THE POLITICAL ECONOMY OF INFLATION, LABOUR MARKET DISTORTIONS AND CENTRAL BANK INDEPENDENCE*

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Using the citizen-candidate model we study the government’s choice of institutions for the labour market and the central bank and derive the implications for inflation and employment. We derive conditions for the existence of equilibria in which the labour market is distorted and the central bank is dependent or independent under a range of conditions affecting central bank dependence, the post-election cycle in inflation and employment and inflation bias. Our results imply that average inflation and inflation variability are lower under an independent central bank whereas employment variability can be lower or higher, consistent with evidence for OECD countries.

Many democratic societies delegate key tasks to non-elected and independent institutions, a prominent example being independent central banks. The belief in the advantage of central bank independence is nursed by the cross-country evidence for OECD countries, which suggests that the degree of central bank independence (as measured by legal indices) is negatively correlated with the average level and the variability of inflation and uncorrelated with the variability of employment.1 While most models in the tradition of Kydland and Prescott (1977) and Barro and Gordon (1983) contradict one of these correlations,2 Alesina and Gatti (1995) and Waller and Walsh (1996) demonstrated that all three of them can be replicated by applying the delegation idea of Rogoff (1985) to a world with post-election cycles in inflation and employment; see Walsh (1998) for a textbook discussion.

This paper identifies two problems with the literature and employs the citizen-candidate model of Osborne and Slivinski (1996) and Besley and Coate (1997) to develop a new framework that resolves these problems and is consistent with the

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evidence mentioned above. The first problem is that the underlying labour market
distortion, which causes the natural rate of employment to fall short of full em-
ployment and drives the key results, is not modelled. Consequently, it remains
unclear why structural reform is not simply directed to remove the distortion. The
second problem is that, contrary to the literature’s prediction, there is not ne-
necessarily a systematic inflation bias in reality when the central bank is independent
(Blinder, 1998). In particular, the evidence in favour of an inflation bias is con-
fined to the 1970s and early 1980s, a period during which high inflation can be
attributed to extraordinary circumstances, such as the Vietnam War, the collapse
of the Bretton Woods System, and the first two oil price shocks. Outside of this
period, neither the performance of the German Bundesbank nor of the countries
that introduced inflation targeting during the 1990s suggests the presence of
inflation bias.3

We argue that the origin of these two problems lies in the assumption that policy
makers have an ambitious employment target that exceeds the natural rate level of
employment. The usual justification is that they are concerned with social welfare
and that equilibrium employment is too low from a social welfare point of view.
Instead, this paper explicitly spells out a model of representative democracy that
derives the monetary policy objective from individual preferences.4

More specifically, we integrate a stylised economy into the citizen-candidate
model of Osborne and Slivinski (1996) and Besley and Coate (1997) so as to
capture the politics that are intertwined with economic policy making in a rep-
resentative democracy. In our set-up, the majority of the population is fully em-
ployed and benefits from a labour market distortion that gives it wage-setting
power whereas involuntary unemployment affects only a minority of the popula-
tion. The fully employed individuals object to a creation of surprise inflation
aimed at reducing unemployment as it decreases their real income and generates
the standard costs of inflation. Nonetheless the elected government may be con-
cerned with unemployment because voting is among multi-dimensional policies.
We also endogenise the institutional choices. Staying in the spirit of the citizen-
candidate model, we assume that the elected government can choose between a
distorted and a competitive labour market and a dependent and an independent
central bank.

We find the following results. First, if supply shocks are relatively large and the
distortion is not too severe, then there is an equilibrium in which the labour
market is distorted and the central bank is dependent. In this equilibrium, there is
a post-election cycle in inflation and employment as in Alesina (1987) and an

3 Specifically, the German Bundesbank averaged 1.9% CPI inflation during 1949–69 and 1982–96
while stabilising the real economy (Clarida and Gertler, 1997). Such small inflation rates are not to be
seen as an inflation bias because measured inflation tends to exaggerate actual inflation and real
interest rate variability requires a small but positive inflation rate. Moreover, actual inflation rates in the
countries that have been operating under inflation targeting have not systematically overshot target
inflation, which would have been the case if there was an inflation bias; see Svensson (1997).

4 Cukierman and Meltzer (1986) and Fratianni et al. (1997) also provide theories in which the policy
objective is not identical to social welfare, but they do not attempt to derive it from individual voting
decisions. This is done in Jonsson (1997), who, however, assumes that the individual objective functions
coincide with social welfare functions.
inflation bias. Second, if supply shocks are relatively small and the distortion is not too severe, then there is an equilibrium in which the labour market is distorted and the central bank is independent. In this equilibrium, there is no post-election cycle and no inflation bias. Moreover, we find that average inflation and inflation variability are lower under an independent than under a dependent central bank whereas employment variability can be lower or higher, which is consistent with the evidence.

The remainder of the paper is organised as follows. Section 1 presents the model and defines the equilibrium. Section 2 characterises the equilibrium election outcomes. Section 3 characterises equilibrium inflation, employment, and institutions. Section 4 discusses the results in light of the related literature and Section 5 concludes.

1. The Model

1.1. Preferences

The economy has a unit interval of identical sectors, each of which comprises one firm and a unit interval of identical individuals. All firms produce the same good so there is perfect competition in the goods market; together with free entry this implies zero equilibrium profits, which are suppressed from now on. Individuals cannot move across sectors, e.g. because of sector-specific skills. Firms and individuals sign nominal wage contracts that last for one period and leave it to the firm to determine employment (‘right-to-manage’).

There is substantial evidence that lay-offs are by inverse seniority (‘last-in-first-out’), rather than by random draw; see, for example, Oswald (1993). We assume that an exogenous share \( \alpha \) of the population are seniors and the rest are juniors. The institution of last-in-first-out requires that the seniors are in the majority, so \( \alpha \in (\frac{1}{2}, 1) \); otherwise the majority of juniors would ensure for themselves last-in-last-out. Last-in-first-out implies that preferences over wages, average per-capita employment, and inflation depend on seniority. We capture this by the following period-by-period specification:

\[
\begin{align*}
    u_k(w_t, p_t, l_t, x_t) &= (w_t - p_t) - \frac{a_k}{2} (l_t - \bar{l})^2 - \frac{b}{2} \pi_t^2 - c(x_t - \bar{x}_k)^2, \\
    \end{align*}
\]

where the subscript \( k \in \{s, j\} \) indicates whether the individual is senior or junior, the subscript \( t \in \{1, 2\} \) indicates the time period, and variables are in logarithms. In particular, \( w_t \) is the nominal wage, \( p_t \) is the price level, \( l_t \) is average per-capita employment in the individual’s sector, \( \bar{l} \) is per-capita full employment in the individual’s sector, \( \pi_t = p_t - p_{t-1} \) is the rate of inflation, \( x_t \) represents unemployment benefits, and \( a_k, b, \) and \( c \) are non-negative weights. Specification (1) implies

\[5\] Equation (1) is an indirect utility function that gives the utilities of seniors and juniors for given realisations of the relevant macro-variables.

\[6\] More precisely, \( l_t \) is total employment in a sector divided by the sector’s workforce. Since there are unit intervals of identical sectors and of individuals in each sector, per-capita employment in the sectors and the whole economy are the same. Moreover, they also equal total employment in the sectors and the whole economy.

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that individuals prefer a higher over a lower real wage and suffer utility losses from deviations of actual from full per-capita employment in their sector, from inflation, and from deviations of unemployment benefits from their bliss points. When layoffs are by inverse seniority the representative senior is less affected by such deviations than the representative junior, so we assume that $0 < a_s < a_j$ and $0 \leq \bar{x}_s < \bar{x}_j$.

Labour demand depends inversely on the real wage and positively on a supply shock $\epsilon_t$:

$$l_t = p_t - w_t + \epsilon_t.$$  

We assume that $\epsilon_t$ is identically and independently distributed with zero mean and finite variance $\sigma^2\epsilon_t$ and that the realisation of $\epsilon_t$ is the same for all sectors.

Individuals also care about a non-economic issue, which we call foreign policy and summarise by a variable $f_t \in \mathbb{R}$. Preferences with respect to $f_t$ are assumed to be separable from those over economic policy and take the form

$$v_m(f_t) = -(f_t - \bar{f}_m)^2,$$

where the subscript $m \in \{1, 2\}$ and $\bar{f}_1 \neq \bar{f}_2$. We thus have four types of individuals: $(s, 1)$, $(s, 2)$, $(j, 1)$ and $(j, 2)$. Denoting the share of seniors and juniors with bliss point $\bar{f}_1$ by $\beta$, there are $\beta \bar{x}$ seniors and $(1-\beta) \bar{x}$ juniors with bliss point $\bar{f}_1$ and $\alpha (1 - \beta)$ seniors and $(1 - \alpha)(1 - \beta)$ juniors with bliss point $\bar{f}_2$.

We assume that there is no discounting and that the relative weight that individuals assign to the different issues is random. The most convenient way of modelling this is to assume that period-by-period preferences over $(w_t, p_t, l_t, x_t, f_t)$ are lexicographic and that with an exogenous probability of one half either the economic issues or the foreign policy issue dominate.

1.2. Elections and Policy Choices

‘Institutions operate in a world of partisan and opportunistic politicians, not in a world of social planners’ (Alesina et al., 1997, p. 212); see also Dixit (1996). To capture this fact, we deviate from the usual practice of assuming benevolent policy makers and study instead the determination of policy in a model of representative democracy. Specifically, we adopt the citizen-candidate model of Osborne and Slivinski (1996) and Besley and Coate (1997) to economic and foreign policy making.

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7 Lay-offs by inverse seniority imply that seniors are locally isolated from fluctuations in per-capita employment (Oswald, 1993). However, they are affected by larger fluctuations, even if they themselves are not laid off. A possible reason is that such shocks lead to a reorganisation process within firms (Pencavel, 1991). This is why we take $a_s$ to be positive. An alternative interpretation is to consider full-time versus part-time workers. North American readers may find this more relevant. Note also that we implicitly assume that unemployment benefits are financed by lump-sum taxes that do not affect employment. The reason for including them is that when we study the election outcome below we want voters to care about the economic preferences of government also when monetary policy is delegated to an independent central bank. Without the presence of $x_t$, the government would not have a relevant economic policy choices to make.

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There are two periods. In the first period an election takes place in which the government is chosen by a majority vote among a set of candidates. The candidate set is determined before the election such that each candidate strictly prefers to be a candidate and all other individuals prefer not to be a candidate. All candidates’ preferences are common knowledge. We assume that individuals vote sincerely, that is, for their preferred candidate. Note that since the set of individuals of a certain type has a positive mass, single individuals cannot vote strategically. Note also that while Osborne and Slivinski (1996) assume sincere voting too, this is not necessary (Besley and Coate, 1997).

The elected government takes office for both periods. There is no precommitment to platforms, so the government implements its preferred policies. In particular, in the first period, the government chooses the central banker and the labour market institution for both periods, and foreign policy and unemployment benefits for this period and the central banker chooses inflation for this period. In the second period, there is no election and the government chooses foreign policy and unemployment benefits and the central banker chooses inflation. The government can change the institutions instantaneously and without costs, so a chosen institution has no precommitment value beyond a government’s term. Nonetheless we will show below that there are equilibria with stable institutions. In what follows we discuss in more detail the government’s choice of institutions.

We begin with the central bank institutions. We assume that the government appoints the central banker from the individuals that populate the economy and that the appointed central banker chooses inflation. This situation is often called institutional independence of the central bank. Institutional independence is a necessary but not a sufficient condition for central bank independence, as the central banker may or may not be personally independent from government. Personal independence ensures that the government cannot indirectly influence monetary policy making.9 In our model, the distinction between personal dependence and personal independence amounts to whether the government appoints a partisan central banker who shares its preferences or whether it delegates to a central banker who may not share its preferences. We call central bank dependence the case in which all governments appoint partisan central bankers and central bank independence the case in which at least some governments delegate to non-partisan central bankers.

We now turn to the labour market institutions. We consider two alternative ways in which the nominal wage of the representative sector can be determined, namely by the representative monopoly trade union or by competition among the

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8 Note that for simplicity candidates do not incur a cost of running and do not collect an office rent.
9 This may take the form of threatening to fire or not to reappoint the central banker when the government is not pleased with her performance. Personally independent central bankers have fixed (and typically long) terms of office, cannot be re-appointed, and can only be removed at considerable costs; see Neumann (1991) and Fratianni et al. (1997) for further discussion of the role of reappointment. Both institutional and personal independence are broadly guaranteed for the more independent central banks, such as the Deutsche Bundesbank, the Federal Reserve, or the Swiss National Bank.

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individuals of that sector. In what follows, we will call these two cases the distorted and the competitive labour market. In both cases there is last-in-first-out. If there are no costs of labour market reform, the government’s choice between the distorted and the competitive labour market is equivalent to the choice of which nominal wages apply during its two period term: the distorted ones or the competitive ones. We now discuss both cases in more detail.

Under the distorted labour market, a monopoly trade union chooses the nominal wage to be paid in the representative sector. We assume that all individuals working in this sector are union members and that union decisions are taken by majority vote. Since the seniors are in the majority, the representative senior is the union’s median voter. Given that the representative monopoly union is small with respect to the aggregate, its median voter takes the expected price level \( p_t^e \) as given when choosing the wage.\(^{10}\) So, they set the distorted nominal wage \( w_t \) so as to maximise the expected value of their utility \( u_{st} \) subject to labour demand (2) and \( p_t^e \). The first-order condition is

\[
\frac{w_t}{p_t^e} = \frac{1}{C_0^a} \frac{1}{C_2^{lln}},
\]

where \( \bar{I}_n \equiv \bar{I} - 1/a_s \) is the natural rate level of employment. Substituting (3) into (2), we obtain a semi-reduced form for per-capita employment in the distorted labour market that resembles the Phillips curve relation typically assumed in the literature:

\[
l_t = \bar{I}_n + \pi_t - \pi^e_t + \varepsilon_t,
\]

where \( \pi^e_t \) is the inflation rate expected by individuals.

Under the competitive labour market, the individuals of the representative sector compete with each other when signing nominal wage contracts with the firm of that sector. The natural rate of employment then equals \( \bar{I} \), so it exceeds the natural rate under the distortion by \( 1/a_s \). In other words, the distortionary effect of monopoly unions is stronger the smaller is \( a_s \), that is, the more the median voter of the representative monopoly union is sheltered from fluctuations in per-capita employment. The nominal wage and employment under competition are given by

\[
\begin{align*}
\frac{w_t}{p_t} &= \frac{1}{C_0} \frac{1}{C_2} - \bar{I}, \\
\frac{l_t}{p_t} &= \bar{I} + \pi_t - \pi^e_t + \varepsilon_t.
\end{align*}
\]

These equations have the same form as under the distortion except that the natural rate of per-capita employment now equals \( \bar{I} \).

1.3. Equilibrium Definition

In the first period the sequence of events is as follows: (i) the distorted and the competitive nominal wage are determined; (ii) nature chooses a set of candi-

\(^{10}\) See Cubitt (1992), Cukierman and Lippi (1999), and Guzzo and Velasco (1999) for analyses of large unions.

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dates, which is observed by all individuals; (iii) nature chooses the dominating issues, which are observed by all individuals; (iv) the government is elected from the candidate set; (v) the government appoints the central banker and chooses between the two nominal wages determined in (i); (vi) nature chooses the realisation of the supply shock, which is observed by all individuals; (vii) the central banker chooses inflation; the government chooses unemployment benefits and foreign policy; (viii) per-capita employment is determined. In the second period the sequence of events is as follows: (ix) the distorted and the competitive nominal wages are determined; (x) the distorted nominal wage determined in (ix) applies if and only if the distorted nominal wage was chosen in (v), otherwise the competitive nominal wage determined in (ix) applies; (xi) nature chooses the realisation of the supply shock, which is observed by all individuals; (xii) the central banker chooses inflation; the government chooses unemployment benefits and foreign policy; (xiii) per-capita employment is determined.

**Definition.** A subgame-perfect equilibrium is

(i) pairs of distorted nominal wages, competitive nominal wages, chosen nominal wages, inflation rates, foreign policies, unemployment benefits, per-capita employments,

(ii) a candidate set,

(iii) an elected candidate,

(iv) a central banker such that:

(a) the distorted nominal wages maximise the expected utility of the representative monopoly union for the relevant periods; the competitive nominal wages clear the labour market of the relevant periods in expected terms;

(b) all individuals in the candidate set strictly prefer to run; all individuals not in the candidate set are indifferent between running and not running or strictly prefer not to run;

(c) the elected candidate wins a simple majority vote among the candidates or is determined by random draw with equal probability among the candidates with the same number of votes;

(d) the chosen nominal wages, the appointed central banker, and the chosen foreign policy and unemployment benefits maximise the (expected) utilities of the governments;

(e) the inflation rates maximise the one-period utilities of the central banker; (f) per-capita employment is determined by the representative firm’s labour demands.

**2. Election Outcomes**

In this Section, we analyse the equilibrium candidate set, which is determined in step (ii), and the equilibrium election outcome, which is determined in step (iv).

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11 While in general subgame-perfection requires one to solve for the equilibrium backwards, there are two special features here that allow us to start with steps (ii) and (iv): Voters vote sincerely and candidates cannot commit and so choose policies according to their known preferences. Thus, we can derive the equilibrium candidate sets and election outcomes before we have derived equilibrium inflation and employment.
Proposition 1. (i) If $\beta \in [0, \frac{1}{2})$ then $(s, 2)$ is an equilibrium candidate set. If $\beta \in (\max\{\frac{x}{1+x}, (2x-1)/x\}, \frac{1}{2})$ and $x \in (\frac{1}{2}, \frac{2}{3})$ then \{(s, 1), (j, 2)\} too is an equilibrium candidate set. Each of the two candidates in the latter set wins with probability $\frac{1}{2}$ and there are no other equilibrium candidate sets. (ii) If $\beta = \frac{1}{2}$ then \{(s, 1), (s, 2)\}, \{(s, 1), (j, 2)\} and \{(s, 2), (j, 1)\} are the only equilibrium candidate sets; in the first one, each candidate wins with probability $\frac{1}{2}$, whereas in the latter two, the senior candidate wins with probability $\frac{3}{4}$. (iii) If $\beta \in (\frac{1}{2}, 1]$ then $(s, 1)$ is an equilibrium candidate set. If $\beta \in (\frac{1}{2}, \min\{1/(1+x), (1-x)/x\})$ and $x \in (\frac{1}{2}, \frac{2}{3})$ then \{(s, 2), (j, 1)\} too is an equilibrium candidate set. Each of the two candidates in the latter set wins with probability $\frac{1}{2}$ and there are no other equilibrium candidate sets.

Proof. See the Appendix.

Proposition 1 shows that if $\beta \in [0, \frac{1}{2})$ then $(s, 2)$ is the Condorcet winner, if $\beta = \frac{1}{2}$ then there is no Condorcet winner, and if $\beta \in (\frac{1}{2}, 1]$ then $(s, 1)$ is the Condorcet winner.\(^{12}\) The proposition also shows that even though the juniors are in the minority there exist equilibria in which the Condorcet winner does not run as a candidate and a junior candidate can be elected. Since we are interested in this possibility, we restrict our attention from now on to parameter values for which this is the case: $\beta \in (\max\{\frac{x}{1+x}, (2x-1)/x\}, \frac{1}{2})$ and $x \in (\frac{1}{2}, \frac{2}{3})$, or $\beta = \frac{1}{2}$, or $\beta \in (\frac{1}{2}, \min\{1/(1+x), (1-x)/x\})$ and $x \in (\frac{1}{2}, \frac{2}{3})$. Given these restrictions, there are multiple equilibrium candidate sets, a feature that is common in the citizen-candidate model. We have nothing to say about which candidate set is more plausible, so we assume that the candidate set is selected randomly. In particular, if $\beta \neq \frac{1}{2}$ then with some positive probability $\hat{\rho}$, nature picks the one-candidate equilibrium. Given this, the ex ante probability that the elected government has senior preferences turns out to be $(1 + \hat{\rho})/2$, which is in $(\frac{1}{2}, 1)$. If, on the other hand, $\beta = \frac{1}{2}$, then we assume that there are positive probabilities $\hat{\rho}_1$, $\hat{\rho}_2$ and $1 - \hat{\rho}_1 - \hat{\rho}_2$ such that the first, second, and third candidate set is picked, respectively. Recalling that a fair coin is tossed when both candidates get the same number of votes, we find that the ex-ante probability that the senior candidate wins is $(3 + \hat{\rho}_1)/4$, which again is in $(\frac{1}{2}, 1)$. So, if $x$ and $\beta$ are such that a two-candidate equilibrium set exists then a senior candidate is elected with some probability $\rho \in (\frac{1}{2}, 1)$.

In sum, we have shown that a multi-dimensional policy space and uncertainty about voters’ preferences can lead to a positive probability that the preferences of a group of individuals that is in the minority as regards monetary policy determine monetary policy. The resulting uncertainty about monetary policy is similar to that in the seminal work of Alesina (1987). The difference is that Alesina assumes the existence of a left-wing and a right-wing party, which differ in the relative weight

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\(^{12}\) A Condorcet winner wins in all pairwise comparisons with other candidates. Strictly speaking, the term Condorcet winner refers to a policy and not a candidate. Since in our setting, the two coincide we take the liberty to use it for both of them.
they attach to employment and which are elected with some exogenous probabilities. Our analysis endogenises the alternatives between which voters can choose and derives policy uncertainty from preference uncertainty. 13

3. Equilibrium Inflation, Employment, and Institutions

We now characterise the full equilibrium. The aim is to find conditions for the existence of equilibria with distorted labour markets.

3.1 Central Bank Dependence and Distorted Labour Markets

We first derive the equilibrium in which the labour market is distorted and the central banker is dependent.

**Proposition 2.** There is an equilibrium in which both types of government choose the distorted labour market and a dependent central bank if and only if

\[
\sigma_r^2 > \frac{(a_s + b)^2(a_j + b)\{[A(\rho)]^2 - b(a_j + b)\}}{2\sigma_r^2 \rho^3 [A(\rho)]^2},
\]

\[
\frac{2b}{[D(\rho)]^2} > \max\left\{ (1 - \rho)^2(a_s + b), \right\}
\]

\[
\frac{[A(\rho)]^2 + (1 - \rho)a_s[(1 - \rho)a_s + 2(1 - \rho)b] + b[(1 - 2\rho)b - \rho^2 a_j]}{2a_s - a_j}
\]

\[
2a_s > a_j.
\]

In this equilibrium, inflation and employment are: 14

\[
\pi_1(d,s|d,d) = \frac{(1 - \rho)D(\rho)}{b} - a_s \frac{\epsilon_1}{a_s + b}, \quad \pi_1(d,j|d,d) = \tilde{l}_n - \frac{(1 - \rho)D(\rho)}{a_s} + \frac{b}{a_s + b} \epsilon_1,
\]

\[
\pi_1(d,j|d,d) = \frac{[1 - \rho]s_d + b[D(\rho)]}{a_s} - \frac{a_j}{a_s + b} \epsilon_1, \quad l_1(d,j|d,d) = \tilde{l}_n + \frac{\rho D(\rho)}{a_s} + \frac{b}{a_s + b} \epsilon_1,
\]

\[
\pi_2(d,s|d,d) = -a_s \frac{\epsilon_2}{a_s + b}, \quad l_2(d,s|d,d) = \tilde{l}_n + \frac{b}{a_s + b} \epsilon_2,
\]

\[
\pi_2(d,j|d,d) = \frac{A(\rho)D(\rho)}{a_s} - a_s \frac{\epsilon_2}{a_s + b}, \quad l_2(d,j|d,d) = \tilde{l}_n + \frac{b}{a_s + b} \epsilon_2,
\]

where \( A(\rho) \equiv (1 - \rho)a_s + \rho a_j + b \) and \( D(\rho) \equiv (a_j - a_s)/A(\rho) \).

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13 There are additional reasons why the government’s preferred monetary policy may differ from that preferred by the majority. To begin with, the literature on opportunistic political business cycles argues that before elections governments create expansionary policies so as to improve their re-election prospects; see for example Rogoff and Sibert (1988) and Fratianni et al. (1997). Moreover, public choice theory argues that governments and bureaucracies overspend. Since seigniorage allows the government to collect revenues without much effort, it is likely to collect more of it than is optimal from the median voter’s point of view (Herrendorf and Neumann, 2000).

14 \((d,s|d,d)\) and \((d,j|d,d)\) indicate that the labour market is distorted and the central banker is senior and junior, respectively, given that individuals expect a distorted labour market and a dependent central banker.

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We start the discussion of this proposition with the equilibrium properties of inflation and employment in (9)–(12). The first noteworthy property is that senior central bankers stabilise less than junior central bankers, implying that under the former supply shocks lead to larger employment fluctuations than under the latter. The reason is that seniors are less affected by changes in employment than juniors. The second noteworthy property is that average inflation behaves differently across the different central bankers and across the different periods. Specifically, senior central bankers create an inflation bias only in the first period while junior central bankers create inflation biases in both periods. To understand this difference note that at the beginning of the second period the preferences of the central banker are known when wages are set, so individuals know that only a junior finds it optimal to increase employment beyond the prevailing natural rate level. Recall that the natural rate has been chosen by the senior median voter of the representative trade union, which is optimal from a senior central banker’s point of view and too low from a junior central banker’s point of view. When wages are set at the beginning of the first period, individuals are uncertain about the election outcome, and so the central banker’s preferences are uncertain. The rational inflation expectation then is a weighted average of the inflation expectations for both types of central bankers. As a result, both types will choose positive inflation rates. Specifically, inflation under a senior falls short of average inflation and inflation under a junior exceeds average inflation, and so senior central bankers create a first-period recession and junior central bankers create a first-period boom. As in Alesina’s (1987) rational partisan model, these post-election cycles in inflation and employment are entirely driven by the uncertainty about the election outcome. The implied behaviour of inflation and employment is consistent with the empirical evidence from OECD countries; see Alesina et al. (1997).

The economic intuition for the equilibrium conditions (6)–(8) is as follows. Condition (6) ensures that stabilisation policy is so important that junior governments do not find it optimal to delegate to a senior central banker. While such delegation would avoid the fluctuations due to policy uncertainty in the first period and the inflation bias in the second period, it would imply a stabilisation policy that is suboptimal from their point of view. Condition (7) ensures that the inflation bias of the second period and the fluctuations due to policy uncertainty are so small that no government finds it optimal to choose the competitive labour market conditions. Condition (7) is met if $a_j - a_s$ is sufficiently small, that is, if the preferences of seniors and juniors are not too different. Condition (8) ensures that the net effect of the distortion (i.e. the gains from higher real wage minus the costs from lower employment) is positive from the juniors point of view.

3.2. Central Bank Independence and Distorted Labour Markets

Before analysing central bank independence, we need to take a stand on which preferences an independent central bank has in our model when the labour market is distorted. Given that we have identified central bank dependence with
both types of government appointing partisans, three possibilities remain for the preferences of the independent central bank: (i) both types of governments appoint senior central bankers; (ii) both types of governments appoint junior central bankers; (iii) senior governments appoint junior central bankers and junior governments appoint senior central bankers. The empirical predictions of these different possibilities are as follows.

**Proposition 3.** (i) If both types of government appoint senior central bankers, then inflation is lower than under central bank dependence, inflation variability is lower, and employment variability may be lower or higher. (ii) If both types of governments appoint junior central bankers, then average inflation is higher than under central bank dependence, inflation variability may be lower or higher, and employment variability is lower. (iii) If senior (junior) governments appoint junior (senior) central bankers, then average inflation is higher than under central bank dependence, inflation variability is higher, and employment variability is lower or higher.

**Proof.** See the Appendix.

The empirical evidence for OECD countries is that central bank independence (as measured by legal indices) is negatively correlated with average inflation and average inflation variability and uncorrelated with employment variability. Only possibility (i) is consistent with this evidence. In what follows, we therefore restrict attention to independent central banks with senior preferences. Next, we characterise an equilibrium in which the labour market is distorted and the central bank is independent with senior preferences.

**Proposition 4.** There is an equilibrium in which both types of government choose the distorted labour market and an independent senior central banker if and only if

\[
\sigma^2 < \frac{(a_s + b)^2}{a_j b^2} \min \left\{ \frac{a_j}{2b} \left( \frac{(2a_s - a_j)(a_j + b)}{a_j - a_s} \right) \right\},
\]

\[2a_s > a_j.\]

In this equilibrium, inflation and employment are:

\[\pi_t(d, s|d, i) = -\frac{a_s}{a_s + b} \epsilon_t, \quad l_t(d, s|d, i) = \bar{l}_n + \frac{b}{a_s + b} \epsilon_t.\]

**Proof.** See the Appendix.

We start the discussion of this proposition by comparing the properties of equilibrium inflation and employment under central bank independence with those under central bank dependence. First, we can see that under central bank independence there is no inflation bias. The reason is that a senior central banker finds the natural rate of employment optimal, and so has no incentive to create surprise inflation in order to boost employment. Second, under central bank
independence there is on average less stabilisation policy than under central bank
dependence. The reason is that a senior central banker attaches a lower weight to
employment fluctuations than a junior one. Finally, under central bank inde-
pendence there is no policy uncertainty and no post-election cycle in inflation and
employment. The reason is that all governments appoint the same type of central
banker. These three differences explain why in our model average inflation and
inflation variability are lower under central bank independence than under de-
pendence whereas employment variability may be lower or higher. Specifically, the
less active stabilisation policy stance reduces inflation variability and increases
employment variability and the elimination of policy surprises after elections re-
duces both inflation and employment variability. This is as in Alesina and Gatti

There are two further noteworthy features. First, our independent central bank
does not create an inflation bias and stabilises employment. As we have argued in
the introduction, this is consistent with the post-war record of the Deutsche
Bundesbank and the recent experience of the countries that introduced inflation
targeting. Second, monetary policy under our independent central bank coincides
with the outcome of a single-item referendum on monetary policy, which the
seniors would win because they are in the majority.

We continue with the intuition for the equilibrium conditions (13) and (14).
Condition (13) ensures that the stabilisation policy stance is so unimportant
relative to the elimination of policy uncertainty and of the inflation bias that the
juniors find it optimal to delegate to a senior central banker. Condition (14)
ensures that the net effect of the distortion is positive from the juniors' point of
view, i.e. the implied wage increase dominates the implied involuntary unem-
ployment. This is as in Proposition 2. The equilibrium conditions have nothing
to do with the seniors because the seniors always are in favour of the distortion
when its effects on monetary policy are eliminated through central bank inde-
pendence.

4. Related Literature

In this section, we discuss our results in light of the existing literature.

4.1. Benevolent Policy Makers

The working paper version of this paper, Herrendorf and Neumann (1998), shows
that we can replicate the standard results of Barro and Gordon if we assume that
the policy objective is social welfare defined as

\[ W_t = ax_t + (1 - x)u_t \]
\[ = (w_t - p_t) - \frac{ax_t}{2} (l_t - \bar{l})^2 - \frac{b}{2} \pi_t^2 - \frac{c}{2} \left[ ax_t + (1 - x)(x - \bar{x})^2 \right]. \]

In particular, we can replicate Rogoff’s (1985) classic result that it is optimal to
appoint an independent central banker who is more conservative than the social
welfare maximiser. Since in the literature the social welfare maximiser is typically identified with the median voter, our analysis implies an important change in the interpretation of conservativeness: while the independent central banker remains more conservative than the social welfare maximiser, he no longer is more conservative than the median voter but as conservative.

4.2. Central Bank Boards

We have assumed that a single central banker decides about monetary policy. In contrast, in the real world central banks are typically governed by central bank boards with staggered appointments. In work prior to ours, Waller and Walsh (1996) and Waller (2000) find that a central bank board with staggered appointments reduces the effects of policy uncertainty on monetary policy also when the central bank is dependent. Proposition 2 of the working paper version of this paper, Herrendorf and Neumann (1998), shows in addition that a central bank board reduces the influence of juniors compared to central bank dependence. Consequently, a central bank board produces policies between those of a dependent central bank and those of an independent central bank. Specifically it reduces average inflation without eliminating it, while the other two predictions remain qualitatively as in Proposition 3. The prediction that a central bank board reduces, but not eliminates, average inflation is consistent with the cross-country evidence that across all OECD countries average inflation has been lower under central bank independence than under dependence, but not zero.

4.3. Reform by Parliament

We have not modelled a parliament here but assumed that the government can change the institutions instantaneously and without costs. While this is in the spirit of the citizen-candidate model, it amounts to the extreme assumption that the government completely controls parliament. Relaxing this assumption and modelling a parliament that passes binding laws may allow one to carry our analysis further in at least two directions.

The first difference that the presence of a parliament may create comes from the fact that it will make institutional changes costly and time consuming. In the context of our model, this is likely to be relevant for parameter constellations for which there is no equilibrium in which junior and seniors choose the same institutions. In these cases, a repeated version of our model predicts that institutions change with each new government. This is not what one observes in reality. Modelling the interaction between government and parliament may lead to the emergence of stable institutions also in the cases in which they do not emerge in our model. This is left to future research.

15 The intuitive reason is that in our model, juniors win the election with probability less than one half. This implies that a central bank board with at least three members and staggered appointments has a senior median voter more often than seniors win the elections.

16 Existing work on institutional reforms in related models includes Ozkan et al. (1997) and Calmfors (2001).
The second difference that the presence of a parliament may create comes from the fact that by changing the central bank law parliament can affect the utility of the central banker. Typical examples include cuts in the bank’s operating budget, changes in the term length, the introduction of more frequent and demanding reporting requirements etc. If the senior majority among the voters translates into a senior majority in parliament, then that majority can threaten to reduce the office rents of a ‘misbehaving’ junior central banker. This should impose tight constraints on how far the monetary policy stance can deviate from that preferred by the senior majority. Thus, when there is a parliament, our senior independent central banker may be a reasonable approximation also in cases in which the conditions (13) and (14) are not met.\textsuperscript{17}

4.4. Other Forms of Heterogeneity

In the present model, involuntary unemployment results from the monopoly power of trade unions when there is last-in-first-out. While trade unions play an important role in several OECD countries, different labour market distortions are important in others. However, this does not limit the interest of our results because they do not depend on the specific origin of the distortion, providing it gives rise to involuntary unemployment only of a minority of the labour force. Alternative possibilities are insider-outsider models, part-time versus full-time workers, or a minimum wage law, which increases the wage paid to workers facing monopsony employers, but tends to cause involuntary unemployment in competitive sectors.

Finally, while we focused on the labour market characteristics of individuals, one may consider whether or not they are net creditors. The overlapping-generations model of Faust (1996) captures this.\textsuperscript{18} In particular, he has an old generation, which is in the minority and holds the money stock, and a young generation, which is in the majority and does not hold money. The young generation then favours inflation surprises that reduce the real value of the outstanding money stock. Faust suggests that the resulting time consistency problem can be resolved by delegating monetary policy to an independent central bank. Moreover, he points out that in the US the appointment process to the central bank board is designed in such a way that on average the majority of debtors is under-represented.\textsuperscript{19} A similar issue about the composition of the central board is likely to be relevant in our model when the parameters are such that seniors and juniors do not agree on the equilibrium institutions.

\textsuperscript{17} Alt (1992) makes this point with respect to the US and provides empirical evidence that one principal of the Federal Reserve is Congress; see also Grier (1991). Moreover, Blinder (1998) points out that an additional constraint on the FED’s behaviour comes from the fact that, in principle, an act of Congress can overturn any of its decisions; see Lohmann (1992) for a formal model of this constraint.

\textsuperscript{18} Bullard and Waller (1998) extend Faust’s model to a growth model with capital accumulation.

\textsuperscript{19} Lohmann (1997) and von Hagen and Süppel (1994) make related points for boards of the Deutsche Bundesbank and the Council of the ECB, respectively.

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5. Conclusion

Employing the citizen-candidate model, we have derived the monetary policy objective from individual preferences in a representative democracy and we have endogenised the decisions about the labour market distortion and central bank independence. While the predictions of our model are consistent with the empirical evidence for OECD countries, there are two features that distinguish it from the existing literature. First, we have identified conditions under which all types of government prefer the distorted labour market to the competitive one and an independent central bank to a dependent one. Not unexpectedly, a necessary condition for this is that the variance of the supply shocks is sufficiently small. Second, we have explained why independent central banks may not generate an inflation bias and, at the same time, stabilise the real economy.

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Appendix

Proof of Proposition 1

We start by calculating the probabilities with which the different candidates win the election, providing the candidate sets are as claimed in the proposition. Trivially, in the one-candidate set, the single candidate wins with probability one. In the two-candidate sets, the senior candidate wins if and only if the economic issues dominate. Since this was assumed to happen with probability $\frac{1}{2}$, she wins with probability $\frac{1}{2}$. If $\beta = \frac{1}{2}$ and $\{(s, 1), (s, 2)\}$ is the candidate set, then each candidate receives half of all votes and the tie-breaking rule decides, implying that both win with probability $\frac{1}{2}$. If $\beta = \frac{1}{2}$ and $\{(s, 1), (j, 2)\}$ or $\{(s, 2), (j, 1)\}$ is the candidate set, the senior candidate wins when the economic issues dominate, whereas the tie-breaking rule decides when $f$ dominates. Thus, the senior candidate wins with probability $\frac{3}{4}$.

We prove the rest of the proposition only for the case $\beta \in [0, \frac{1}{2})$. The proofs for the other cases are analogous. We start by showing that $(s, 2)$ is a one-candidate equilibrium. $(s, 2)$ wants to run when she is the only candidate because she wins with probability one. What about other types declaring candidacy? No other individual of type $(s, 2)$ enters, because this would not improve that individual’s expected utility. In particular, if $(s, 1)$ entered, then all individuals would vote for the candidate who shares their bliss point $f_1$. Since $\beta < \frac{1}{2}$, there are more individuals with $f_1$ and $(s, 2)$ would still win with probability one. If $(j, 1)$ entered, then $(s, 2)$ would get the votes of all seniors when the economic issues dominate and the votes of all individuals with bliss point $f_2$ when $f$ dominates. Thus, $(s, 2)$ would still win with probability one. If $(j, 2)$ entered, then all seniors would always vote for $(s, 2)$. Since they are in the majority, $(s, 2)$ would still win with probability one. So, $(s, 2)$ beats all other candidates in pairwise comparisons and is thus the only one-candidate equilibrium.

Next, we turn to two-candidate equilibria and show first that $\{(s, 1), (j, 2)\}$ is the equilibrium candidate set if $\beta \in \left(\max\{z/(1 + z), (2z - 1)/z\}, \frac{1}{2}\right)$ and $z \in \left(\frac{1}{2}, \frac{2}{3}\right)$. We start by showing that both candidates can win the election. Since here individuals vote sincerely and $z$, $1 - \beta > \frac{1}{2}$, $(s, 1)$ wins when the economic issues dominate and $(j, 2)$ wins when $f$ dominates.
The next step is to prove that no other individual wishes to enter. First, if \((s, 2)\) entered, then the condition that she loses against \((j, 2)\) when the economic issues dominate is 
\[ \pi(1 - \beta) < 1 - \pi, \] 
which is ensured by the above conditions on \(\pi\) and \(\beta\). When \(f\) dominates, \((s, 1)\) beats her if \(\pi(1 - \beta) < \beta\), which is ensured too. Furthermore, by entering \((s, 2)\) would take votes away from her second-preferred candidates, i.e. \((s, 1)\) when the economic issues dominate and \((j, 2)\) when \(f\) dominates. Hence, she does not find it optimal to run. The case of \((j, 1)\) contemplating to enter is similar: she would get fewer votes than \((s, 1)\) and would take votes away from the candidates she likes best given she cannot win.

We also have to show that there is no other set of two candidates that is part of an equilibrium. From the first part of the proof, it is obvious that \((s, 2)\) cannot be part of a two-candidate equilibrium. So we only have to show for the remaining two combinations of candidates that one of the two does not wish to run. If \{\((s, 1), (j, 1)\)\} were the candidate set, all seniors would always vote for the senior candidate, who would always win. If the two candidates were \{\((j, 1), (j, 2)\)\}, then the seniors would always vote for the candidate who shares their respective bliss point \(f_m\) and \((j, 2)\) would always win. Hence, in both cases one candidate would leave the candidate set.

We now turn to the possibility of a three-candidate equilibrium. Four combinations are possible. First, suppose \{\((s, 2), (j, 1), (j, 2)\)\} is the set of candidates. Then, \((s, 2)\) wins when the economic issues dominate and \((j, 1)\) wins when \(f\) dominates. If \((j, 2)\) dropped out then \((s, 2)\) would win always, which \((j, 2)\) prefers compared to \((j, 1)\) winning when \(f\) dominates. Thus, \((j, 2)\) drops out. Second, suppose \{\((s, 1), (j, 1), (j, 2)\)\} is the set of candidates. Then, \((s, 1)\) wins when the economic issues dominate and \((j, 2)\) wins when \(f\) dominates. This would not change if \((j, 1)\) drops out. Thus, \((j, 1)\) drops out. Third, suppose \{\((s, 1), (s, 2), (j, 1)\)\} is the set of candidates. Then, \((j, 1)\) wins when the economic issues dominate and \((s, 2)\) wins when \(f\) dominates. If \((s, 1)\) dropped out then \((s, 2)\) would always win, which \((s, 1)\) prefers. Thus, \((s, 1)\) drops out. Fourth, suppose \{\((s, 1), (s, 2), (j, 2)\)\} is the set of candidates. In this case, \((j, 2)\) wins when the economic issues dominate and \((s, 1)\) wins when \(f\) dominates. If \((s, 2)\) drops out, then \((s, 1)\) wins when the economic issues dominate and \((j, 2)\) wins when \(f\) dominates, which \((s, 2)\) prefers. Thus, \((s, 2)\) drops out.

Finally, a similar reasoning implies for the four-candidate set \{\((s, 1), (s, 2), (j, 1), (j, 2)\)\}: \((j, 1)\) always gets fewer votes than \((s, 1)\). Dropping out improves the chances of \((j, 2)\) when the economic issues dominate and of \((s, 1)\) when \(f\) dominates. Given that she cannot win, these are her preferred candidates. Thus, \((j, 1)\) drops out. QED

**Proof of Proposition 2**

We start the proof by expressing \(u_k\) as a function of \(\pi_t, \pi'_t, x_t, \) and \(\epsilon_t\). If the labour market is competitive, then (1) and (5) imply that

\[ u_k(\pi_t, \pi'_t, x_t, \epsilon_t) = -\bar{I} + \pi'_t - \pi_t - \frac{a_k}{2}(\pi_t - \pi'_t + \epsilon_t)^2 - \frac{b}{2}(\pi_t)^2 - c(x_t - \bar{x}_k)^2. \tag{A.1} \]

If the labour market is distorted, then (1), (3), and (4) imply that

\[ u_k(\pi_t, \pi'_t, x_t, \epsilon_t) = -\bar{I}_m + \pi'_t - \pi_t - \frac{a_k}{2}(\pi_t - \pi'_t + \epsilon_t + \bar{I}_m) - \frac{b}{2}(\pi_t)^2 - c(x_t - \bar{x}_k)^2. \tag{A.2} \]

Individuals may not know which monetary policy preferences the central bank will have when they set the nominal wages at the beginning of the first period. In order to allow for all cases, we call \(\theta \in [0,1]\) the probability with which the central banker will be a senior.

---

20 Note that \(p_t - p'_t = \pi_t - \pi'_t\). Note also that the more tedious derivations of the three following proofs are available from the authors upon request.
\( \theta = 0 \) and \( \theta = 1 \) mean that the central banker is known to be a junior and a senior, respectively. Using (A.1) equilibrium inflation and employment when the labour market is competitive and a senior central banker is elected with probability \( \theta \) can be shown to be:\(^{21}\)

\[
\pi_c(e, s|c, \theta) = -\frac{a_s}{a_s + b} \epsilon_t, \quad \pi_c(e, j|c, \theta) = \frac{b}{a_s + b} \epsilon_t, \quad \pi_c(e, j|c, \theta) = \tilde{I} + \frac{b}{a_s + b} \epsilon_t. \quad (A.3)
\]

Using (A.2), equilibrium inflation and employment when the labour market is distorted and a senior central banker is elected with probability \( \theta \) can be shown to be:

\[
\pi_c(d, s|d, \theta) = \frac{1 - (\theta)D(\theta)}{b} - \frac{a_s}{a_s + b} \epsilon_t, \quad \pi_c(d, s|d, \theta) = \tilde{I} - \frac{(1 - (\theta)D(\theta))}{a_s} + \frac{b}{a_s + b} \epsilon_t, \quad (A.5)
\]

\[
\pi_c(d, j|d, \theta) = \frac{(1 - \theta)a_s + b|D(\theta)|}{a_s b} - \frac{a_j}{a_j + b} \epsilon_t, \quad \pi_c(d, j|d, \theta) = \tilde{I} + \theta|D(\theta)| + \frac{b}{a_s + b} \epsilon_t. \quad (A.6)
\]

Equations (9) and (10) follow from (A.5) and (A.6) by setting \( \theta = \rho \), the probability with which a senior government is elected and appoints a senior central banker. Equations (11) and (12) follow from (A.5) and (A.6) by setting \( \theta = 1 \) and \( \theta = 0 \), respectively.

We can now turn to the problem of a senior government. Given that in equilibrium the labour market is distorted and the central bank is dependent, choosing the distortion and a senior leads to the following expected utility of a senior government:\(^{22}\)

\[
E[U_s(d, s|d, d)] = \frac{1}{a_s} - \tilde{I} + E[\pi_1(d, s|d, d)] - \frac{a_s}{2} E[l_1(d, s|d, d)] - \frac{b}{2} E[|D(d)|^2] + \frac{1}{a_s} - \tilde{I} - \frac{a_s}{2} E[l_2(d, s|d, d)] - \tilde{I}^2 - \frac{b}{2} E[\pi_2(d, s|d, d)]^2
\]

\[
= \frac{1}{a_s} - 2\tilde{I} - \frac{(1 - \rho)^2(a_s + b)|D(\rho)|^2}{a_s b} - \frac{a_s b}{a_s + b} \sigma^2_e. \quad (A.7)
\]

There are three possible deviations: (i) distortion and junior central banker; (ii) competition and junior central banker; (iii) competition and senior central banker. (i) does not improve expected utility because the senior median voter of the trade union has already chosen the real wage that is optimal for the seniors. (ii) is strictly dominated by (iii) because a junior central banker stabilises suboptimally from a senior government’s point of view.\(^{23}\) The expected utility from (iii) follows from (A.3):

\[
E[U_s(e, s|d, d)] = -2\tilde{I} - \frac{a_s b}{a_s + b} \sigma^2_e. \quad (A.8)
\]

Comparing this expression with (A.7) shows that this deviation does not pay if and only if

\[
\frac{2b}{|D(\rho)|^2} > (1 - \rho)^2(a_s + b),
\]

which is the first part of (7) in the text.

\(^{21}\) \((e, s|c, \theta)\) indicates that the labour market is competitive and a senior becomes the central banker given that individuals expect the labour market to be competitive and attach a probability \( \theta \) to a senior central banker.

\(^{22}\) In what follows we will denote by upper case \( U \) the sum of the equilibrium utilities in the first and the second period. Note that we have assumed there is no discounting. Note also that each government will set \( x_t = x_\infty \), so unemployment benefits do not show up in \( U \).

\(^{23}\) These two claims are straightforward to show formally.
Finally, we consider the problem of junior governments. Given that in equilibrium the labour market is distorted and the central bank is dependent, choosing the distortion and a junior leads to the following expected utility of a junior government:

\[
E[U_j(d, j|d, d)] = \frac{1}{a_s} - \bar{I} + E[\pi'_1(d, j|d, d) - \pi_1(d, j|d, d)] - \frac{a_j}{2} E[L_s(d, j|d, d) - \bar{I}]^2
\]

(A.9)

Using this expression and (A.9), one can show that deviation (iii) does not pay if and only if

\[
\frac{2}{a_s^2} - 2\bar{I} - \frac{a_j}{a_j + b} \sigma_e^2 - \frac{[D(\rho)]^2}{2a_s^2 b} (2(1 - \rho)^2 a_i^2 + \rho^2 a_j^2 + 2(1 - \rho)b^2 + 2\rho(1 - \rho)a_i b + (2(1 - \rho)a_i b).}
\]

Again, there are three possible deviations: (i) competition and a senior central banker; (ii) competition and a junior central banker; (iii) distortion and a senior central banker. For the same reasons as before, (i) is dominated by (ii). The expected utility from the deviation (ii) follows from (A.4):

\[
E[U_j(c, j|d, d)] = 2 \left\{ -\bar{I} - \frac{a_s}{2} E[L(c, j|d, d) - \bar{I}]^2 - \frac{b}{2} E[\pi_2(c, j|d, d)]^2 \right\} \quad \text{(A.10)}
\]

Comparing this expression with (A.9) shows that this deviation does not pay if and only if (8) in the text holds and

\[
\frac{2b}{[D(\rho)]^2} > \frac{[A(\rho)]^2 + (1 - \rho)a_s[(1 - \rho)a_s + (1 - 2\rho)b] + b[(1 - 2\rho)b + (2 - \rho)a_i b]}{2a_s - a_j},
\]

which is the second part of (7) in the text.

The expected utility from deviation (iii) is

\[
E[U_j(d, s|d, d)]
\]

(A.11)

\[
= \frac{1}{a_s} - \bar{I} + E[\pi'_1(d, s|d, d) - \pi_1(d, s|d, d)] - \frac{a_j}{2} E[L_s(d, s|d, d) - \bar{I}]^2 - \frac{b}{2} E[\pi_2(d, s|d, d)]^2
\]

\[
+ \frac{a_j}{2} E[L_s(d, s|d, d) - \bar{I}]^2 - \frac{b}{2} E[\pi_2(s, s|d, d)]^2
\]

\[
= \frac{2a_s - a_j}{a_s^2} - 2\bar{I} - \frac{b(a_s^2 + a_i b)}{(a_s + b)^2} \sigma_e^2
\]

\[
- \frac{[D(\rho)]^2[(1 - \rho)^2 a_i^2 + 2(1 - \rho)b^2 + 2(1 - \rho)^2 a_i b + (1 - \rho)a_i b]}{2a_s^2 b}
\]

Using this expression and (A.9), one can show that deviation (iii) does not pay if and only if condition (6) in the text holds. QED

**Proof of Proposition 3**

We start with a distorted labour market and a dependent central bank, so \( \theta = \rho \) in (A.5) and (A.6). The three statistics are then:
In case (iii), junior governments appoint seniors, so the probability of a senior central banker) and case (ii) corresponds to \( \theta = 0 \) in (A.5) and (A.6) (both governments appoint a junior central banker). The three statistics are then:

\[
E[\pi(d, d)] = \frac{(1 - \rho)D(\rho)[2b + (2 - \rho)a_i + \rho a_j]}{2a_ib},
\]

\[
\text{Var}[\pi(d, d)] = \left[ \frac{\rho a_i^2}{(a_i + b)^2} + \frac{(1 - \rho)a_i^2}{(a_i + b)^2} \right] \sigma^2 + \frac{\rho (1 - \rho) [D(\rho)]^2}{2a_i^2},
\]

\[
\text{Var}[l(d, d)] = \left[ \frac{\rho b^2}{(a_i + b)^2} + \frac{(1 - \rho)b^2}{(a_i + b)^2} \right] \sigma^2 + \frac{\rho (1 - \rho) [D(\rho)]^2}{2a_i^2}.
\]

When the labour market is distorted and the central bank is independent, case (i) corresponds to \( \theta = 1 \) in (A.5) and (A.6) (both governments appoint a senior central banker) and case (ii) corresponds to \( \theta = 0 \) in (A.5) and (A.6) (both governments appoint a junior central banker). The three statistics are then:

\[
E[\pi(d, (i))] = 0, \quad \text{Var}[\pi(d, (i))] = \frac{a_i^2}{(a_i + b)^2} \sigma^2, \quad \text{Var}[l(d, (i))] = \frac{b^2}{(a_i + b)^2} \sigma^2,
\]

\[
E[\pi(d, (ii))] = \frac{a_i - a_j}{a_ib}, \quad \text{Var}[\pi(d, (ii))] = \frac{a_j^2}{(a_i + b)^2} \sigma^2, \quad \text{Var}[l(d, (ii))] = \frac{b^2}{(a_j + b)^2} \sigma^2.
\]

In case (iii), junior governments appoint seniors, so the probability of a senior central banker is \( 1 - \rho \), implying \( \theta = 1 - \rho \) in (A.5) and (A.6). The three statistics are then:

\[
E[\pi(d, (iii))] = \frac{\rho D(\rho)[2b + (1 + \rho)a_i + (1 - \rho)a_j]}{2a_ib},
\]

\[
\text{Var}[\pi(d, (iii))] = \left[ \frac{(1 - \rho)a_i^2}{(a_i + b)^2} + \frac{\rho a_i^2}{(a_i + b)^2} \right] \sigma^2 + \frac{\rho (1 - \rho) [D(\rho)]^2}{2a_i^2},
\]

\[
\text{Var}[l(d, (iii))] = \left[ \frac{(1 - \rho)b^2}{(a_i + b)^2} + \frac{\rho b^2}{(a_i + b)^2} \right] \sigma^2 + \frac{\rho (1 - \rho) [D(\rho)]^2}{2a_i^2}.
\]

Comparing these results, it is straightforward to prove the different comparative static claims of the proposition. QED

**Proof of Proposition 4**

We start the proof by noting that expression (15) follows from (A.5) and (A.6) by setting \( \theta = 1 \).

We first consider the problem of senior governments. Given that in equilibrium the labour market is distorted and the central banker is a senior, choosing the distortion and a senior leads to the following expected utility of a senior government: \(^{25}\)

\[
E[U_s(d, s|d, i)] = 2 \left\{ \frac{1}{a_i} - \frac{a_i}{2} E[\pi_2(d, s|d, i)] - \frac{b}{2} E[\pi_2(d, s|d, i)]^2 \right\}
\]

\[
= \frac{1}{a_i} - 2 \frac{b}{a_i + b} \sigma^2.
\]

The following deviations are possible: (i) distortion and junior central banker; (ii) competition and junior central banker; (iii) competition and senior central banker. (i) does

\(^{24}\) The equilibrium in this case is the same as that in hypothetical case where the central bank is dependent and a senior government is elected with probability \( 1 - \rho \), instead of \( \rho \).

\(^{25}\) In what follows we will denote by upper case \( U \) the sum of the utilities in the first and the second period.

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not improve expected utility because the senior median voter of the trade union has already chosen the real wage that is optimal for the seniors. (ii) is strictly dominated by (iii) because a junior central banker does not stabilise optimally from a senior government’s point of view. The expected utility from (iii) follows from (A.3):

$$E[U_j(c, s|d, i)] = 2\left\{ -\bar{l} - \frac{a_j}{2} E[l_j(c, s|d, i) - \bar{l}]^2 - \frac{b}{2} E[\pi_i(c, s|d, i)]^2 \right\} = -2\bar{l} - \frac{a_j b}{a_s + b} \sigma_{e}^2. $$

Comparing this expression with (A.12) shows that this deviation does not pay either.

Next, we consider junior governments. Given that in equilibrium the labour market is distorted and the central banker is senior, choosing the distortion and a senior leads to the following expected utility of a junior government:

$$E[U_j(d, s|d, i)] = 2\left\{ \frac{1}{a_s} \bar{l} - \frac{a_j}{2} E[l_j(d, s|d, i) - \bar{l}]^2 - \frac{b}{2} E[\pi_2(d, s|d, i)]^2 \right\} = \frac{2a_s - a_j}{a_s^2} - 2\bar{l} - \frac{b(a_s^2 + a_j b)}{(a_s + b)^2} \sigma_{e}^2. $$

As above, if the junior deviates by choosing competition, then she will choose a junior central banker. The expected utility from doing this is the same as when a dependent central banker is expected, $E[U_j(c, j|d, i)] = E[U_j(c, j|d, j, d)]$. Comparing (A.10) with (A.13) shows that this deviation does not pay if and only if

$$\sigma_{e}^2 < \frac{(2a_s - a_j)(a_s + b)^2(a_j + b)}{a_s^2 b^2(a_j - a_s)^2}. \text{ (A.14)}$$

In order to compute the expected utility from deviating by choosing the distortion and a junior central banker, we first find the deviation that maximises a junior central banker’s utility given a senior central banker is expected:

$$\pi(d, j|d, i) = \frac{a_j - a_s}{a_s(a_j + b)} - \frac{b}{a_j + b} \epsilon. $$

The expected utility from this deviation is:

$$E[U_j(d, j|d, i)] = \frac{1}{a_s} \bar{l} - E[\pi_1(d, j|d, i)] - \frac{a_j}{2} E[l_j(d, j|d, i) - \bar{l}]^2 - \frac{b}{2} E[\pi_1(d, j|d, i)]^2$$

$$+ \frac{1}{a_s} \bar{l} - \frac{a_j}{2} E[l_j(d, j|d, i) - \bar{l}]^2 - \frac{b}{2} E[\pi_2(d, j|d, i)]^2$$

$$= \frac{2a_s - a_j}{a_s^2} - 2\bar{l} - \frac{a_j(a_j - a_s)^2}{2a_s^2 b(a_j + b)} - \frac{a_j b}{a_j + b} \sigma_{e}^2. $$

Comparing this expression with (A.13) shows that this deviation does not pay if and only if

$$\sigma_{e}^2 < \frac{a_j(a_s + b)^2}{2a_s^2 b^3}. $$

Combining this inequality with (A.14) gives (13) in the text. QED

References


