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Moneycracy

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Abstract

How do wage and other financial benefits affect the set of candidates for political office? We answer the question by studying self-selection into politics of individuals with heterogeneous skills and heterogeneous motivations. Our predictions are in line with the efficiency wage results proposed by the extant literature when a benchmark model is considered with skills as the sole characteristic of individuals. Welfare is increasing in the politicians' wage since the best, *i.e.*, high-skilled, individuals are attracted to politics only if remuneration covers their high opportunity costs. Our findings are remarkably different when also motivation is taken into account. Welfare is not likely to be maximum when the politicians' wage is maximum for individuals are attracted whose motivation is well fitted with the market rather than the public sector. Finally, we provide an overview of the labor market of politicians in some Western countries and suggest that the Italian case might be representative of our inefficiency wage mechanism, which we call *moneycracy*.

Keywords: Politicians' remuneration, Skills, Motivation, Moneycracy.

JEL Codes: P16 (Political Economy), J45 (Public Sector Labor Markets), J24 (Human Capital; Skills; Occupational Choice; Labor Productivity), J32 (Nonwage Labor Costs and Benefits; Private Pensions).

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Introduction

It is widely recognized that good government is a crucial prerequisite for economies to flourish. In turn, the effectiveness of policy-making depends on the quality of the elected officials, *i.e.*, on their ability to maximize welfare by making decisions on behalf of the citizens. Since politicians are chosen within the pool of those willing to serve, finding a convincing answer to the following question is a relevant economic issue: how do wage and other financial benefits affect political self-selection?

Besley (2005) argues that political selection is important because the control of politicians through elections might be limited. Interestingly, he also observes (p. 44): "Much of the modern literature on political economy has not only neglected the problem of political selection, it has been positively hostile to the topic." This is why only recently the economists have tackled this issue. See, *e.g.*, Caselli & Morelli (2004) and Messner & Polborn (2004) for theoretical analyses; and Ferraz & Finan (2009) for empirical evidence. These papers generally measure quality of the political class through one dimension, skills. The importance of politicians' competence for government decision-making is indeed axiomatic. Accordingly, a common prediction is provided, which is in line with the adverse selection framework of the efficiency wage theory (see, *e.g.*, Weiss, 1980; and Malcolmson, 1981). Since remuneration is mainly fixed in the public sector, whilst markets reward skills, only low-skilled individuals will run for office. As a result, increasing financial benefits from holding office may attract better candidates and enhance the policy outcome.

A possible shortcoming of the above analysis is that it deals with politicians without taking explicitly into account one of oldest and most discussed topics by public administration scholars, motivation (see, *e.g.*, Rainey & Steinbauer, 1999). Public service motivation of politicians, or more generally of public servants, is defined as "an individual's predisposition to respond to motives grounded primarily or uniquely in public institutions and organizations" (Perry & Wise, 1990). Put differently, working activity of politicians is also driven by something different than material incentives such as money or career advancements. This notion has recently been brought into economic thinking. Besley (2005), *e.g.*, argues that motivation of politicians "can be thought of as hard-wired into preferences rather being dependent on external reinforcement".

Accordingly, the current paper extends the existing literature by including explicitly the role of politicians' motivation. More exactly, we examine how the level of politicians' financial remuneration affects self-selection into politics of individuals with *both* heterogeneous skills *and* heterogeneous motivations.

The relevant issue of work motivation has been tackled by various strands of the economics literature. For instance, Handy & Katz (1998) study the selection of intrinsically motivated managers in the non-profit sector. Heyes (2005) focuses on the nursing labor market. The design of optimal incentives when agents are intrinsically motivated is instead developed by Besley & Ghatak (2005), Delfgaauw & Dur (2007), and Stowe (2009).

In this paper, we introduce a citizen-candidate model where individuals decide whether to run for office. Only one individual is elected randomly and provides a public good.[1] The others devote themselves to a private activity in the market sector.[2] Given our focus on self-selection into politics rather than on behavior once in office, we adopt a static framework based on the comparison of the individuals' payoff from one period in office against one period in the market. Accordingly, we disregard the role played by reelection in affecting moral hazard problems (see, *e.g.*, Smart & Sturm, 2004, and Beniers & Dur, 2007, for analysis of this topic).

Motivated, or *public-fit*, individuals are defined as those having high fit with the public sector environment in terms of value congruence. One can think of persons whose main work values and goals are public-oriented, *e.g.*, they aim at serving the interests of a community. This type of individuals are supposed to be well fitted with the public sector, where they have high probability of obtaining their work goals (see Delfgaauw & Dur, 2010, for a similar definition of public service motivated individuals). By contrast, non-motivated, or *market-fit*, individuals have good fit with the market sector for their main work values are market-oriented, *e.g.*, they enjoy performing business occupations and/or aim at getting high monetary incomes. We suppose that, for any given level of skills, (i) public-fit individuals are weakly more efficient than market-fit when providing the public good; (ii) market-fit citizens are weakly more efficient than public-fit when running the private activity. We also assume that, for any given type of fit, high-skilled individuals are more productive than low-skilled in both public and market sectors. Utilitarian welfare is maximum (minimum) in our framework when an individual with both public fit and high skills (market fit and low skills) is in office for she is able to supply the maximum (minimum) level of public good enjoyed by the whole society.

Theories of person-environment fit, broadly defined as the compatibility between an individual and a work environment that occurs when their characteristics are well matched, have been popular in the management literature since Parsons (1909). The idea that the person-environment fit can be a crucial determinant of work motivation is not new in the economics literature. Besides Delfgaauw & Dur (2010), Besley & Ghatak (2005) show that motivation of workers is positively affected by the extent to which they agree with the mission being pursued by an organization.

Our main findings stand in contrast with the efficiency wage predictions proposed by the afore-

[1] The assumption of a random election mechanism is aimed at focusing our attention on the effect of financial remuneration on self-selection. We hence disregard the role of political parties, voters, and electoral rules in affecting quality of the elected politician. In doing so, like *e.g.* Besley (2004), we suppose that the individuals' type is private information, *i.e.*, that each individual knows her own type but ignores the type of the others.

[2] Politics and the private sector are assumed to be mutually exclusive in our framework. This might be considered as a restrictive hypothesis becasue in some countries members of parliament have the option to keep on working in the market sector while in office. Such option is called moonlighting and it is registered, among others, in the British House of Commons, in the German Bundestag, in the Italian Parlamento, and in the European Parliament. A recent stream of empirical literature studies the impact of this extra option on political selection: see Geys & Mause (2013) for a survey of the literature on moonlighting politicians. Accordingly, in Section 5 we allow for politicians' outside employment and show under which conditions our findings are robust to this specification.

mentioned literature on political selection. We demonstrate that increasing the politician's reward has not a monotonically positive impact on the expected value of welfare. The reason is twofold. On one hand, the opportunity costs of entering politics borne by the worst politician, *i.e.*, a market-fit low-skilled individual, are relatively high due to her wrong fit. On the other hand, the top politician, *i.e.*, a public-fit high-skilled individual, incurs relatively low opportunity costs due to her right fit. Accordingly, the worst (best) politician does not demand the lowest (highest) reservation wage. This means that the worst potential candidates are crowded out if a minimum reward is set and that the best ones are attracted even if the reward is not maximum. As a corollary, paying politicians a lot attracts high-skilled individuals whose work motivation is yet market oriented, hence poorly fitted with the public sector. This adverse selection effect is referred to as *moneycracy*.[3]

Finally, we provide a descriptive overview of politicians' labor market in some Western countries, with a special focus on Italy. The Italian case turns out to be interesting for our theoretical analysis. Italy is home to the highest number of parliamentarians in Europe. More interestingly, they are the highest paid. Yet welfare, as measured by GDP per capita and Public Debt/GDP ratio, is not higher than the other countries considered. Moreover, Italy experienced an important rise of the legislators' real wage over the last three decades. At the same time there has been a non-decreasing selection of high-skilled individual, on one hand, and an *increasing* selection of market-fit individuals in parliament, on the other hand. This suggests that the "moneycratic" mechanism of selection highlighted by our theoretical framework might be in action in the Italian Parliament.

Overall, our analysis might contribute to the vivid debate about the politicians' remuneration that is currently taking place in Italy. Given the severe crisis that has been hitting Italy's economy since 2008, the common wisdom is that the parliamentary wage should be reduced for ethical reasons. In their book "The Ruling Class, Management and Politics in Modern Italy", Boeri *et al.* (2010, p. 84) suggest that the same recipe should be advocated also for efficiency reasons:

> "[...] We conclude that the sharp increase in the parliamentary wage in Italy has contributed to the decline of the quality of the elected legislators over time."

Similarly, Pirani (2010) comments on the increasing presence of managers in the Lower house of the Italian Parliament and seems to emphasize the existence of a moneycratic mechanism of political selection:

> "È probabile trattarsi di persone che perseguono gli interessi aziendali, attraverso la loro posizione politica. Un conflitto di interessi che assume dimensioni macroscopiche

[3] The more common terms of plutocracy or moneyocracy are related to the concept of government by the rich, with no explanation of why they are rich. By contrast, we state explicitly that individuals get top income in our framework thanks to their high skills *and* market-fit (they can be considered as self-made men), rather than because their parents are rich. This makes a crucial difference in our framework since a rich heir with, *e.g.*, high skills and public fit would raise no concern about selection. In the light of this, moneycracy could be defined as government by the wannabe rich.

quando verifichiamo un dato senza precedenti: tra i parlamentari eletti alle ultime politiche (2008) sono i manager a far la parte del leone (un deputato su quattro)."[4]

An analogous opinion can be found in Reggiani & Rizzolli (2012):

"[...] ci hanno illuso che pagando di più i politici avremmo ottenuto politici migliori. Ci sembra invece che, offrendo alte remunerazioni e generosi privilegi, abbiamo attirato in gran numero candidati che ambiscono ad essere eletti solo per poter accedere a questo trattamento privilegiato e non perché motivati dalla missione di poter contribuire genuinamente al bene comune in modo diretto ed attivo."[5]

The remainder of the paper is organized as follows. In Section 1 we survey the related literature. In Section 2, we lay out the theoretical framework. In Section 3, we study a benchmark model where individuals are characterized only by skills. In Section 4 we solve the general model and provide the main results. In Section 5 we extend the analysis by introducing moonlighting. In Section 6 we provide a descriptive overview of the labor market of politicians in some Western countries. Section 7 concludes.

1 Related Literature

This paper introduces explicitly motivation into the political selection literature. Accordingly, our contribution has a connection, in the first place, with the literature on work motivation. The bottom line of the economics papers dealing with such a topic is that motivation impacts positively on the individual's productivity and/or utility. Some authors (see, *e.g.*, Heyes, 2005) assume that workers receive a non-pecuniary benefit which increases with their motivation level. Francois (2000) focuses on the provision of social services and suppose that motivated workers' utility depends also on the level of output produced. Handy & Katz (1998) assume that, for any given level of ability, more motivated workers are able to produce higher output than less motivated colleagues. Similarly, Delfgaauw & Dur (2007) and Stowe (2009) suppose that motivation reduces the workers' effort disutility, which is the approach we opt for in this paper.

Our framework is close to Delfgaauw & Dur (2010) and Dal Bó *et al.* (2013) who consider individuals with different market ability and different public service motivation. Delfgaauw & Dur (2010) study self-selection into public management but their focus is not on potential adverse selection effects caused by high flat financial remuneration. By contrast, this is the research question of Dal

[4] "These persons (the managers) are likely to exploit the political position to improve their private business. The deriving conflict of interest is huge as 25% of the deputies elected in 2008 are managers, the highest percentage since the existence of the Italian Republic." English translation by the authors.

[5] "[...] we have been told that we would have attracted better politicians by paying them more. In contrast, it seems that we attracted candidates who run for office only to get money and benefits rather than public-spirited candidates." English translation by the authors.

Bó *et al.* (2013). They consider applicants for public sector positions in Mexico and find that higher wages attract more able applicants as measured by their IQ, personality, and proclivity towards public sector work. This stands in contrast to our findings because the authors assume market ability of applicants to be increasing in their public service motivation. In our paper we adopt a more general approach by not imposing any functional relation between the two characteristics.

The second strand of literature which we contribute to is that on political selection. The basic theoretical framework used to study the decision to enter politics is the citizen-candidate model. This strand, inaugurated by the works of Besley & Coate (1997) and Osborne & Slivinski (1996), removes the artificial distinction between citizens and politicians by recognizing that public officials are selected from those citizens who choose to become candidates. Our paper continues in this tradition.

The two seminal papers assume candidates' heterogeneity in preference. Our article is instead closer to a second generation of citizen-candidate models, where agents are supposed to differ with respect to their quality as a politician. Within this framework, Caselli & Morelli (2004) and Messner & Polborn (2004) study how relative salaries in the political and private sectors affect the average ability of elected politicians. In particular, Caselli & Morelli (2004) present an adverse selection model where the population is composed of high and low-ability individuals. High-ability individuals are more productive both in the private sector and in the public sector. Similarly, in Messner & Polborn (2004) the opportunity cost of serving in office is higher for more productive candidates. The main finding of both contributions is that increasing the remuneration of the elected politicians enhances their average ability.

Comparable results are found by Besley (2004). He describes a political agency model with two types of politicians. He considers the effects of the politicians' wage on both the behavior in office and the candidature decision. In accordance with the two aforementioned papers, Besley (2004) demonstrates that increasing wages raises voter welfare. Empirical support to this result comes from Ferraz & Finan (2009). They study salaries of local legislators across Brazil's municipal governments and find that higher wages improve the quality of legislators, as measured by education, type of previous profession, and political experience in office.[6]

Our model introduces an element of novelty within the citizen-candidate framework by allowing for two dimensions of heterogeneity between agents: not only skills, but also motivation. Relying on this richer formulation, we are able to differentiate public sector productivity from market sector productivity and to show that increasing the politicians' wage can be welfare-reducing.

Two articles in the citizen-candidate literature (Smart & Sturm, 2004, and Poutvaara & Takalo, 2007) describe circumstances in which raising wage can affect welfare negatively. The main mechanism behind this result is dynamic in Smart & Sturm (2004). The higher remuneration increases the

[6] A similar result is found by Gagliarducci and Nannicini (2013) who use data on Italian municipal governments from 1993 to 2001 and conclude that higher wage attracts more educated candidates.

value to be re-elected. Accordingly, the politicians are induced to implement policies that guarantees re-election rather than policies aimed at increasing the voters' welfare. Our comparable results are due to selection rather than moral hazard problems. Poutvaara & Takalo (2007) present a model of costly campaigning that produces informative but noisy signals of candidates' abilities. One of their results is that increasing the reward may lower the average candidate quality. This is mainly driven by the presence of high campaigning costs, which are instead irrelevant and then disregarded in our framework. As reported before, our mechanism relies instead on the selection of individuals with a low degree of fit with the public sector.

Interestingly, a bidimensional heterogeneity among agents can be found in the citizen-candidate frameworks proposed by Mattozzi & Merlo (2008) and Beniers & Dur (2007). Mattozzi & Merlo (2008) introduce a dynamic model where politicians display two dimensions of ability, political skills and market ability. Whilst skills and fit are independent in our framework, Mattozzi & Merlo (2008) assume that better politicians are more likely to be better managers and viceversa, as in Dal Bó *et al.* (2013). They find that high-ability citizens are willing to serve for a period (political careers), after which they might leave parliament and capitalize on the political experience. In line with the efficiency wage theory, the authors also show that better incumbent politicians are less likely to leave politics when the wage level increases.

Beniers & Dur (2007) study the effect of electoral competition on the behavior of politicians who are heterogeneous both in competence and in how much they care about the public interest. In their dynamic framework each incumbent official, before the second-period election, acquires an informational advantage over voters concerning the quality of the policies she has implemented. When a policy turned out to be a failure, it can be reversed before the next elections. This action implies highest welfare for the voters but a reputational loss for the incumbent. Consequently, only those politicians who care sufficiently about the public interest are willing to admit a policy failure and take the risk of losing the re-election. The authors show that politicians are less inclined to admit that a policy has failed when they believe other politicians are more likely to behave opportunistically. Interestingly, the incentives to behave opportunistically increase with the politicians' pay.

2 Setup

Consider a society with N individuals, N large. We first denote with parameter w direct remuneration plus any other financial benefits from holding office. We introduce the following three-period citizen-candidate model.

$t = 0$ The level of parameter w is publicly announced.

$t = 1$ N individuals decide whether to run for office. Afterward, only one individual is elected randomly among the candidates. Throughout the paper we refer to her as a politician and to

individuals who are not elected or decide not to run for office as a citizen.

$t = 2$ The politician exerts an effort level $e \in [0, \infty)$ to provide a public good, the amount of which is denoted by $P(e)$, $P' > 0 > P''$ and $P'(\infty) = 0$. If no individual run for office, the public good is not supplied. By contrast, each citizen gets income $M(a)$, $M' > 0 > M''$ and $M'(\infty) = 0$, from a productive activity she runs in the market sector, where parameter $a \in [0, \infty)$ represents the effort level she provides when involved in such a task. Afterward, the politician receives the reward w which is financed through a lump-sum tax levied on all N members of the society.

Individuals are endowed with two characteristics chosen by Nature before the game starts. Parameter $\gamma_i \in \{\gamma_P, \gamma_M\}$, $\gamma_P \neq \gamma_M$, represents the degree of fit or compatibility with the working environment, either the public sector or the market one. Parameter $\theta_j \in \{\theta_L, \theta_H\}$, $\theta_H > \theta_L$, measures the level of skills. Four types, denoted by $ij = \{M, P\} \times \{L, H\}$, are thus present in the society. The proportion of type-ij individuals is $\lambda_{ij} > 0$, with $\sum_{ij} \lambda_{ij} = 1$. We introduce the following

Definition 1 *An individual endowed with fit parameter γ_P is referred to as public-fit. An individual endowed with fit parameter γ_M is referred to as market-fit.*

Parameters γ_i and θ_j are assumed to affect both type-ij politician's effort disutility function, denoted by

$$c(e, \gamma_i, \theta_j), \tag{1}$$

and the corresponding value of type-ij citizen, indicated by

$$s(a, \gamma_i, \theta_j). \tag{2}$$

Functions (1) and (2) are increasing and convex in e and a: $c_e > 0$, $c_e(0) = 0$, $c_{ee} > 0$, $s_a > 0$, $s_a(0) = 0$, and $s_{aa} \geq 0$, subscripts e, a and ee, aa denoting first and second derivatives, respectively. We let

$$c(e, \gamma_i, \theta_H) \leq c(e, \gamma_i, \theta_L), \tag{3}$$

$$s(a, \gamma_i, \theta_H) \leq s(a, \gamma_i, \theta_L), \tag{4}$$

$c_e(e, \gamma_i, \theta_H) < c_e(e, \gamma_i, \theta_L)$, and $s_a(a, \gamma_i, \theta_H) < s_a(a, \gamma_i, \theta_L)$. *Ceteris paribus*, an individual with higher skills incurs nonhigher disutility and less marginal disutility both in public and market sectors. These hypotheses are standard. In addition, we make the following

Assumption 1 $c(e, \gamma_P, \theta_j) \leq c(e, \gamma_M, \theta_j)$,

Assumption 2 $s(a, \gamma_P, \theta_j) \geq s(a, \gamma_M, \theta_j)$.

Assumption 1 states that, *ceteris paribus*, a public-fit individual incurs nonhigher effort disutility than a market-fit one when elected. Assumption 2 states that, *ceteris paribus*, a market-fit individual incurs less effort disutility than a public-fit one when working in the market sector. The two hypotheses capture in a simple way the negative relation between person-environment fit and effort disutility. Finally, we let the marginal effort disutility in the public sector be nonhigher in case of public fit,

$$c_e\left(e, \gamma_P, \theta_j\right) \leq c_e\left(e, \gamma_M, \theta_j\right), \tag{5}$$

and that in the market sector be lower in case of market fit,

$$s_a\left(a, \gamma_P, \theta_j\right) > s_a\left(a, \gamma_M, \theta_j\right). \tag{6}$$

Before proceeding, we remark that the politician receives a reward w independent of her type, *i.e.* a flat reward. This is a common assumption in the related literature. Besley (2004) points out that "politicians tend to be regulated by career concerns rather than formal incentive contracts". Indeed, it is problematic to link monetary incentives to key observable outcomes in the context of politics. Moreover, politicians are charged with a wide variety of tasks which compete for their attention. Accordingly, the remuneration system for them is generally supposed to be low-powered.[7]

With the aim of a better understanding of the role played by fit in our framework, we first study a benchmark case where effort disutility is affected only by skills.

3 A Benchmark Model of Efficiency Wages in Politics

We simplify the set-up of Section 2 by supposing that fit does not appear in the individuals' effort disutility functions. Accordingly just two types of individuals, low-skilled and high-skilled denoted by $j = \{L, H\}$, are present in the society. In addition, (1) and (2) rewrite as $c\left(e, \theta_j\right)$ and $s\left(a, \theta_j\right)$. The model is solved backwards, starting from the third-period politician's choice of effort while in office.

The Politician. When a type-j individual is elected her payoff function as a politician is

$$U_j \equiv P\left(e\right) - c\left(e, \theta_j\right) + w - \frac{w}{N}, \tag{7}$$

where $P\left(e\right)$ is the public good consumption linear utility, $c\left(e, \theta_j\right)$ is the effort disutility, w is the reward, and, finally, $\frac{w}{N}$ represents the lump-sum tax.[8]

[7] For example, Mattozzi & Merlo (2008) and Messner & Polborn (2004) consider a fixed salary. Caselli & Morelli (2004), Poutvaara & Takalo (2007), Beniers & Dur (2007) and Besley (2004) introduce flat private rents from holding office, which are defined as the utility value of both financial and psychological rewards from public office. At the best of our knowledge, an exception is Gersbach (2003), who proposes a model where the politicians' pay is made conditional on the realization of macroeconomic events.

[8] Costs of running for office are assumed to be zero. In the citizen-candidate literature positive costs are often introduced which are equal across individuals. Following this approach would not affect our results.

At $t = 2$ type-j politician selects the effort level e_j^* to maximize payoff U_j. In symbols,

$$e_j^* \equiv \arg\max_e \left[P(e) - c(e, \theta_j) + w - \frac{w}{N} \right]. \tag{8}$$

F.O.C. $P'(e) - c_e(e, \theta_j) = 0$ is necessary and sufficient to find a solution to problem (8). We let

$$U_j^* \equiv P\left(e_j^*\right) - c\left(e_j^*, \theta_j\right) + w - \frac{w}{N} \tag{9}$$

be the payoff obtained by a type-j politician after exerting the optimal effort $e_j^* > 0$.

Applying the implicit function theorem to F.O.C. yields $\partial e / \partial \theta = c_{e\theta} / (P'' - c_{ee})$, which is positive by assumption. This implies that a politician with higher skills exerts more effort,

$$e_H^* > e_L^*. \tag{10}$$

Citizens. We now turn to the citizens' third-period choice of effort in the market sector. When a type-j individual is not elected or does not run for office, her payoff is

$$Z_j \equiv M(a) - s(a, \theta_j) + \overline{P} - \frac{w}{N}, \tag{11}$$

where: $M(a) - s(a, \theta_j)$ is the market activity income net of the effort disutility; $\overline{P}$ is the public good consumption linear utility, with $\overline{P}$ indicating the optimal level of public good provided by the elected politician; finally, $\frac{w}{N}$ is the lump-sum tax.

At $t = 2$ a type-j citizen chooses the effort level $a_j^* > 0$ to maximize payoff Z_j. F.O.C. is $M'(a) - s_a(a, \theta_j) = 0$. We denote by

$$Z_j^* \equiv M\left(a_j^*\right) - s\left(a_j^*, \theta_j\right) + \overline{P} - \frac{w}{N} \tag{12}$$

the payoff obtained by a type-ij citizen after exerting the optimal effort a_j^*.

Individuals with higher skills exert higher effort in the market sector. To prove it, we apply the implicit function theorem to F.O.C. and get $\partial a / \partial \theta = s_{a\theta} / (M'' - s_{aa})$, which is positive by assumption. As a result

$$a_H^* > a_L^*. \tag{13}$$

Politician's Reservation Reward. We now go backwards at $t = 1$, when all individuals choose whether to run for office. To study such a decision, we introduce the notion of type-j politicians' reservation reward, denoted by $\underline{w}_j$ and defined as the minimum reward level a type j is willing to accept to run for office. Individuals are assumed to care just about money when making the entry decision. This amounts to say that they compare reward w, obtained in case they are elected, to

market income $M(a)$, earned when they are not elected or do not run for office. Instead, public good consumption utility P and effort disutilities $c(.)$ and $s(.)$ are neglected.[9]

Recalling that the election is random, we let $p \in (0,1)$ be a candidate j's probability of election. Accordingly, a type-j individual's expected monetary payoff at $t=1$ when she runs for office is $p\left(w-\frac{w}{N}\right)+(1-p)\left[M\left(a_j^*\right)-\frac{w}{N}\right]$. With probability p she is elected and obtains the flat reward net of the lump-sum tax. With probability $1-p$ she is not elected and ends up with the net optimal market income. On the contrary, $M\left(a_j^*\right)-\frac{w}{N}$ is the net monetary return she gets when not running for office. By definition of reservation reward, $\underline{w}_j$ must solve equality

$$p\left(w-\frac{w}{N}\right)+(1-p)\left[M\left(a_j^*\right)-\frac{w}{N}\right]=M\left(a_j^*\right)-\frac{w}{N}. \tag{14}$$

As a straightforward result, $\underline{w}_j$ is equal to type-j individuals' market income, which represents their monetary opportunity cost of becoming a politician. In symbols,

$$\underline{w}_j = M\left(a_j^*\right). \tag{15}$$

Relying on (13) and recalling that $M'(a)>0$ we can write

$$\underline{w}_H > \underline{w}_L, \tag{16}$$

according to which a type-H agrees to accept a higher minimum reward than a type-L to run for office for she incurs higher opportunity costs.

Welfare. Before proceeding, we are interested in studying how the politician's skills affect welfare of the society. Adopting a utilitarian approach, we define welfare as the sum of utilities of all individuals. Utilitarian welfare when a type-j individual is in office is denoted by S_j and amounts thus to

$$S_j \equiv U_j + (\lambda_j N - 1) Z_j + \lambda_{-j} N Z_{-j}, \tag{17}$$

where $\lambda_j > 0$ denotes the proportion of type-j individuals in the society, with $\sum_j \lambda_j = 1$, whilst subscript $-j = L, H$ expresses the citizens' type different from that of the politician. Accordingly, $\lambda_j N - 1$ indicates the set of type-j citizens but the politician and $\lambda_{-j} N$ the citizens of the other type. Plugging e_j^*, a_j^* and a_{-j}^* into (17) and rearranging yields the optimal welfare when type-j is in office,

$$S_j^* = NP\left(e_j^*\right) - c\left(e_j^*, \theta_j\right) + (\lambda_j N - 1)\left[M\left(a_j^*\right) - s\left(a_j^*, \theta_j\right)\right] + \lambda_{-j} N\left[M\left(a_{-j}^*\right) - s\left(a_{-j}^*, \theta_{-j}\right)\right]. \tag{18}$$

[9] This is a simplifying hypothesis aimed at disregarding strategic interaction among individuals at the entry stage. It is in the spirit of Caselli & Morelli (2004) framework, where each individual candidate does not take into account her potential influence on the average level of the public good when she decides whether to run. If we relax such a simplifying assumption, in line with Messner & Polborn (2004), the results of Proposition 1 are not affected. Indeed, they show that the expected quality of running candidates increases as the remuneration of the official increases in a setup where candidates consider both their direct remuneration and the possible improvement of the public good level (if they rather than worse candidates serve) as the benefits of running for office.

The first two terms represent the public good consumption utility, enjoyed by all individuals, net of the politician's effort disutility. The last two terms denote the citizens' market activity income net of their effort cost.

The optimal welfare is enhanced when a high-skilled instead of a low-skilled individual is in office,

$$S_H^* > S_L^*, \tag{19}$$

provided that N is large. To prove this we build upon (18) to rewrite (19) as

$$P\left(e_H^*\right) - P\left(e_L^*\right) > \frac{\left(Z_H^* - Z_L^*\right) - \left(U_H^* - U_L^*\right)}{N-1}. \tag{20}$$

The RHS of (20) is close to zero since N, which denotes the size of the entire society, is large. In this case (20) is approximately equivalent to $e_H^* > e_L^*$, which is fulfilled.

A trade-off is at stake when comparing S_H^* to S_L^*. The public sector benefits from the presence of a high-skilled instead of a low-skilled politician. The market sector is penalized by the presence of a low-skilled instead of a high-skilled citizen. Yet, skills are more relevant in the public where the beneficial impact of a type-H individual is spread among all citizens. Put differently, welfare of the society is assumed to be positively affected by quality of the elected official, as measured by skills. Even though identifying positive causality between quality of government and welfare is not straightforward, recent empirical evidence confirms that political leaders play an important role in enacting right policies, which affect significantly the economic performance: see, *e.g.*, Jones & Olken (2005); and Besley *et al.* (2010).

Efficiency Wages. The last step of our benchmark analysis studies whether and how the level of remuneration w, publicly announced at $t = 0$, affects welfare of the society. It is worth remarking that w does not appear in the expression of optimal welfare (18) because w is transferred from citizens to the politician. Yet, relying on inequality (16), we are able to show that w can affect welfare through the following selection mechanism.

1. If $w < \underline{w}_L$, no individual decides to run for office since reward w does not satisfy the participation constraint of all individuals. In this case the level of public good is zero, no tax is levied and therefore the welfare equals

$$S_0 \equiv N \textstyle\sum_j \lambda_j \left[M\left(a_j^*\right) - s\left(a_j^*, \theta_j\right)\right]. \tag{21}$$

2. If $\underline{w}_L \leq w < \underline{w}_H$, only type-$L$ individuals run for office. As a result, a type-L will be elected with probability $p = \lambda_L/\lambda_L = 1$ and the deriving optimal welfare is $E_L(S) \equiv S_L^*$, which we assume to be higher than S_0.[10]

[10] Note that inequality $S_L^* > S_0$ is equivalent to $P\left(e_L^*\right) > \left\{c\left(e_L^*, \theta_L\right) + \left[M\left(a_L^*\right) - s\left(a_L^*, \theta_L\right)\right]\right\}/N$. In line with condition (20), we assume that welfare is higher when a politician, even if low-skilled, is in office than when nobody is elected, because a positive level of public good is provided which is enjoyed by all citizens.

3. If $w \geq \underline{w}_H$, all individuals run for office. Since the election is random and $\lambda_L (1 - \lambda_L)$ is the proportion of type-L (type-H) individuals in the society, the elected politician will be type-L with probability $p = \lambda_L / (\lambda_L + 1 - \lambda_L) = \lambda_L$ and type-H with probability $1 - p = (1 - \lambda_L) / (\lambda_L + 1 - \lambda_L) = 1 - \lambda_L$. As a result, the expected optimal welfare, *i.e.*, the welfare before the election takes place, is $E_H (S) \equiv \lambda_L S_L^* + (1 - \lambda_L) S_H^*$. It is easy to check that $E_H (S) > E_L (S)$ under condition (19).

We sum up our findings in the following

Proposition 1 *When only skills affect the individuals' effort disutility, the expected value of welfare of the society is increasing in the politician's reward.*

Conditions (16) and (19) ensure that both reservation reward and welfare are increasing in skills. As a consequence, the efficiency wage theory applies when just skills matter. Setting a relatively high remuneration for politicians, $w \geq \underline{w}_H$, is the only way to attract good candidates and enhance the expected value of welfare. This policy recommendation is in line with some early results concerning the effect of wages on political selection (Caselli & Morelli, 2004; Messner & Polborn, 2004; and Besley, 2004). Yet, in the remainder of the paper we show that the prediction of Proposition 1 is dramatically modified when the notion of fit comes onto the stage.

4 The Importance of Motivation

In this section we solve backwards the model laid out in Section 2, where the individuals' effort disutility depends on skills and fit.

4.1 The Politician

When a type-ij individual is elected her payoff function as a politician at $t = 2$ is

$$U_{ij} \equiv P (e) - c (e, \gamma_i, \theta_j) + w - \frac{w}{N}, \tag{22}$$

where effort disutility $c (e, \gamma_i, \theta_j)$ depends now on both the skill and the fit parameters, γ and θ. We denote by

$$U_{ij}^* \equiv P \left(e_{ij}^*\right) - c \left(e_{ij}^*, \gamma_i, \theta_j\right) + w - \frac{w}{N} \tag{23}$$

the payoff obtained by type-ij politician after exerting the optimal effort $e_{ij}^* > 0$.

We know from the above analysis that, for any given type of fit, a politician with higher skills exerts higher optimal effort, $e_{iH}^* > e_{iL}^*$. Similarly, condition (5) along with our assumptions on $P (e)$ and $c (e, \gamma_i, \theta_j)$ ensure that, for any given level of skills, a politician with public fit exerts nonlower optimal effort, $e_{Pj}^* \geq e_{Mj}^*$.

4.2 Citizens

When a type-ij individual is not elected or does not run for office, her payoff function as a citizen at $t = 2$ is

$$Z_{ij} \equiv M(a) - s(a, \gamma_i, \theta_j) + \overline{P} - \frac{w}{N}. \tag{24}$$

We recall that $\overline{P}$ is public good consumption utility, with $\overline{P}$ denoting the optimal level of public good provided by the elected politician. We indicate by

$$Z^*_{ij} \equiv M\left(a^*_{ij}\right) - s\left(a^*_{ij}, \gamma_i, \theta_j\right) + \overline{P} - \frac{w}{N} \tag{25}$$

the payoff obtained by a type-ij citizen when she exerts the optimal effort $a^*_{ij} > 0$.

Relying on the above analysis we can demonstrate that, for any given type of fit, a citizen with higher skills exerts higher optimal effort, $a^*_{iH} > a^*_{iL}$. Similarly, condition (6) along with our assumptions on $M(a)$ and $s(a, \gamma_i, \theta_j)$ ensure that, for any given level of skills, a citizen with market fit exerts higher optimal effort, $a^*_{Mj} > a^*_{Pj}$.

4.3 Politician's Reservation Reward

We now go backwards at $t = 1$, to study the individuals' choice to run for office. The key concept is type-ij politician's reservation reward, denoted by $\underline{w}_{ij}$. As shown in Section 3, $\underline{w}_{ij}$ equals the type-ij individuals' market income,

$$\underline{w}_{ij} = M\left(a^*_{ij}\right). \tag{26}$$

The reservation reward increases with the market income, which represent type-ij individual's opportunity cost of becoming a politician.

It is worth studying how $\underline{w}_{ij}$ is affected by fit and skills. First notice that inequality

$$\underline{w}_{Pj} < \underline{w}_{Mj} \tag{27}$$

is equivalent to $M\left(a^*_{Pj}\right) < M\left(a^*_{Mj}\right)$ which holds true since $a^*_{Mj} > a^*_{Pj}$ and $M'(a) > 0$. As a result, for any given level of skills a politician with public fit demands a lower reservation reward. The reason is that she incurs lower opportunity costs of entering politics because of a wrong fit with the market sector. Similarly, inequality

$$\underline{w}_{iH} > \underline{w}_{iL} \tag{28}$$

can be rewritten as $M(a^*_{iH}) > M(a^*_{iL})$, which is fulfilled since $a^*_{iH} > a^*_{iL}$ and $M'(a) > 0$. The reservation reward increases thus with skills.

We study the ranking of reservation wages in the following

Lemma 1 *(i) A public-fit low-skilled politician requires the minimum reservation reward. (ii) A market-fit high-skilled politician demands the maximum reservation reward. In symbols,*

$$\begin{array}{lll} \underline{w}_{PL} < \underline{w}_{PH} < \underline{w}_{ML} < \underline{w}_{MH} & \textit{iff} & a^*_{PH} < a^*_{ML}, \quad (a) \\ \underline{w}_{PL} < \underline{w}_{ML} < \underline{w}_{PH} < \underline{w}_{MH} & \textit{iff} & a^*_{PH} > a^*_{ML}. \quad (b) \end{array} \tag{29}$$

Public fit affects negatively the politician's reservation reward according to (27). By contrast, skills have a positive impact given (28). As a result, a politician with public fit and worse skills (market fit and better skills) requires the lowest (highest) reservation reward. In addition, a type-PH politician demands a lower reservation reward than a type-ML iff $M\left(a_{PH}^{*}\right) < M\left(a_{ML}^{*}\right)$, or equivalently $a_{PH}^{*} < a_{ML}^{*}$, in which case she incurs lower opportunity costs of entering politics. When the opposite occurs, $a_{PH}^{*} > a_{ML}^{*}$, it is instead a type-ML who requires a lower reservation reward than a type-PH.

4.4 Welfare

In this subsection we are interested in studying how fit and skills of the politician affects welfare of the society. Following the approach of Section 3, utilitarian welfare when type-ij individual is in office is denoted by S_{ij} and amounts to

$$S_{ij} \equiv U_{ij} + \left(\lambda_{ij}N - 1\right) Z_{ij} + \textstyle\sum_{fk} \lambda_{fk} N Z_{fk}. \tag{30}$$

Recall that parameter $\lambda_{ij} > 0$, with $\sum_{ij} \lambda_{ij} = 1$, denotes the proportion of type-ij individuals in the society, whilst subscript $fk \neq ij$, $f = P, M$ and $k = H, L$, expresses the three citizens' types that differ from politician's type. For instance, if $ij = PH$ then $fk = PL$, ML, MH. Accordingly, $\lambda_{ij}N - 1$ indicates the set of type-ij citizens but the politician and $\sum_{fk} \lambda_{fk} N$ are all the other citizens in the society. Plugging e_{ij}^{*}, a_{ij}^{*} and a_{fk}^{*} into (30) and rearranging yields the optimal welfare when a type-ij is in office

$$\begin{aligned} S_{ij}^{*} = NP\left(e_{ij}^{*}\right) - c\left(e_{ij}^{*}, \gamma_i, \theta_j\right) + \left(\lambda_{ij}N - 1\right)\left[M\left(a_{ij}^{*}\right) - s\left(a_{ij}^{*}, \gamma_i, \theta_j\right)\right] \\ + \textstyle\sum_{fk} \lambda_{fk} N \left[M\left(a_{fk}^{*}\right) - s\left(a_{fk}^{*}, \gamma_f, \theta_k\right)\right]. \end{aligned} \tag{31}$$

We first show that the optimal welfare is enhanced when, *ceteris paribus*, a public-fit instead of a market-fit individual is in office,

$$S_{Pj}^{*} > S_{Mj}^{*}. \tag{32}$$

Indeed, inequality (32) can be rewritten as[11]

$$\left(N - 1\right)\left[P\left(e_{Pj}^{*}\right) - P\left(e_{Mj}^{*}\right)\right] + \left(U_{Pj}^{*} - U_{Mj}^{*}\right) > Z_{Pj}^{*} - Z_{Mj}^{*}. \tag{33}$$

The LHS is positive. Indeed, $e_{Pj}^{*} \geq e_{Mj}^{*}$ and $P' > 0$, and $U_{Pj}^{*} > U_{Mj}^{*}$ by Assumption 1.[12] The RHS is instead negative because $Z_{Mj}^{*} > Z_{Pj}^{*}$ is implied by Assumption 2. As a result, inequality (33) is fulfilled. The reason is twofold. On one hand, a public-fit instead of a market-fit politician does not decrease the level of public good, thus not deteriorating the payoff of all citizens, and increases her own payoff. On the other hand, the market sector benefits from the presence of a market-fit instead of a public-fit citizen.

[11] See Appendix A.1 for computations.
[12] See Appendix A.2 for computations.

In line with condition (19), we can show that

$$S^*_{iH} > S^*_{iL} \tag{34}$$

is approximately equivalent to $e^*_{iH} > e^*_{iL}$, which is fulfilled. The positive impact of a high-skilled politician is spread among all citizens, thus outdoing the negative effect in the market sector due to the presence of a low-skilled citizen.

Taking into account (32) and (34), we are able to state the following

Lemma 2 *(i) Welfare is maximum when a public-fit high-skilled individual is in office. (ii) Welfare is minimum when a market-fit low-skilled individual is in office. In symbols,*

$$\begin{array}{lll} S^*_{ML} < S^*_{MH} < S^*_{PL} < S^*_{PH} & \textit{iff} & P(e^*_{PL}) - P(e^*_{MH}) > \frac{(Z^*_{PL} - Z^*_{MH}) - (U^*_{PL} - U^*_{MH})}{N-1}, \quad (a) \\ S^*_{ML} < S^*_{PL} < S^*_{MH} < S^*_{PH} & \textit{iff} & P(e^*_{MH}) - P(e^*_{PL}) > -\frac{(Z^*_{PL} - Z^*_{MH}) - (U^*_{PL} - U^*_{MH})}{N-1}. \quad (b) \end{array} \tag{35}$$

Both public fit and skills have a positive impact on welfare. Accordingly, welfare is maximum (minimum) when the elected official is type-PH (-ML). In addition, expressions

$$\pm \frac{(Z^*_{PL} - Z^*_{MH}) - (U^*_{PL} - U^*_{MH})}{N-1} \tag{36}$$

are close to zero since N is large. Accordingly (35-a) is approximately equivalent to $e^*_{PL} > e^*_{MH}$ and (35-b) to $e^*_{MH} > e^*_{PL}$. Two conclusions can be drawn. (i) A type-PL producing a higher level of public good than a type-MH,

$$e^*_{PL} > e^*_{MH}, \tag{37}$$

is (almost) a necessary and sufficient condition for welfare to be higher when a public-fit individual instead of a market-fit one is in office for any level of skills. (ii) A type-MH producing a higher level of public good than a type-PL

$$e^*_{MH} > e^*_{PL}, \tag{38}$$

is (almost) a necessary and sufficient condition for welfare to be higher when a high-skilled individual instead of a low-skilled one is in office for any type of fit.

4.5 Inefficiency Wages?

In this subsection we go backwards at $t = 0$ and study how the level of w affects welfare through the selection of candidates.

According to Lemmata 1 and 2, two alternative orderings of both the reservation reward and the optimal welfare might arise. Four different combinations must then be taken into account, which we sum up in Table 1.

We arrange the reservation rewards of Lemma 1 in ascending order,

$$\underline{w}_1 \equiv \underline{w}_{PL},\ \underline{w}_2 \equiv \min\{\underline{w}_{ML}, \underline{w}_{PH}\},\ \underline{w}_3 \equiv \max\{\underline{w}_{ML}, \underline{w}_{PH}\},\ \underline{w}_4 \equiv \underline{w}_{MH}. \tag{39}$$

We also rewrite the optimal welfare in the following manner,

$$S_1^* \equiv S_{PL}^*,\ S_2^* \equiv \min\left\{S_{ML}^*, S_{PH}^*\right\},\ S_3^* \equiv \max\left\{S_{ML}^*, S_{PH}^*\right\},\ S_4^* \equiv S_{MH}^*, \tag{40}$$

so that S_n^*, $n = 1, 2, 3, 4$, denotes welfare of the society when the individual in office demands the *n-th* smallest reservation reward. By doing so, we are able to simplify the analysis of the reward level effects on the individuals' self-selection choices and, in turn, on the optimal expected value of welfare.

Reservation rewards/Welfare	Ranking (35-a): $S_{ML}^* < S_{MH}^* < S_{PL}^* < S_{PH}^*$	Ranking (35-b): $S_{ML}^* < S_{PL}^* < S_{MH}^* < S_{PH}^*$
Ranking (29-a): $\underline{w}_{PL} < \underline{w}_{PH} < \underline{w}_{ML} < \underline{w}_{MH}$	**Scenario (i)**: public-fit enter first and enhance the welfare	**Scenario (ii)**: public-fit enter first; high-skilled enhance the welfare
Ranking (29-b): $\underline{w}_{PL} < \underline{w}_{ML} < \underline{w}_{PH} < \underline{w}_{MH}$	**Scenario (iii)**: low-skilled enter first; public-fit enhance the welfare	**Scenario (iv)**: low-skilled enter first and worsen the welfare

Table 1: Orderings of Reservation Rewards and Welfare

1. If $w < \underline{w}_1$, no individual decides to run for office. The public good is not supplied, no tax is levied and welfare is

$$\underline{S} \equiv N \textstyle\sum_{ij} \lambda_{ij} \left[M\left(a_{ij}^*\right) - s\left(a_{ij}^*, \theta_{ij}\right)\right]. \tag{41}$$

   In line with the benchmark analysis (see Footnote 10), we let $\underline{S}$ be lower than S_{ML}^*, the welfare level associated to the worst politician, type-ML according to Lemma 2.

2. If $\underline{w}_1 \leq w < \underline{w}_2$, only type-1 individuals, *i.e.* those requiring the smallest reservation reward, run for office. As a result, a type-1 will be elected with probability $p = \lambda_1/\lambda_1 = 1$, where λ_1 is the proportion of type-1 individuals. The deriving optimal welfare is

$$E_1(S) \equiv S_1^*. \tag{42}$$

3. If $\underline{w}_2 \leq w < \underline{w}_3$ type-1 and type-2 individuals run for office. Given that the election is random, the elected politician will be type-1 with probability $p = \lambda_1/(\lambda_1 + \lambda_2)$ and type-2 with probability $1 - p = \lambda_2/(\lambda_1 + \lambda_2)$, where $\lambda_1(\lambda_2)$ is the proportion of type-1 (type-2) individuals in the society and $\lambda_1 + \lambda_2$ is the proportion of candidates. As a result, the expected optimal welfare, *i.e.* welfare before the election takes place, is

$$E_2(S) \equiv \frac{\lambda_1}{\lambda_1 + \lambda_2} S_1^* + \frac{\lambda_2}{\lambda_1 + \lambda_2} S_2^*. \tag{43}$$

4. If $\underline{w}_3 \leq w < \underline{w}_4$ type-1, -2, and -3 individuals run for office. The expected optimal welfare is therefore

$$E_3(S) \equiv \frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3} S_1^* + \frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3} S_2^* + \frac{\lambda_3}{\lambda_1+\lambda_2+\lambda_3} S_3^*. \tag{44}$$

5. Finally, if $w \geq \underline{w}_4$ all individuals run for office. This means that the expected value of welfare is

$$E_4(S) \equiv \lambda_1 S_1^* + \lambda_2 S_2^* + \lambda_3 S_3^* + \lambda_4 S_4^*. \tag{45}$$

First, in Appendix A.3 we verify that the expected value of welfare increases with the politician's reward, $E_{n+1}(S) > E_n(S)$, iff

$$S_{n+1}^* > E_n(S), \tag{46}$$

for any given $n = 1, 2, 3$. Taking into account that $E_n(S)$ is a convex combination of values S_n^*, condition (46) has an intuitive explanation. The expected value of welfare increases with the politician's reward iff the welfare level attached to the new type entering as w rises, S_{n+1}^*, is higher than the expected value of welfare before her entry, $E_n(S)$. Obviously, the expected value of welfare decreases with the politician's reward iff

$$S_{n+1}^* < E_n(S). \tag{47}$$

It is worth observing that the worst politician, type-ML, demands the third smallest reservation reward in Scenarios (i) and (ii) and the second smallest in Scenarios (iii) and (iv). Taking into account (39) and (40), this amounts to say that S_3^* represents the minimum welfare level in Scenarios (i) and (ii) and S_2^* in Scenarios (iii) and (iv). By contrast, the best politician, type-PH, demands the second smallest reservation reward in Scenarios (i) and (ii) and the third smallest in Scenarios (iii) and (iv). This means that S_2^* is the maximum welfare level in Scenarios (i) and (ii) and S_3^* in Scenarios (iii) and (iv). As a result, neither (46) nor (47) are fulfilled for any n, *i.e.*, increasing the politician's reward has not a monotonically positive impact on the expected value of welfare. Indeed, in the first two scenarios, $S_3^* < E_2(S)$ and $S_2^* > E_1(S)$. In the last two, $S_2^* < E_1(S)$ and $S_3^* > E_2(S)$.

The above finding, which stands in contrast to Proposition 1, is summed up in the following

Proposition 2 *When both skills and fit affect the individuals' effort disutility, the expected value of welfare of the society fluctuates in the politician's reward.*

The reason for this result is twofold. On one hand, the opportunity costs of entering politics borne by the worst politician, type-ML, are relatively high due to her market fit. On the other hand, the top politician, type-PH, incurs relatively low opportunity costs due to her public fit. Accordingly, the worst (best) politician does not demand the lowest (highest) reservation reward.[13]

[13] A similar result is found by Barigozzi & Turati (2012) in the case of the nursing labor market.

In what follows we are interested in deriving the parametric conditions under which $E_4(S)$, the expected value of welfare when the politician's reward is at its highest, $w \geq \underline{w}_4$, is not maximum. We study separately the four scenarios.

(i) In Scenario (i), the ordering of reservation rewards is given by (29-a) and that of welfare by (35-a): see Table 1. Relying on (39) and (40) we can rewrite (35-a) as

$$S_2^* > S_1^* > S_4^* > S_3^*. \tag{48}$$

It is easy to check that $E_2(S)$ is the maximum expected level of welfare. Indeed, inequality $E_2(S) > E_1(S)$ is implied by $S_2^* > S_1^*$; $E_2(S) > E_3(S)$ by $\min\{S_1^*, S_2^*\} > S_3^*$; and $E_2(S) > E_4(S)$ by $\min\{S_1^*, S_2^*\} > \max\{S_3^*, S_4^*\}$. Scenario (i) is characterized by two aspects. For any level of skills, public-fit politicians are cheaper than market-fit and welfare is higher when a public-fit individual, rather than a market-fit, is in office. Setting a relatively low reward which attracts only public-fit, $w \in [\underline{w}_2 \equiv \underline{w}_{PH}, \underline{w}_3 \equiv \underline{w}_{ML})$, is hence welfare-maximizing. At lower rewards, $w \in [\underline{w}_1 \equiv \underline{w}_{PL}, \underline{w}_2 \equiv \underline{w}_{PH})$, only low-skilled individuals enter within the group of public-fit. At higher rewards, $w \geq \underline{w}_3 \equiv \underline{w}_{ML}$, also market-fit individuals are attracted but they worsen the welfare.

(ii) In Scenario (ii) for any level of skills public-fit politicians are cheaper than market-fit and for any type of fit welfare is higher when a high-skilled individual, instead of a low-skilled one, is in office. In symbols, rankings (29-a) and (35-b) are fulfilled. The latter ranking can be rewritten as

$$S_2^* > S_4^* > S_1^* > S_3^*. \tag{49}$$

$E_2(S) > \max\{E_1(S), E_3(S)\}$ is implied by $\min\{S_1^*, S_2^*\} > S_3^*$. Yet, condition $\min\{S_1^*, S_2^*\} > \max\{S_3^*, S_4^*\}$ does not hold here. The sign of $E_2(S) - E_4(S)$ is hence undecidable without further investigation. According to (49), the *ex-post* first-best situation here is to have a type-2 ($\equiv$ type-PH) in office. Any other type would generate a welfare loss. Inequality $E_2(S) > E_4(S)$ can be reduced to

$$\left(\frac{\lambda_{PL}}{\lambda_{PL}+\lambda_{PH}} - \lambda_{PL}\right)(S_{PH}^* - S_{PL}^*) < \lambda_{ML}(S_{PH}^* - S_{ML}^*) + \lambda_{MH}(S_{PH}^* - S_{MH}^*). \tag{50}$$

When setting a relatively low remuneration $w \in [\underline{w}_2 \equiv \underline{w}_{PH}, \underline{w}_3 \equiv \underline{w}_{ML})$ instead of fixing $w \geq \underline{w}_4 \equiv \underline{w}_{MH}$, the society incurs the expected costs given by the LHS of (50). Paying less augments from λ_{PL} to $\lambda_{PL}/(\lambda_{PL}+\lambda_{PH})$ the probability of electing a type-PL, who brings about the welfare loss $S_{PH}^* - S_{PL}^*$. At the same time, the society avoids the expected costs denoted by the RHS of (50) because it eliminates the probability of electing both a type-ML, who causes the welfare loss $S_{PH}^* - S_{ML}^*$, and a type-MH, who generate the loss $S_{PH}^* - S_{MH}^*$. Therefore $E_4(W)$ is not the maximum expected value of welfare if (50) is fulfilled. In turn this is likely to occur when the expected welfare loss $\lambda_{ML}(S_{PH}^* - S_{ML}^*)$ caused by type-ML is relatively high.

(iii) In Scenario (iii) the ordering of reservation rewards is given by (29-b) and that of welfare by (35-a). The welfare ranking can be rewritten as

$$S_3^* > S_1^* > S_4^* > S_2^*. \tag{51}$$

First notice that $S_2^* < \min\{S_1^*, S_3^*\}$ implies $E_2(S) < \min\{E_1(S), E_3(S)\}$. In Appendix A.3 we show that $S_1^* > S_4^*$ implies $\max\{E_1(S), E_3(S)\} > E_4(S)$. Accordingly, $E_4(S)$ is never the maximum expected level of welfare. The intuition is simple. Relying on (39) and (40), $S_1^* > S_4^*$ can be rewritten as $S_{PL}^* > S_{MH}^*$. In this case setting the maximum reward $w \geq \underline{w}_4 \equiv \underline{w}_{MH}$ is welfare-reducing since it attracts also high-skilled market-fit individuals who give a worse contribution than public-fit, both high- and low-skilled.

(iv) Low-skilled politicians are cheaper than high-skilled but they give a worse contribution to the society in Scenario (iv). In symbols, rankings (29-b) and (35-b) hold true, hence the welfare ordering is

$$S_3^* > S_4^* > S_1^* > S_2^*. \tag{52}$$

The minimum expected value of welfare is $E_2(S)$. Unlike in Scenario (iii), S_1^* is lower than S_4^* here so we cannot rule out the situation where $E_4(S)$ is maximum. Ranking (52) ensures that the *ex-post* first-best picture here is to have a type-3 ($\equiv$ type-PH) in office. One can check that $E_1(S) > E_4(S)$ and $E_3(S) > E_4(S)$ are equivalent to

$$(1-\lambda_{PL})(S_{PH}^* - S_{PL}^*) < \lambda_{ML}(S_{PH}^* - S_{ML}^*) + \lambda_{MH}(S_{PH}^* - S_{MH}^*) \tag{a}$$

and

$$\left(\frac{\lambda_{PL}}{\lambda_{PL}+\lambda_{ML}+\lambda_{PH}} - \lambda_{PL}\right)(S_{PH}^* - S_{PL}^*) + \left(\frac{\lambda_{ML}}{\lambda_{PL}+\lambda_{ML}+\lambda_{PH}} - \lambda_{ML}\right)(S_{PH}^* - S_{ML}^*) < \lambda_{MH}(S_{PH}^* - S_{MH}^*), \tag{b}$$

(53)

respectively. This scenario is similar to the benchmark case described by Proposition 1. Still, setting the maximum reward $w \geq \underline{w}_{MH}$ is not welfare-maximizing if (53) holds true. Note that, *mutatis mutandis*, inequalities (53) can be read as (50). Focus first on (53-a), which is likely to be fulfilled when the expected welfare loss $\lambda_{ML}(S_{PH}^* - S_{ML}^*)$ caused by type-ML is relatively high. In this case $E_1(S) > E_4(S)$ because setting the minimum reward $w \in [\underline{w}_1 \equiv \underline{w}_{PL}, \underline{w}_2 \equiv \underline{w}_{ML})$ has the virtue of crowding out the worst candidates. Consider now (53-b), which is likely to hold true when the two terms of the LHS are relatively low. This occurs in turn if fraction λ_{PH} of the best potential politicians is significant with respect to λ_{PL} and λ_{ML}. Setting $w \in [\underline{w}_3 \equiv \underline{w}_{PH}, \underline{w}_4 \equiv \underline{w}_{MH})$ instead of $w \geq \underline{w}_4 \equiv \underline{w}_{MH}$ increases then the probability of electing a top politician and $E_3(S)$ turns out to be higher than $E_4(S)$.

We sum up our findings in the following

Proposition 3 *(a) If for any level of skills the welfare is enhanced when a public-fit politician rather than a market-fit one is in office, $S_{PL}^* > S_{MH}^*$, the expected value of welfare is not maximum when the*

politician's reward is maximum. (b) If for any type of fit the welfare is enhanced when a high-skilled politician rather than a low-skilled one is in office, $S^*_{MH} > S^*_{PL}$, the expected value of welfare is not maximum when the politician's reward is maximum provided that conditions (50) *or* (53) *are fulfilled.*

Inequality $S^*_{PL} > S^*_{MH}$ is a sufficient condition for $E_4(S)$ not to be maximum. Lemma 2 ensures that $S^*_{PL} > S^*_{MH}$ is (almost) implied by $e^*_{PL} > e^*_{MH}$. The latter condition holds true when a right fit is more important than higher skills in enhancing the effort level of the politician. In this context, public-fit individuals are better politicians. Setting a relatively low remuneration is welfare-maximizing since it prevents market-fit individuals from running for office.

By contrast, inequality $S^*_{MH} > S^*_{PL}$ states that high-skilled individuals are better politicians. Still $E_4(S)$ might not be maximum since the politician requiring the maximum reservation reward, type MH, is not the best politician due to her wrong fit.

In line with the efficiency wage theory, Proposition 1 asserts that as long as skills are the sole determinant of individuals' effort disutility expected value of welfare is maximum when the politician's reward is maximum, *i.e.*, $w \geq \underline{w}_H$. This is not likely to occur in our richer framework according to Proposition 3, since the wrong fit of the most expensive class of politicians, type-MH, makes them relatively little productive. As mentioned in the introduction, this potential adverse selection mechanism is referred to as moneycracy since people whose work motivation is well fitted with the market rather than the public sector are attracted to politics.

5 Extension: Moonlighting

With the aim of testing the robustness of our theoretical findings, we enrich our analysis by introducing explicitly the moonlighting option. In other words, we relax the assumption that politics and the market sector are mutually exclusive. Accordingly, a type-ij individual may work in the market sector while in office and get an extra-income $m\left[M\left(a^*_{ij}\right) - s\left(a^*_{ij}, \gamma_i, \theta_j\right)\right]$, where $m \in (0,1)$ measures the moonlighting activity. A regulated moonlighting is considered, *i.e.* m is assumed to be sufficiently low so that the outside employment does not affect a type-ij politician's effort. Accordingly, the payoff obtained by a type-ij politician after exerting the optimal public effort e^*_{ij} and market effort a^*_{ij} is given by

$$U^m_{ij} \equiv U^*_{ij} + m\left[M\left(a^*_{ij}\right) - s\left(a^*_{ij}, \gamma_i, \theta_j\right)\right]. \tag{54}$$

Her reservation reward reduces to

$$\underline{w}^m_{ij} = (1-m)\,\underline{w}_{ij} \tag{55}$$

because politics becomes more attractive. Finally, welfare increases to

$$W^m_{ij} = W^*_{ij} + m\left[M\left(a^*_{ij}\right) - s\left(a^*_{ij}, \gamma_i, \theta_j\right)\right]. \tag{56}$$

First notice that the positive effect on welfare is small because it concerns only the politician's payoff. As a result Lemma 2 is approximately unaffected by the moonlighting option. Second, it is easy to check that Lemma 1 is unaffected as long as m does not depend on the politician's type. We can conclude that introducing the option of a regulated moonlighting activity for the politician does not affect our results.

6 Descriptive Overview of the Labor Market of Politicians

In this section we provide a brief overview of the labour market of politicians in some Western countries, with special focus on Italy.

Figure 1 illustrates the parliamentarians' net annual rewards in EU. The total amount is given by the basic salary plus additional allowances and benefits, such as per-diem reimbursements, the level of which can differ across individuals according to seniority, different duties, and residence. Consequently, Figure 1 reports an average value of parliamentarians' remuneration in 25 European countries. It is interesting to observe that the top level is reached by the Italians.[14]

Average rewards of parliamentarians				
1 Italy 144.084,36	6 UK 81.600,00	11 France 62.779,44	16 Portugal 41.387,64	21 Malta 15.768,00
2 Austria 106.583,40	7 Belgium 72.017,52	12 Finland 59.640,00	17 Spain 35.051,90	22 Lithuania 14.196,00
3 Netherlands 86.125,56	8 Denmark 69.264,00	13 Sweden 57.000,00	18 Slovakia 25.920,00	23 Latvia 12.900,00
4 Germany 84.108,00	9 Greece 68.575,00	14 Slovenia 50.400,00	19 Czech Rep 24.180,00	24 Hungary 9.132,00
5 Ireland 82.065,96	10 LUX 66.432,60	15 Cyprus 48.960,00	20 Estonia 23.064,00	25 Poland 7.369,70

Figure 1: Average wage of parliametarians in Europe (Source: Corriere della Sera, 2005)

In order to compare different pays relying on the same typology of duties, Figure 2 contains a list of rewards of the Members of European Parliament (MEPs) prior to July 2009. Again, Italian MEPs' reward turns out to be the highest. It is, for instance, two times that of the Germans and the British, three times that of the Portuguese, and four times that of the Spanish.[15]

On top of that, Italian legislators are allowed to keep their regular jobs outside Parliament. Consequently, working in the Italian Parliament implies a substantial pecuniary gain for a large majority of legislators. For example, in 2004 an Italian legislator earned an annual parliamentary

[14] For instance, Stella and Rizzo (2007) report that "the basic salary for Italian senators is 5,235 euros a month, but on top of that they claim daily expenses, which on average amount to an extra 4,000 euros a month. When you factor in the average phone bill - 340 euros a month - the real monthly income is nearer to 12,000 euros a month".

[15] Starting in July 2009, the salary of MEPs is paid by the EU and pegged to 38.5% of a European Court judge's earning. This eliminated the substantial disparities among parliamentarians from different EU countries.

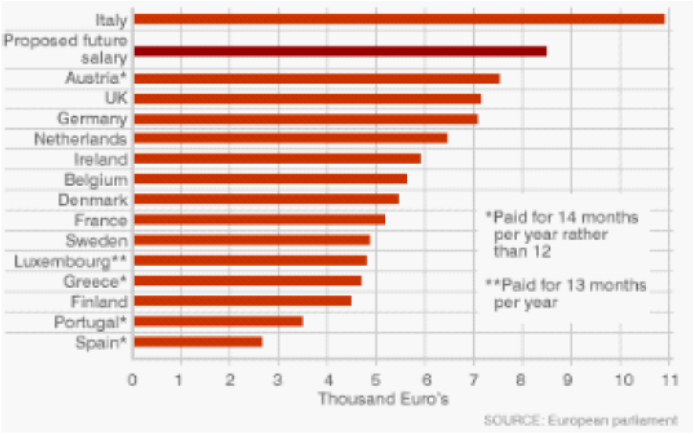

Figure 2: MEPs' SALARIES (Source: Latza Nadeau, 2012)

wage of 146,533 euros plus another 56,335 euros on average from additional sources. To have an order of magnitude, the total amount was 1.8 times larger than the average earnings of an Italian manager.

Some interesting aspects emerge from the data. Italian parliamentarians receive the highest reward in Europe. In addition, such reward is higher than the average income of Italian managers. Following the prediction of Proposition 1, the above information should suggest that welfare in Italy is likely to be higher than in the other countries considered due to the selection of high-skilled elected officials.

In what follows, we rely on some descriptive statistics to check whether a positive correlation exists between politicians' wage and welfare. To this aim, we identify two key elements which are generally considered as proxies for welfare: GDP per capita and Public Debt as percentage of GDP. Figure 3 shows that parliamentarians' rewards and GDP per capita are positively correlated in many European countries. Interestingly, the only exception is given by Italy, where the top level of politicians' pay is associated to a relatively low standard of living.

A similar conclusion can be drawn when looking at Figure 4, which contains information on Public Debt/GDP ratios in 25 European countries. Despite a special financial treatment for parliamentarians, Italy offers a poor performance for the ratio is the third highest.

We also have a look at the evolution over time of Italian legislators' remuneration. Figure 5 compares the average real annual income of Italian managers in the private sectors, which increased by 69.2% between 1985 and 2004, and the average real total annual income of Italian legislators, which instead grew by 96.7%.[16]

[16] Additional information is given by the comparison between the Italian legislators and the US counterpart. In Italy, the before-tax real annual parliamentary wage (in 2005 Euros) increased from 10,712 euros in 1948 to 137,691 euros in 2006, an overall growth of 1,185.4%. In the US, the before-tax real annual congressional wage (in 2005 Dollars) increased from 101,297 dollars in 1948 to 160,038 dollars in 2006, an overall growth of 58%. Interestingly, Italy's real GDP per capita grew by 449.5% over the same period, whilst the US one grew by 241.7%.

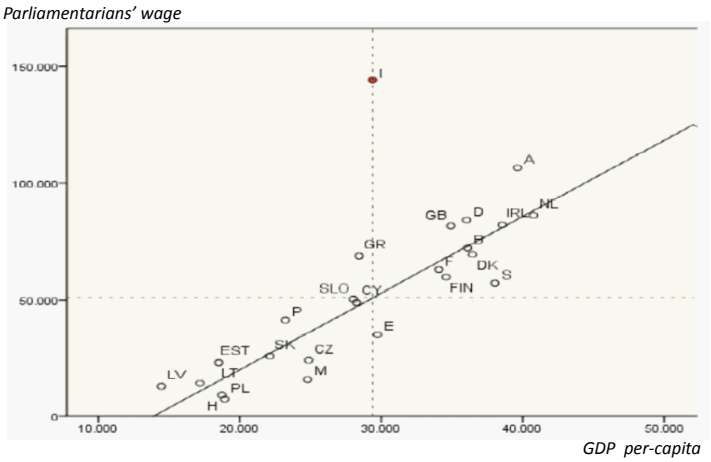

Figure 3: Parliamentarians' reward and GDP per capita in Europe (Source: Pelagatti, 2011)

Public Debt / GDP Ratio (2011)				
1 Greece 162%	6 Belgium 100%	11 Austria 74%	16 Finland 49%	21 Czech Rep 41%
2 Iceland 128%	7 UK 86%	12 Malta 70%	17 Latvia 45%	22 Sweden 38%
3 Italy 120%	8 France 85%	13 Spain 68%	18 Denmark 44%	23 Lithuania 36%
4 Portugal 113%	9 Germany 82%	14 Netherlands 65%	19 Slovakia 43%	24 LUX 17%
5 Ireland 105%	10 Hungary 81%	15 Poland 57%	20 Slovenia 42%	25 Estonia 6%

Figure 4: Public debt/GDP ratio (Source: Index Mundi - Country Facts)

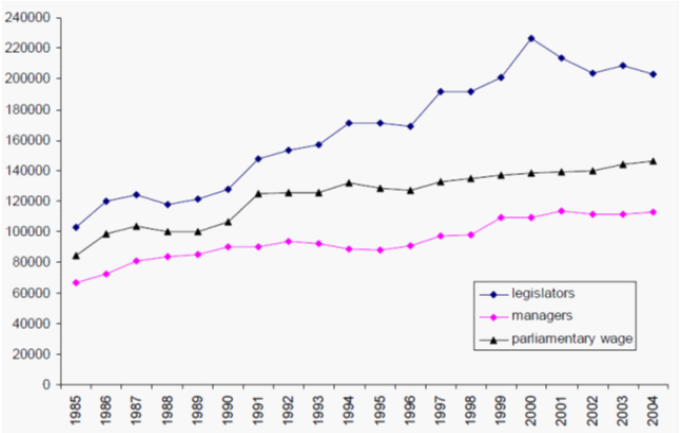

Figure 5: Average annual real income 1985-2004, Italian legislators and managers, 2005 euros (Source: Boeri et al., 2010)

It is evident that the above limited information cannot be used to identify causality between the politicians' wage and the welfare. Still, as far as GDP per capita and Public Debt/GDP ratio can be interpreted as proxies for welfare and, in turn, the quality of government plays a role in affecting welfare, evidence on Italy, as shown in Figures 3 and 4, seems to be at odds with the prediction of efficiency wage in politics emphasized by the early literature on political selection. Our framework could offer a possible theoretical explanation based on the moneycratic mechanism, according to which the increasingly high parliamentary wage in Italy, as described in Figure 5, has been likely to attract high-skilled individuals whose work motivation is yet market oriented.[17]

Figure 6 illustrates the percentage of high-skilled individuals, defined as those with (at least) tertiary education, in the Italian population (Source: OECD Factbook, 2011-2012) and in the Italian parliament over the last decades.[18] Trend concerning the Italian population (red line) is slightly positive in the period 1998-2006. Similarly, trend of the parliamentarians is not negative (blue line). It seems there is no evidence of a decreasing selection of high-skilled individuals in the Italian parliament.

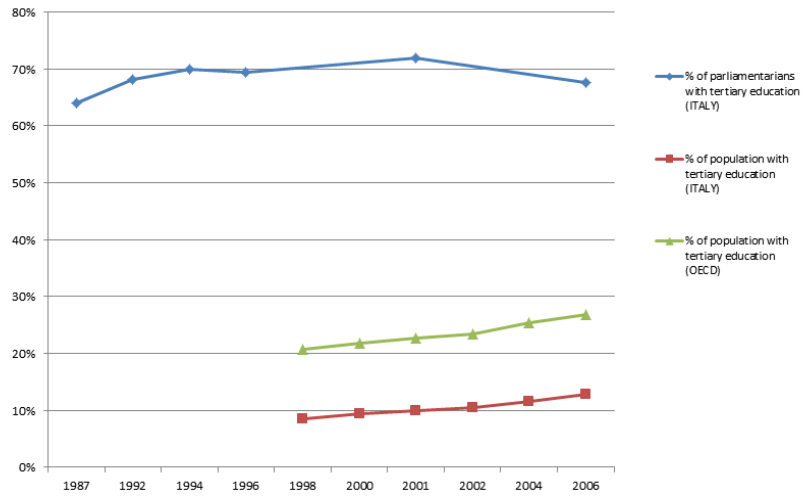

Figure 6: High-skilled citizens and parliamentarians in Italy (1987-2006)

Figure 7 illustrates instead the fraction of public-fit individuals in the Italian population (source: World Values Surveys) and in the Italian parliament (source: Unique Database). Public-fit citizens are defined as those interested in politics.[19] Public-fit parliamentarians are instead defined in two

[17] More exactly, the highest reservation wage is $\underline{w}_{MH}$ in our setup according to Lemma 1. As a result, high-skilled market-fit individuals enter the pool of candidates when w goes beyond such a cut-off, which was likely to occur in Italy over the last decades.

[18] Information on Italian parliamentarians derives from a unique database covering the period 1987-2006 (Legislatures X to XV) and developed by Gagliarducci *et al.* (2010).

[19] More exactly, the questions analysed in the World Values Survey are: (i) Which of these statements comes nearest

different ways. Individuals with (i) both party affiliation and institutional appointments (*e.g.*, major or counsellor of a municipality, president or counselor of a region/province, member of the European parliament) before entering the parliament; (ii) party affiliation but no institutional appointments before entering the parliament. The second definition is closer to that adopted for the citizens and probably reflects the idea of public service motivation better than the second definition, which includes instead remunerated occupations.[20] Interestingly, the fraction of public-fit individuals in the Italian population (green line) is clearly increasing, whilst that of parliamentarians is generally declining under both definitions (red and blue lines). This might be evidence of a decreasing selection of public-fit individuals (or, equivalently, increasing selection of market-fit individuals) in the Italian parliament.

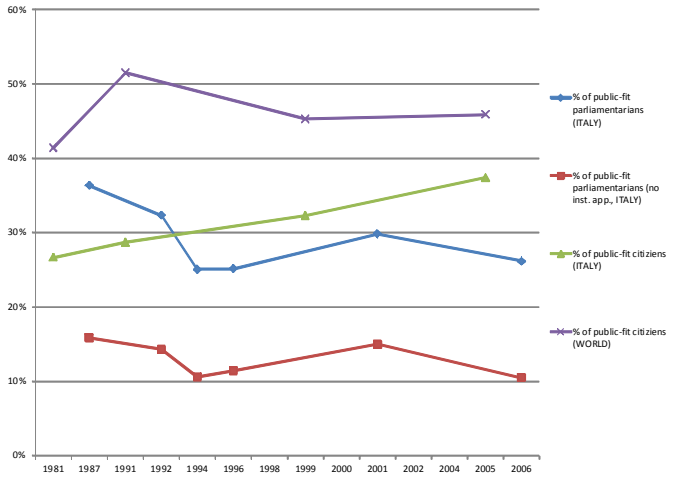

Figure 7: Public-fit citizens and parliamentarians in Italy (1981-2006)

Obviously, the above descriptive evidence cannot be used to draw any convincing conclusion on the role played by politicians' wage on self-selection into politics and, in turn, on the level of welfare. Still, it is evocative of the fact that the Italian case is definitely peculiar and could represent an example of the inefficiency wage mechanism predicted by our theoretical framework. Indeed, high remuneration of the Italian legislators seems not to be correlated to high welfare, as measured by GDP per capita and Public Debt/GDP ratio, thus contradicting Proposition 1. In addition, Italy experienced an important rise of the legislators' real wage: from almost 80,000 euros in 1985 to around 140,000 in 2004, according to Figure 5. At the same time, there has been a non-decreasing selection of high-skilled individual in parliament, on one hand, and an increasing selection of market-fit individuals,

to describing your interest in politics? a) Active interest; b) interest but inactive; c) not greater than other (interests); d) not at all interested (sample 1981). (ii) How interested would you say you are in politics? a) Very interested; b) somewhat interested; c) not very interested; d) not at all interested (samples 1991, 1999, 2005). We define as public-fit individuals those who answered a) or b).

[20] For further details on the empirical definition of public fit, see Fedele & Naticchioni (2013), who rely on the same dataset as Gagliarducci *et al.* (2010) and analyze the effect of person-environment fit on choices of self-selection into politics and effort once in office in presence of moonlighting.

on the other hand. This selection process is consistent with the predictions of Proposition 2.

7 Conclusion

In this paper we studied the decision to enter politics of individuals with both heterogeneous skills and heterogeneous motivations. We first considered a benchmark model where skills are the sole determinant of individuals' effort disutility. In this context, welfare is increasing in the politicians' wage since best (*i.e.*, high-skilled) individuals are attracted to politics only if remuneration covers their high opportunity costs. Our findings are remarkably different when also motivation is taken into account. We first demonstrated that welfare fluctuates in the politicians' wage. We then derived conditions under which welfare is not maximum when the politicians' wage is maximum. The key aspect is that paying politicians a lot attracts people whose work motivation is well fitted with the market rather than the public sector. This adverse selection mechanism has been called moneycracy. With the aim of testing the robustness of our theoretical findings, we then enriched our analysis by introducing moonlighting. Finally, we provided a descriptive overview of politicians' wage in some Western countries and suggested that the Italian case can be thought of as being representative of the moneycratic mechanism.

Overall, our analysis suggests that ignoring work motivation when studying choices of self-selection into vocational labor markets, such as politics, might jeopardize the predictive power of the theory.

A Appendix

A.1 Inequality $S^*_{Pj} > S^*_{Mj}$

Taking into account (31) and letting

$$\begin{aligned} P_{ij} &\equiv NP\left(e^*_{ij}\right) - c\left(e^*_{ij}, \gamma_i, \theta_j\right), \\ M_{ij} &\equiv M\left(a^*_{ij}\right) - s\left(a^*_{ij}, \gamma_i, \theta_j\right), \end{aligned} \tag{57}$$

inequality $S^*_{Pj} > S^*_{Mj}$ can be rewritten as

$$\begin{aligned} &P_{PH} + \left(\lambda_{PH}N - 1\right)M_{PH} + \lambda_{PL}NM_{PL} + \lambda_{MH}NM_{MH} + \lambda_{ML}NM_{ML} > \\ &P_{MH} + \left(\lambda_{MH}N - 1\right)M_{MH} + \lambda_{PH}NM_{PH} + \lambda_{PL}NM_{PL} + \lambda_{ML}NM_{ML}, \end{aligned} \tag{58}$$

when $j = H$ and

$$\begin{aligned} &P_{PL} + \left(\lambda_{PL}N - 1\right)M_{PL} + \lambda_{PH}NM_{PH} + \lambda_{MH}NM_{MH} + \lambda_{ML}NM_{ML} > \\ &P_{ML} + \left(\lambda_{ML}N - 1\right)M_{ML} + \lambda_{PH}NM_{PH} + \lambda_{PL}NM_{PL} + \lambda_{MH}NM_{MH}, \end{aligned} \tag{59}$$

when $j = L$. Rearranging (58) gives

$$P_{PH} - M_{PH} > P_{MH} - M_{MH}. \tag{60}$$

Rearranging (59) gives

$$P_{PL} - M_{PL} > P_{ML} - M_{ML}. \tag{61}$$

Summing up, $S^*_{Pj} > S^*_{Mj}$ can be rewritten as $P_{Pj} - M_{Pj} > P_{Mj} - M_{Mj}$ which is equivalent to (33) in the text after substituting (57).

A.2 Inequality $U^*_{Pj} > U^*_{Mj}$

$U^*_{Pj} > U^*_{Mj}$ can be rewritten as

$$P\left(e^*_{Pj}\right) - c\left(e^*_{Pj}, \gamma_P, \theta_j\right) > P\left(e^*_{Mj}\right) - c\left(e^*_{Mj}, \gamma_M, \theta_j\right), \tag{62}$$

which holds true since

$$P\left(e^*_{Pj}\right) - c\left(e^*_{Pj}, \gamma_P, \theta_j\right) > P\left(e^*_{Mj}\right) - c\left(e^*_{Mj}, \gamma_P, \theta_j\right) \tag{63}$$

by definition of optimal effort and strict concavity of P and

$$P\left(e^*_{Mj}\right) - c\left(e^*_{Mj}, \gamma_P, \theta_j\right) \geq P\left(e^*_{Mj}\right) - c\left(e^*_{Mj}, \gamma_M, \theta_j\right) \tag{64}$$

by Assumption 1. A similar reasoning can be invoked to show that $Z^*_{Mj} > Z^*_{Pj}$ is implied by Assumption 2.

A.3 Inefficiency Wages?

Condition (46)**.** We study the following three inequalities.

(i) $E_1(S) < E_2(S)$ is equivalent to

$$S^*_1 < \frac{\lambda_1}{\lambda_1+\lambda_2} S^*_1 + \left(1 - \frac{\lambda_1}{\lambda_1+\lambda_2}\right) S^*_2 \Leftrightarrow S^*_1 < S^*_2 \Leftrightarrow E_1(S) < S^*_2. \tag{65}$$

(ii) $E_2(S) < E_3(S)$ is equivalent to

$$\begin{gathered}
\frac{\lambda_1}{\lambda_1+\lambda_2} S^*_1 + \left(1 - \frac{\lambda_1}{\lambda_1+\lambda_2}\right) S^*_2 < \frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3} S^*_1 + \frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3} S^*_2 + \left(1 - \frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3}\right) S^*_3 \Leftrightarrow \\
\left(\frac{\lambda_1}{\lambda_1+\lambda_2} - \frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3}\right) S^*_1 + \left(1 - \frac{\lambda_1}{\lambda_1+\lambda_2} - \frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3}\right) S^*_2 < \left(1 - \frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3}\right) S^*_3 \Leftrightarrow \\
\frac{\frac{\lambda_1}{\lambda_1+\lambda_2} - \frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3}}{1 - \frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3}} S^*_1 + \frac{1 - \frac{\lambda_1}{\lambda_1+\lambda_2} - \frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3}}{1 - \frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3}} S^*_2 < S^*_3 \Leftrightarrow \\
\frac{\lambda_1}{\lambda_1+\lambda_2} S^*_1 + \left(1 - \frac{\lambda_1}{\lambda_1+\lambda_2}\right) S^*_2 < S^*_3 \Leftrightarrow E_2(S) < S^*_3.
\end{gathered} \tag{66}$$

(iii) $E_3(S) < E_4(S)$,

$$\frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3}S_1^* + \frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3}S_2^* + \left(1 - \frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3}\right)S_3^* <$$
$$\lambda_1 S_1^* + \lambda_2 S_2^* + \lambda_3 S_3^* + (1-\lambda_1-\lambda_2-\lambda_3)S_4^* \Leftrightarrow$$
$$\frac{\frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3} - \lambda_1}{1-\lambda_1-\lambda_2-\lambda_3}S_1^* + \frac{\frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3} - \lambda_2}{1-\lambda_1-\lambda_2-\lambda_3}S_2^* + \frac{1-\frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3} - \lambda_3}{1-\lambda_1-\lambda_2-\lambda_3}S_3^* < S_4^* \Leftrightarrow$$
$$\frac{\lambda_1}{\lambda_1+\lambda_2+\lambda_3}S_1^* + \frac{\lambda_2}{\lambda_1+\lambda_2+\lambda_3}S_2^* + \left(1 - \frac{\lambda_1+\lambda_2}{\lambda_1+\lambda_2+\lambda_3}\right)S_3^* < S_4^* \Leftrightarrow E_3(S) < S_4^*. \quad (67)$$

Condition (46) in the text sums up the three above results.

Scenario (iii). $E_3(S)$ can be rewritten as

$$E_3(S) = E_1(S) + \left[\frac{\lambda_2(S_2^* - S_1^*) + \lambda_3(S_3^* - S_1^*)}{\lambda_1+\lambda_2+\lambda_3}\right]. \quad (68)$$

$E_1(S) > E_3(S)$ is thus equivalent to

$$\lambda_2(S_1^* - S_2^*) > \lambda_3(S_3^* - S_1^*). \quad (69)$$

$E_4(S)$ can be rewritten as

$$E_4(S) = E_1(S) + [\lambda_2(S_2^* - S_1^*) + \lambda_3(S_3^* - S_1^*) + \lambda_4(S_4^* - S_1^*)], \quad (70)$$

$E_1(S) > E_4(S)$ is thus equivalent to

$$\lambda_2(S_1^* - S_2^*) + \lambda_4(S_1^* - S_4^*) > \lambda_3(S_3^* - S_1^*). \quad (71)$$

Since $S_1^* > S_4^*$, (69) implies (71) with the effect that $E_1(S) > E_3(S)$ implies $E_1(S) > E_4(S)$. A similar reasoning ensures that $E_3(S) > E_1(S)$ implies $E_3(S) > E_4(S)$.

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