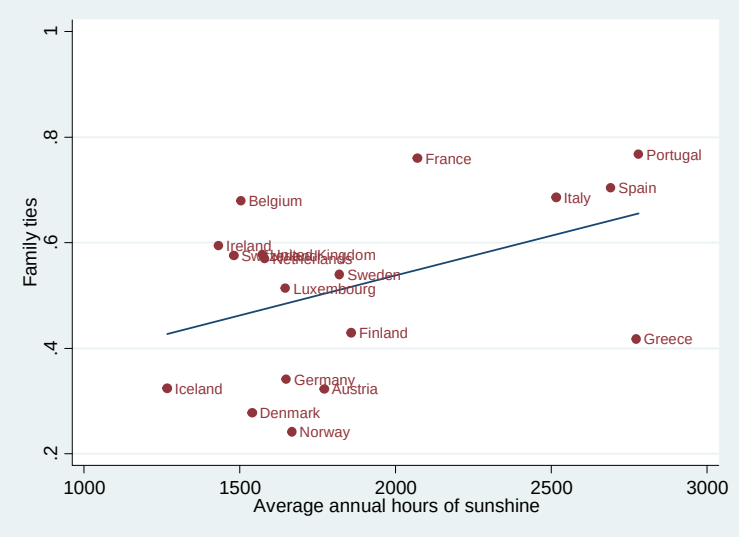

Figure 3: Family ties and sunshine. The figure displays the correlation in a cross-section of countries between a measure of family ties and the average time of sunshine. Data base: EVS and WVS for family ties. The average time of sunshine is given by the website climatedata.eu. The sample period is 1981-2004.

Meanwhile Figures 4 and 5 feature a positive correlation between sunshine and the measures of regulation in the rental and labor markets.

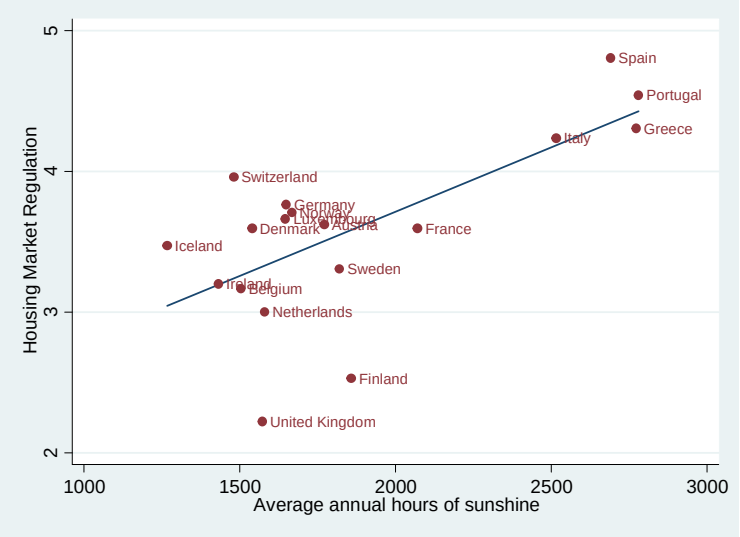

Figure 4: Housing Market Regulation and sunshine

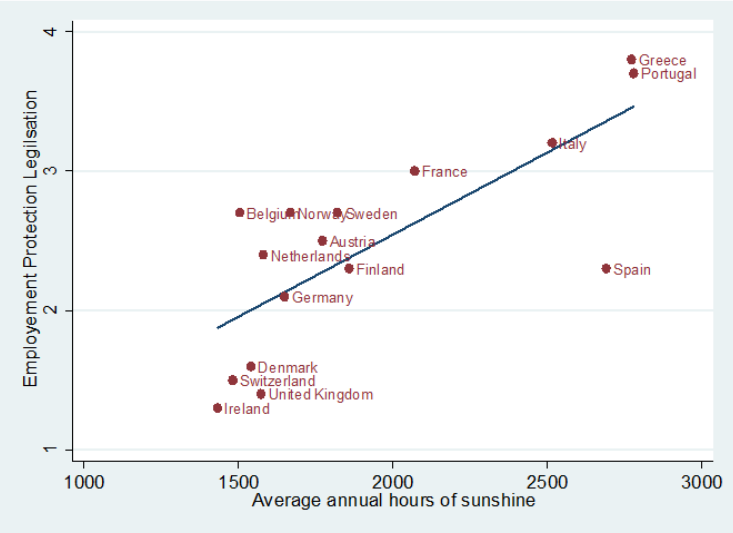

Figure 5: Employement Protection Legislation and Sunshine.

3 Model

We develop a theory where southern countries are characterized by a Mediterranean equilibrium with procedural formalism (PF) and local social networks, whereas northern countries feature a Scandinavian and Anglo-Saxon equilibrium without regulation and local social networks.

There are two symmetric countries peopled by homogenous individuals and differing in climate amenities. In each country there are M landlords and T potential tenants. Among the M landlords, only V have a vacant dwelling. The matching side of the model obeys the so-called urn-ball matching technology associated to coordination frictions. Each potential tenant sends one application to a vacant dwelling. Applicants are connected when they belong to the social network of the landlord, whereas they are anonymous in the opposite case. The probability of being connected increases with the size of social networks.

A given landlord may receive several applications and chooses the most profitable one. Therefore, applicants are ranked according to match surplus. Such a surplus decreases with the cost of dispute resolution. With PF, connected applicants become more attractive compared to anonymous applicants. Indeed, the dispute can be solved within the social network and does not involve going to court. It follows that PF increases the probability of obtaining the lease for connected applicants, whereas it decreases the probability for anonymous ones. In other words, belonging to a large social network increases the gain derived from PF.

If a potential tenant knows N landlords, the probability that he knows a landlord with a vacancy is

$$n = 1 - \left(1 - \frac{V}{M}\right)^N. \tag{3}$$

The probability n increases with V and N. Hereafter, we refer to n as the *network size*. With probability

n the agent learns that a landlord in his social network rents a dwellings and applies as a connected agent. With complementary probability $1-n$, this is not the case and the agent applies as an anonymous agent. The only interest of the social network is that conflict resolution does not depend on law. A landlord evicting a defaulting tenant pays D^n if the pair belongs to the same social network and D^m if not. Significantly, PF only affects D^m.

All applicants have default probability δ and defaulting agents do not pay the rent. As all potential tenants have the same default probability, the only interest of PF is that $D^n < D^m$, which ensures that landlord prefer connected agents. To simplify, we assume there are only two possible levels of regulation $D^m = 0$ and $D^m = D^n + \varepsilon > D^n$.

Individuals enjoy climate amenities only if they have a rental. Hence, an individual who has a rental in the southern country obtains the utility a_s, while an individual who has a rental in the northern country has utility a_n. We normalize a_s to one while $a_n \in [0, 1)$.

Lastly, network building is costly. To obtain the probability n, the potential tenant has to pay $C_n = n^2/s$ where $s > 0$ is a scale parameter of the cost function.

We solve the model in two configurations. We first examine the closed economy case without migration. There we show that there is no social demand for procedural formalism in the rental market and for building local social networks. We then turn to the open economy case where individuals can migrate between countries. This may generate both procedural formalism and local social networks.

3.1 Closed country

We first study the case where countries are not open to each other so that individuals cannot migrate. The timing of the model is as follows:

1. The magnitude of regulation D^m is chosen.
2. Each individual chooses how much to invest in local social networks.
3. All individuals send one application to one vacant dwelling.
4. Landlords select one applicant (if any).
5. The rent is bargained between the landlord and the tenant.
6. Tenants pay the rent with probability $1 - \delta$.

The model is solved by backward induction.

Bargaining step.—With probability $1-\delta$, the tenant pays the rent R and enjoys housing consumption a_j. With probability δ, he defaults on the rent and is evicted. Housing consumption is then normalized to zero. A tenant of type $i = n$ is connected, while a tenant of type $i = m$ is anonymous. The opportunity cost of rental is C. A landlord accepting a type-i tenant obtains the expected payoff

$$R\left(1-\delta\right) - \delta D^i + \delta C, \tag{4}$$

and if he refuses, he gets the opportunity cost C. The tenant obtains the expected payoff:

$$\left(a_j - R\right)\left(1-\delta\right). \tag{5}$$

A match between a type-i tenant and a landlord generates the following match surplus

$$S_j^i = (1-\delta)(a_j - C) - \delta D^i. \tag{6}$$

The surplus generated by an anonymous match depends on PF, whereas the surplus created by a connected match does not. The rent results from Nash bargaining between the landlord and the tenant:

$$\max_R \left((a_j - R)(1-\delta)\right)^\beta \left(R(1-\delta) - \delta D^i + \delta C - C\right)^{1-\beta}, \tag{7}$$

where $\beta \in [0,1]$ is the bargaining power of tenants. The resulting rent is :

$$R_j^i = \frac{\beta\delta D^i + \beta C(1-\delta) + (1-\beta)(1-\delta)a_j}{(1-\delta)}. \tag{8}$$

The expected landlord's income is

$$\begin{aligned} Y_j^i &= C + (1-\beta) S_j^i \\ &= C + (1-\beta)\left[(1-\delta)(a_j - C) - \delta D^i\right]. \end{aligned} \tag{9}$$

The expected income Y_j^i depends positively on the match surplus S_j^i. Hence, Y_j^i is negatively affected by the default probability δ and by the cost of dispute resolution D^i. Moreover, if the expected income is lower than the rental opportunity cost C, landlords prefer not to rent. To simplify the analysis, we suppose that δ is lower than the threshold δ_j above which landlords prefer not to rent:

$$\delta_j = \frac{a_j - C}{a_j - C + D^m}, \tag{10}$$

as $D^m > D^n$.

Selection step and optimal level of social network.—We compute the probability of getting a lease for an agent and his optimal level of social network according to the magnitude of resolution D^m. We proceed to this computation under the assumption that there is a symmetric equilibrium where all agents choose the same network size.

We start with the case of a regulated rental market. Then $D^m = D^n + \varepsilon$ and, from the landlords' perspective, a connected tenant is always better than an anonymous tenant, i.e., $Y_j^n > Y_j^m$. Hence, a connected agent gets the lease if selected by the landlord among the t other connected tenants who are also also matched with him. Therefore, when all other agents have a network of size n, the probability of getting a lease for a connected tenant matched with a landlord is

$$P_n = \sum_{t=0}^{T-1} \Pr(X = t) \sum_{t_n=0}^{t} \Pr(Z = t_n \mid X = t) \frac{1}{t_n + 1}, \tag{11}$$

where $\Pr(X = t)$ is the probability that the landlord is matched with t other potential tenants, $\Pr(Z = t_n \mid X = t)$ is the probability that the landlord is matched with t_n connected potential tenants among the t potential tenants matched with him, and $1/(t_n + 1)$ is the probability of being selected by the landlord among the $t_n + 1$ connected potential tenants matched with him. The probability P_n can be written as follows

$$P_n = \sum_{t=0}^{T-1} \frac{(T-1)!}{t!(T-1-t)!} \left(\frac{1}{V}\right)^t \left(1 - \frac{1}{V}\right)^{T-1-t} \sum_{t_n=0}^{t} \frac{(t)!}{t_n!(t-t_n)!} \left(\frac{Tn}{T}\right)^{t_n} \left(1 - \frac{Tn}{T}\right)^{t-t_n} \frac{1}{t_n + 1}, \tag{12}$$

where $1/V$ is the probability of sending an application to one particular landlord and Tn/T is the probability that the applicant belongs to the social network of the landlord.

Similarly, an anonymous tenant gets the lease if there is no connected tenant matched with the landlord and if he is selected by the landlord among the t other anonymous tenants also matched with him. Therefore the probability of getting a lease for an anonymous tenant matched with a landlord is

$$P_m = \sum_{t=0}^{T-1} \Pr(X=t) \Pr(Z=0 \mid X=t) \frac{1}{t+1} \tag{13}$$

$$= \sum_{t=0}^{T-1} \frac{(T-1)!}{t!(T-1-t)!} \left(\frac{1}{V}\right)^t \left(1-\frac{1}{V}\right)^{T-1-t} \frac{(t)!}{0!(t-0)!} (n)^0 (1-n)^t \frac{1}{t+1}. \tag{14}$$

We assume a large number of tenants and landlords. When V and T become arbitrarily large, we have

$$P_n = \frac{\theta}{n}\left(1-e^{-\frac{n}{\theta}}\right) \text{ and } P_m = \frac{\theta}{(1-n)}\left(e^{-\frac{n}{\theta}} - e^{-\frac{1}{\theta}}\right). \tag{15}$$

where $\theta = V/T$ is the market tightness.

The probabilities P_n and P_m are negatively affected by the network size n :

$$\frac{dP_n}{dn} = \frac{\theta}{n^2}\left[e^{-\frac{n}{\theta}}(1+\frac{n}{\theta})-1\right] < 0 \tag{16}$$

$$\frac{dP_m}{dn} = \frac{\theta}{(1-n)^2} e^{-\frac{1}{\theta}} \left[e^{-\frac{n-1}{\theta}}(1+\frac{n-1}{\theta})-1\right] < 0 \tag{17}$$

This illustrates the negative externality generated by the formation of social networks. The average network size decreases both the probability of getting a lease when connected (because competition increases within the typical network) and the probability of getting a lease when anonymous (because the landlord is more likely to receive applications from connected applicants).

Nevertheless, investing in the network may be individually rational as the probability of getting a lease for a potential tenant with network size n_i is $n_i P_n + (1-n_i) P_m$, which is increasing in the own network size but decreasing in the network size of the other applicants. The corresponding utility is

$$U_j^{reg} = \beta\left(n_i S_j^n P_n + (1-n_i) S_j^m P_m\right) - C_n. \tag{18}$$

The equilibrium level of investment in social network is the result of a non cooperative game played by potential tenants whose payoffs are their expected utility.

Note also that, in symmetric equilibrium where $n_i = n$, the probability of obtaining a rental is given by

$$nP_n + (1-n) P_m = \theta(1-e^{-\frac{1}{\theta}}), \tag{19}$$

which is independent of the equilibrium level of social network. This is due to the fact that all agents are identical. Therefore what is won, in terms of rental probability, by agents when connected is just lost when anonymous.

Proposition 1 *Assume $D^m > D^n$. When the country regulates the rental market, the equilibrium investment in social network is strictly positive.*

Proof. The best reply n_i of a potential tenant to n is such that

$$dU_j^{reg}/dn_i = \underbrace{\beta\left(S_j^n P_n - S_j^m P_m\right)}_{A>0} - \frac{2n_i}{s} = 0, \tag{20}$$

which is equivalent to

$$n_i = \beta\left(S_j^n P_n - S_j^m Pm\right)\frac{s}{2}.$$

The symmetric equilibrium solves this equation for $n_i = n$. The best reply is a decreasing function of n as

$$\frac{dA}{dn} = \beta S_j^n\left(\frac{\theta}{n^2}(e^{-\frac{n}{\theta}}(1+\frac{n}{\theta})-1)\right) - \beta S_j^m\left(\frac{\theta}{(1-n)^2}e^{-\frac{1}{\theta}}(e^{-\frac{n-1}{\theta}}(1+\frac{n-1}{\theta})-1)\right) < 0. \tag{21}$$

Therefore, the level of social network maximizing the expected utility of the potential tenant is strictly positive as $\beta\left(S_j^n P_n - S_j^m Pm\right)\frac{s}{2} > 0$ when $n = 0$. ■

We then consider the case of an unregulated rental market. If $D^m = 0$, individuals have no interest in developing their local social network because the cost of conflict resolution within the social network exceeds the judicial cost. Hence, landlords are indifferent between all applicants and the probability of getting a lease for a potential tenant matched with a landlord is

$$\begin{aligned} P &= \sum_{t=0}^{T-1}\Pr(X=t)\frac{1}{t+1} \\ &= \sum_{t=0}^{T-1}\frac{(T-1)!}{t!(T-1-t)!}\left(\frac{1}{V}\right)^t\left(1-\frac{1}{V}\right)^{T-1-t}\frac{1}{t+1}. \end{aligned} \tag{22}$$

When V and T become arbitrarily large, we have

$$P = \theta\left(1-e^{-\frac{1}{\theta}}\right). \tag{23}$$

The probability P is negatively affected by the number of potential tenants T:

$$\frac{dP}{dT} = -\frac{V}{T^2}\left(1-e^{-\frac{1}{\theta}}\right) + \frac{1}{T}e^{-\frac{1}{\theta}} < 0.$$

The applicant's expected utility is the product of the probability P by the match surplus $S_j = (1-\delta)(a_j - C)$ weighted by the bargaining power β, i.e.,

$$U_j^{unreg} = \beta S_j P. \tag{24}$$

Regulation choice.— We can now characterize the subgame perfect equilibrium of this multistage game. There is a sole player in the first stage maximizing the expected welfare of a potential tenant.

Proposition 2 *In a closed economy, in equilibrium there is no regulation of the rental market and no investment in social network:* $D^m = n^* = 0$.

Proof. According to Proposition 1, we have to compare the expected utility of a potential tenant with regulation and a positive investment in social network with the expected utility of the same potential tenant without regulation and without social network. Equation (19) shows us that the probability of housing is unaffected by the level of social network, whereas the regulation destroys social surplus, therefore the potential tenant is better off without regulation. ■

3.2 Open country

In this subsection, we suppose that agents can migrate between the two countries. A potential tenant locates where the expected utility is the highest. Hereafter, the individuals living in their native country are the local individuals and the individuals who migrate are the foreigners. Hence, if F_{south} is the number of individual who migrate in the southern country and F_{north} is the number of individuals who migrate in the northern one, then the potential number of tenants in the southern country is $T_{south} = T - F_{north} + F_{south}$, while in the northern country we have $T_{north} = T - F_{south} + F_{north}$. Moreover, we assume that only local individuals can have a social network.

We only consider "symmetric equilibria", i.e., in each country all local agents make the same investment. Thus, the numbers of potential connected tenants and anonymous tenants in the southern country are, respectively, $T_j^n = n_j (T - F_{-j})$ and $T_j^m = (1 - n_j)(T - F_{-j}) + F_j$ with $j = north$ or $south$.

We suppose that migration decisions are made after the regulation has been chosen and individuals have invested in local social networks. The timing is as follows:

1. The magnitude of regulation D^m is chosen.
2. Each individual chooses how much to invest in local social networks.
3. Potential tenant choose residential country. It depends on climate amenities, market tightness and regulation.
4. All individuals send one application to one vacant dwelling.
5. Landlords select one applicant (if any).
6. The rent is bargained between the landlord and the tenant.
7. Tenants pay the rent with probability $1 - \delta$.

The model is solved by backward induction.

Bargaining and selection steps.—The bargaining and selection steps are similar to the closed economy case. Therefore, the probabilities of getting a lease are

$$P_j^n = \frac{V}{T_j^n}\left(1 - e^{-\frac{T_j^n}{V}}\right) \text{ and } P_j^m = \frac{V}{T_j^m}\left(e^{-\frac{T_j^n}{V}} - e^{-\frac{T_j}{V}}\right), \tag{25}$$

if the market is regulated and

$$P_j = \frac{V}{T_j}\left(1 - e^{-\frac{T_j}{V}}\right), \tag{26}$$

if not.

Hence, the probability of getting a lease for a local individual that invests n_i is given by $n_i P_j^n + (1 - n_i) P_j^m$ and that of a foreigner by P_j^m if the rental market is regulated and P_j if not. Thus, the utility levels expected by a local individual and a foreigner are

$$U_j^{local} = \beta\left(n_i S_j^n P_j^n + (1 - n_i) S_j^m P_j^m\right) - C_n, \tag{27}$$

$$U_j^{foreigner} = \beta S_j^m P_j^m, \tag{28}$$

if the rental market is regulated and

$$U_j = \beta S_j P_j, \tag{29}$$

if not.

Furthermore, as above, the probabilities P_j^n, P_j^m and P_j decrease with the market tightness. However, in contrast with the closed economy case, the probability of getting a lease for a local individual when all local agents have the same social network size, $n_j P_j^n + (1 - n_j) P_j^m$ is a function of n_j as long as $F_j > 0$. The existence of foreigners implies that forming social networks can be beneficial to all local agents.

Migration step.—When the countries are closed and the rental markets are unregulated, individuals living in the southern country have a higher utility than individuals living in the northern one. Indeed,

$$U_{south} = \beta S_{south} P > U_{north} = \beta S_{north} P, \tag{30}$$

because $a_s > a_n$.

As P_j^n, P_j^m and P_j decrease with the number of potential tenants, migration affects the probability of getting a lease in both countries. Therefore, with open countries, the number of migrants balances the climate amenity differential. In equilibrium, none wants to change country.

Proposition 3 *i) With symmetric countries only differing in climate amenities, migration is exclusively North-South, i.e., $F_{south} \geq 0$ and $F_{north} = 0$.*

ii) The number of migrants decreases with PF and the size of social networks in the southern country.

The proof is in the appendix. The intuition goes as follows. If the two countries regulate the rental market, migration takes place from north to south up to the point where the gain incurred by the immigrants due to better climate amenities are compensated by the decline in probability of getting a lease. If only the northern country regulates its rental market, then none in the southern country has incentive to migrate as both the climate amenity and the probability of getting a lease are lower in the northern country. Lastly, if only the southern country regulates, no individual in the south wants to migrate because optimal regulation guarantees that the expected utility of a local agent is larger than the expected utility of a foreigner, whereas foreigners, by equilibrium reasoning, have the same utility as local individuals in the northern country. Hence, we can summarize that the migration is exclusively North-South. Furthermore, the number of migrants decreases with PF and social networks because PF and social network both decrease the probability of getting a lease and the rental surplus of foreigners.

Optimal size of social networks.—The optimal size of social networks is individually chosen by the local agents taking migration as given. In line with Proposition 2, accounting for migration only affects the number of potential tenants in the northern country (which decreases) and the number of anonymous tenants in the southern country (which increases). Hence, we can deduce the following result with the same reasoning as in the closed economy case.

Proposition 4 *When a country does not regulate, the equilibrium size of social network is zero, whereas when it regulates and $D^m > D^n$, the optimal size of social network is strictly positive.*

Regulation choice.—PF is decided non cooperatively by the two countries whose payoffs are the expected utility of a local potential tenant. This first stage of the game is played taking the following steps of the game into account.

Proposition 5 *In the open economy case, two types of "symmetric" equilibria emerge, an equilibrium with regulation and social network in the southern country and no regulation and no social network in the northern country and another equilibrium without regulation and social network in both countries.*

(i) The equilibrium with social network and regulation occurs when the cost of conflict resolution within the network and the scale parameter of the cost of network formation are sufficiently low, i.e., $D^n < \frac{(1-\delta)(a_s-C)(n^* P^n_{south}-P)+(1-n^*)P^m_{south}S^m}{\delta n^* P^n_{south}}$ *and* $s > n^{*2}/(U_{south}(n^*, F^{**}_{south}) - U_{south}(F^*_{south}))$.

(ii) The other equilibrium arises when this set of conditions is not fulfilled.

The proof is in the appendix.

The intuition goes as follows: it is a dominant strategy for the northern country not to regulate as it never hosts immigrants, whereas the regulation and its ensuing costs in terms of social network building and decreased surplus only make sense when they can increase the probability of lease. We saw that as long as there is no immigant in a country the probability to get a lease is independent of the equilibrium investment in social network. Therefore, equilibria (i) and (ii) are the only possible ones. The south attracts immigrants and regulation may be welfare improving if it sufficiently increases the probability of getting a lease. This is the case when D^n is small enough, i.e. the destruction of the surplus is not too important and when s is large enough, i.e. the cost of building the social network is not too high.

To summarize, the climate amenity differential may generate two different equilibria: a Mediterranean equilibrium with PF and social networks in the southern country and a Scandinavian and Anglo-Saxon equilibrium without regulation and social networks in the northern country. Individuals in the northern country have no interest in regulating the rental market because the migration pressure is nonexistent. Meanwhile, PF and social networks help to mitigate the negative impact of migration for individuals in the southern country.

4 Discussions

We discuss the role played by the climate amenity differential and highlight the potential labor market implications of our theory.

4.1 Climate amenity differential and local social networks

The aim of this subsection is to emphasize that the optimal size of social network increases with the climate amenity differential. We already know that the climate amenity differential drives the country with the best climate amenities to regulate the rental market and invest in local social networks. We also know that the number of migrants from north to south increases with the climate amenity differential. Therefore, Proposition 4 implies that the optimal size of social network increases with the climate amenity differential.

This theoretical prediction is interesting because it rationalizes the set of correlations shown in Section 2 whereby individuals leaving in southern Europe tend to invest more in their local social network. According to our model, this is a natural reaction of individuals in an environment where the rental market is very regulated and the best way to get a lease is to overcrowd the unconnected applicants by applying for a rental within the social network.

To illustrate this result, we follow Bonleu (2015) and calibrate the model on the French 2006 Housing Survey. The parameters of the calibration are given by Table 4.

Parameters	T	V	α	C	β	n	D^m	D^n	δ	a_n
Baseline	9140	7783	1	0.5	0.5	$[0,1]$	1.1	1	0.005	$[1, 0.7]$

Table 4: Parameter values

Figure 6 shows the size of social networks in the southern country as a function of the amenity differential. As long as the differential is too small, individuals have no incentive to regulate the rental market and, therefore, do not invest in their local social network. When the amenity differential gets sufficiently large, the migration pressure becomes strong and individuals react by increasing procedural formalism and investing in their local social network.

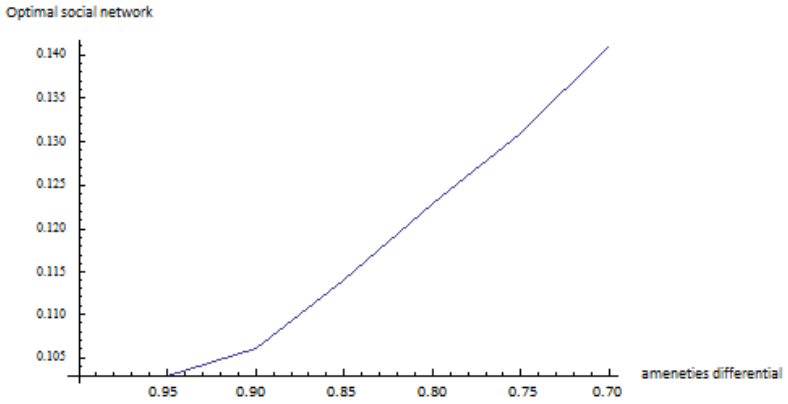

Figure 6: Social networks and the climate amenity differential.

Figure 7 emphasizes the implications for migration. It compares the laissez-faire case with the equilibrium allocation. In both cases, the number of migrants increases with the climate amenity differential. However, setting procedural formalism and investing in local social network discourages some of the potential migrants.

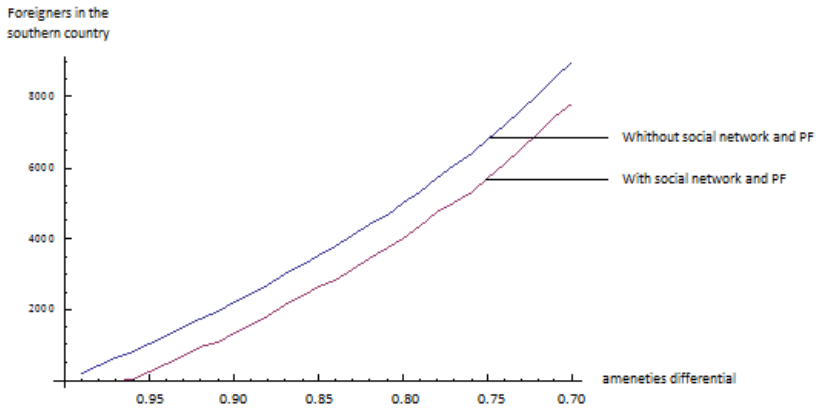

Figure 7: Foreigners and the climate amenity differential

4.2 What about the labor market?

The aim of this subsection is to discuss the impact of regulation and local social networks on the labor market equilibrium. Firstly, we argue that the climate amenity differential can also generate a social demand for job protection. Secondly, we explain that there is a strong complementarity between the labor and rental markets.

Good climate amenities attract individuals from the north to the south. This not only deteriorates the search prospects for would be renters in the south, but also reduces the odds of finding jobs. This phenomenon arises when job creation is weakly elastic so that the number of available jobs does not react to the workforce size. Then individuals can protect their access to jobs by regulating the labor market, just like they protect their access to rentals by regulating the rental market. Protecting jobs by increasing the cost of litigation reduces the incentive to hire unconnected applicants. Employers then prefer to recruit workers belonging to their social network because the cost of conflict resolution, though potentially large, become actually cheaper than in front of a court.

Moreover, individuals in a regulated rental market may well ask regulation on the labor market. David et al (2010) show that individuals with high social capital have low mobility and that job protection reinforces the accumulation of local social capital further reducing worker mobility. Elaborating on this relationship between family ties and worker mobility, Alesina et al (2015) argue that individuals with strong family ties rationally choose to regulate the labor market in order to reduce firms' monopsony power. In our theory, workers benefiting from good climate amenities have incentive to regulate the rental market. This may reduce their mobility, generating the kind of market power put forward by Alesina et al. In turn, such individuals should be willing to reduce employers' market power through labor market regulation.

Overall, these mechanisms lead to a broader Mediterranean equilibrium characterized by high climate amenities, large local social capital, low mobility and strong regulation on the rental and labor markets. A contrario, northern countries would know a Scandinavian and Anglo-saxon equilibrium characterized by low climate amenities, small local social capital, high mobility and low regulation on the rental and

labor markets.

5 Conclusion

This paper addresses a central question: What is the origin of market regulation and local social capital? We argue that countries benefiting from good climate amenities tend to regulate more and their citizens invest more in local social capital. Such countries are attractive, which provides migration incentive and fosters competition for scarce resources. In turn individuals react by increasing market regulation and associated procedural formalism in case of judicial dispute. Meanwhile they invest more in their local social networks.

This general idea is developed in the case of a particular market, the rental market, and in a particular geographic area, Europe. We first provide a set stylized facts emphasizing attractiveness to southern Europe and the fact that southern European countries are characterized by a more regulated rental market and extensive use of local social ties. We then propose and solve a search-theoretic model featuring two symmetric countries with a climate amenity differential, matching frictions on the rental market, choice of network formation and, ultimately, choice of procedural formalism in the rental market. This model highlights an equilibrium configuration where the southern country regulates its market whereas its people invest in local social networks to avoid the judicial cost of litigation. Meanwhile the northern country does not regulate its rental market and northern citizens have no incentive to invest in their local social network.

Our analysis could be extended in two directions. Firstly, we would like to introduce individual heterogeneity within countries to study the various incentives to adopt market regulation and build local social networks. Secondly, we would like to model the joint determination of the rental and labor market regulations.

Appendix

A Proofs

A.1 Proof of Proposition 3

The northern country (hereafter North) and the southern country (hereafter South) simultaneously choose whether to regulate their rental market. Therefore, there are four cases to study: both North and South regulate, North does not regulate and South regulates, North regulates and South does not, and both North and South do not regulate. In any case, migration, if existing, is exclusively from North to South.

If both North and South are unregulated we have

$$P_{south} = \frac{V}{T - F_{north} + F_{south}} \left(1 - e^{-\frac{T - F_{north} + F_{south}}{V}}\right), \tag{31}$$

$$P_{north} = \frac{V}{T - F_{south} + F_{north}} \left(1 - e^{-\frac{T - F_{south} + F_{north}}{V}}\right). \tag{32}$$

Hence, $U_{south} = \beta S_{south} P_{south}$ and $U_{north} = \beta S_{north} P_{north}$. Before opening to migration, we have $U_{south} > U_{north}$. Moreover $dU_{south}/dF_{north} > 0$ and $dU_{north}/dF_{north} < 0$, therefore none migrates to North. Indeed, $\beta S_{south} P_{south} > \beta S_{north} P_{north}$. However, we have $dU_{south}/dF_{south} < 0$ and $dU_{north}/dF_{south} > 0$. Therefore, on the one hand, $\lim_{F_{south} \to 0} U_{south} > \lim_{F_{south} \to 0} U_{north}$ as $S_{south} > S_{north}$. On the other hand $\lim_{F_{south} \to T} U_{south} = \beta S_{south}\ V/\left(2T\right)\left(1 - e^{-\frac{2T}{V}}\right)$ and $\lim_{F_{south} \to T} U_{north} = \beta S_{north}$. Hence, if $\ln\left(a_s - C\right) - \ln(a_n - C) < \ln(1) - \ln(P_{south})$ there exist $F^*_{south} \in [0, T)$ such that $U_{south}(F^*_{south}) = U_{north}(F^*_{south})$. On the contrary, if $\ln\left(a_s - C\right) - \ln(a_n - C) > \ln(1) - \ln(P_{south})$, then $F^*_{south} = T$ and $U_{north}(F^*_{south} = T) < U_{south}(F^*_{south} = T)$.

If North regulates and South does not regulate, a foreigner in North has a probability of getting a lease P^m_{north} and corresponding expected utility $U^{foreigner}_{north} = \beta S^m_{north} P^m_{north}$. We know that $\beta S^m_{north} P^m_{north} < \beta S_{north} P_{north}$ because $P^m_{north} < P_{north}$ and $S^m_{north} < S_{north}$ as $D^m = D^n + \varepsilon > 0$. Moreover, as we have seen in the previous case, $\beta S_{north} P_{north} < \beta S_{south} P_{south}$. Then, $\beta S_{south} P_{south} > \beta S^m_{north} P^m_{north}$ and none migrates to North. Hence, we have $F^*_{north} = 0$ and $nP^n_{north}\left(F^*_{north} = 0\right) + \left(1 - n\right) P^m_{north}\left(F^*_{north} = 0\right) = P_{north}$ as in the previous case. Moreover, as in the previous case, the rental surplus in South is larger than the rental surplus in North. Indeed, $S_{south} > S^m_{north}$ and $S_{south} > S^n_{north}$. Thus, applying the same reasoning as in the previous case implies there exists $F^*_{south} \in [0, T)$ such that $U_{south}(F^*_{south}) = U^{local}_{north}(F^*_{south})$.

If South regulates and North either regulates or does not do it, then individuals in South regulate the rental market if and only if $\beta S_{south} P_{south} < \beta\left(nS^n_{south} P^n_{south} + \left(1 - n\right) S^m_{south} P^m_{south}\right) - C_n$. As individuals with expected utility $\beta S_{south} P_{south}$ have no interest in migrating, individuals who would have the utility $\beta\left(nS^n_{south} P^n_{south} + \left(1 - n\right) S^m_{south} P^m_{south}\right) - C_n$ have also no incentive to migrate because they would have $\beta\left(nS^n_{south} P^n_{south} + \left(1 - n\right) S^m_{south} P^m_{south}\right) - C_n > \beta S_{south} P_{south} > \beta S_{north} P_{nortth} > \beta S^m_{north} P^m_{north}$. Lastly, if local individuals in South choose to regulate the rental market, then foreigners in South obtain expected utility $\beta S^m_{south} P^m_{south}$ instead of $\beta S_{south} P_{south}$. Moreover, as $P_{south} > P^m_{south}$ and $S_{south} > S^m_{south}$ because $D^m = D^n + \varepsilon > 0$, we can deduce that foreigners obtain $\beta S^m_{south} P^m_{south} < \beta S_{south} P_{south}$. Then, social

networks and PF decrease North-South migration when the South is unregulated. Hence, when South is regulated, the level of North-South migration is given by F^{**}_{south} and depends on optimal levels of social networks and PF such that $0 \leq F^{**}_{south} < F^{*}_{south}$.

A.2 Proof of Proposition 5

The first point to note is that it is a dominant strategy for the northern country not to regulate. To see this, note that the northern country never hosts immigrants in equilibrium as stated by Proposition 3. The absence of immigration means that the probability of getting a lease is independent of the network size, which means that building social networks is a pure loss as it is costly and destroys match surpluses. Proposition 4 states that in a country regulating its rental market, there is a strictly positive investment in social network. Therefore, not regulating the rental market in the north is a dominant strategy.

Equilibrium (i) occurs when the southern country is better off with regulation when the northern country does not regulate. Payoff in the south is given by

$$\begin{aligned} U^{local}_{south}(n^*, F^{**}_{south}) &= n^* S^n_{south} \frac{V}{Tn^*}\left(1 - e^{-\frac{Tn^*}{V}}\right) \\ &\quad + (1-n^*) S^m_{south} \frac{V}{F^{**}_{south} + T(1-n^*)}\left(e^{-\frac{Tn^*}{v}} - e^{-\frac{F^{**}_{south}+T}{V}}\right) - C_n, \end{aligned} \tag{33}$$

if the rental market is regulated and, otherwise,

$$U_{south}(F^{*}_{south}) = S_{south} \frac{V}{F^{*}_{south} + T}\left(1 - e^{-\frac{F^{*}_{south}+T}{V}}\right). \tag{34}$$

Regulation is an equilibrium if and only if $U^{local}_{south}(n^*, F^{**}_{south}) - U_{south}(F^{*}_{south}) > 0$, i.e, if and only if

$$s > \frac{n^{*2}}{(U_{sud}(n^*, F^{**}_{south}) - U_{sud}(F^{*}_{south})} \tag{35}$$

and

$$0 < n^* S^n_{south} \frac{V}{Tn^*}\left(1 - e^{-\frac{Tn^*}{V}}\right) + (1-n^*) S^m_{south} \frac{V}{F^{**}_{south} + T(1-n^*)}\left(e^{-\frac{Tn^*}{v}} - e^{-\frac{F^{**}_{south}+T}{V}}\right) \tag{36, 37}$$

$$- S_{south} \frac{V}{F^{*}_{south} + T}\left(1 - e^{-\frac{F^{*}_{south}+T}{V}}\right), \tag{38}$$

which implies that

$$D^n < \frac{(1-\delta)(a_s - C)(n^* P^n_{south} - P) + (1-n^*) P^m_{south} S^m}{\delta n^* P^n_{south}}. \tag{39}$$

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