Public Employment as a Policy Tool in Unionized Labour Market

Mauri Kotamaki

Abstract

This paper investigates the effectiveness and usefulness of public employment as a fiscal policy tool. We calibrate a dynamic general equilibrium model which places the magnifying glass in the unionized labour market. Using this calibrated model we investigate the interplay of private and public employment as a tool in the policy maker’s toolbox. We show that government employment crowds out private employment. In addition we find, surprisingly, that the government has a role in the labour market. A good policy rule for the government depends on the preferences of the politician, yet, taking advantage of the median voter theorem, we find clear cut policy recommendation.

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1. Introduction

The public sector accounts for a significant share of total employment in developed countries. In the 21st century the general government employment (of total labour force) has been around 15% in the US, 18% in the UK and between 23 and 30 percent in the Nordic countries. This means that the public sector plays an important role in the labour market. Surprisingly, research on the interaction of the private and public sector labour markets hasn’t, however, been very active. Although the general government employment is present in many empirical analyses of the cycle (cf. Pappa [2009], Perotti [2007]), an explicit modelling of the consequences of these labour market flows has been rather mild. This is surprising as many papers, such as Pappa [2009] or Cavallo [2005], also underline the importance of distinguishing private employment from public employment.

There are a number of empirical articles that conclude that an increase in the public employment leads to crowding out of private employment in the medium or long run. Firstly, there is a direct transmission channel such that the government chooses how many vacancies to post in the public sector, thus, affecting the supply of labour in the private sector at the same time. In effect, government faces a tradeoff between more vacancies in the public sector and a higher rate of unemployment in the private sector (Hörner et al. [2007]).

Secondly, an increase in public sector wage rate leads to an increase in the private sector wage rate and therefore, eventually, an increase in the overall unemployment rate (Demekas and Kontolemis [2000]). Note that this doesn’t necessarily mean that the public sector is a leader in the wage setting process. For example, a random, unanticipated productivity shock in a certain government sector will lead to pressure in wages in that particular sector, which, in due time, will affect the corresponding private sector firm’s wage setting process and increase the unemployment rate in that particular sector.

Thirdly, the crowding out of private employment depends on the substitutability of public and private labour (Algan et al. [2002]). Crowding out is small if the public sector produces clearly collective goods such as justice or defence. On the other side, crowding out is bigger if the produced public goods compete with the private sector. The examples include goods from sectors such as transport, education and health.

Increase in public sector employment will, of course, also lead to a higher
level of public expenditures. The public sector must eventually react to this by increasing the tax rate or alternatively decreasing other public expenditures. An increase in taxes increases distortions in for example labour supply and consumption decisions. A country with a big public sector might distort the economy more than a country with smaller public sectors, especially if we believe in non-linear effects of taxation (Koskela and Viren (2000), Malley and Moutos (1996)). A cut in the expenditure side, on the other hand, is politically challenging and, thus, may not be conducted in an optimal manner. One possible outcome is that the public sector will expand "too much" in time resulting in increasing number of distortions and meddling in the private sector. Many economists already see signs of this in the present day.

The relative working conditions also matter. If the public sector jobs are viewed to be very attractive compared to the private sector, the crowding out will be larger. Some developing countries offer concrete examples. In addition, the mobility of the labour force contribute to the crowding out. If an additional public sector employer makes the private labour market tighter, a potential recruit might move to another state or country, thus, the visible crowding out is smaller because the mobile worker doesn’t show in official unemployment statistics, yet there is an increase in emigration and brain drain.

One of the objectives of this paper is to investigate the economic impact of public sector employment on private sector employment and unemployment. Economic theory doesn’t provide straightforward answers. Instead, the size and sign of the impact is ambiguous and depends on many factors. Another, related, objective of this paper is to investigate what is an optimal government policy in the economic cycle. More specifically, how the public sector wages and employment should change when the economy is hit by a total factor productivity (TFP) shock. Also, we discuss the effects of public employment with respect to income distribution and social welfare. All the aforementioned issues are important in the fiscal policy debate.

In the next section we shall present the most important empirical descriptives concerning the focus of this paper. In the third section we present a dynamic general equilibrium model in which the private and the public sectors interact in the labour market. The model used here is a relative to the models used by Ardagna (2007), Fernandez-de-Córdoba et al (2012) and Koskela and Viren (2000). In the fourth section we calibrate the model. The fifth section simulates the response of the model to a number of shocks to give a taste of the dynamics of the model. In addition, we take a look
at public sector labour market policy rules in subsection 5.4, that is, we study an optimal policy rule for public sector employment and wage setting when the economy is hit by a total factor productivity shock. After finding out the best policy response, we make a policy recommendation and discuss briefly about the implementation of the rule. The sixth section considers the robustness of the model. The seventh section concludes.

2. Descriptive Statistics on Employment and Wages

In this section we compare the properties of employment and wages in the private and public sectors for the postwar period in the United States. The data on employment is from the Current Employment Statistics (CES), the Bureau of Labour Statistics (BLS) monthly employment survey. We report descriptives from 1948 to 2011. We also report subsamples from 1948-1979 and 1980-2011.

Our measure of private employment ($n^p_t$) includes all employees in the private sector. The measure of the public sector employment ($n^g_t$) includes all employees at the federal, state and local government levels. We also report statistics for the public employment to private employment ratio, elasticities and standard deviations. The original data is in monthly frequency which we average into quarterly frequency. Our measure of $x_t$ is the Hodrik-Prescott filtered series of $\log(x_t)$ with a smoothing parameter of 1,600. The elasticity is obtained by estimating equation $\hat{y}_t = \alpha_1 + \alpha_2 \hat{x}_t + \epsilon_t$ with OLS where $y$ and $x$ are logarithmic and detrended. The regression coefficient $\alpha_2$ is the elasticity of $y_t$ with respect to $x_t$. The employment statistics are reported in table 1.

Table 1 shows that the private employment is strongly procyclical, the correlation between gross domestic product and private employment is over 0.8 in all periods. The public employment is procyclical, but less so compared to the private employment. Also, the procyclicality is significantly lower in 1980-2011 period compared to 1948-1979 period. The share of public employment to private employment, on the other hand, is strongly countercyclical; the correlation is of public employment to private employment ratio and gross domestic product is almost -0.8. Lastly, public employment and private employment seem to evolve partly in tandem. The correlation between public and private employment is 0.32 in 1948-2011. The correlation does decline over time, thus, it is only 0.22 in 1980-2011.

4
Table 1: US Employment (CES)

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Corr($n^p, GDP$)</td>
<td>0.83</td>
<td>0.84</td>
<td>0.83</td>
</tr>
<tr>
<td>Std($n^p$)/Std(GDP)</td>
<td>1.00</td>
<td>0.96</td>
<td>1.09</td>
</tr>
<tr>
<td>Corr($n^g, GDP$)</td>
<td>0.21</td>
<td>0.27</td>
<td>0.10</td>
</tr>
<tr>
<td>Std($n^g$)/Std(GDP)</td>
<td>0.53</td>
<td>0.52</td>
<td>0.54</td>
</tr>
<tr>
<td>Corr($n^g/n^p, GDP$)</td>
<td>-0.75</td>
<td>-0.74</td>
<td>-0.77</td>
</tr>
<tr>
<td>Std($n^g/n^p$)/Std(GDP)</td>
<td>0.97</td>
<td>0.90</td>
<td>1.11</td>
</tr>
<tr>
<td>Corr($n^g, n^p$)</td>
<td>0.32</td>
<td>0.38</td>
<td>0.22</td>
</tr>
<tr>
<td>Elas($n^g, n^p$)</td>
<td>0.17</td>
<td>0.21</td>
<td>0.11</td>
</tr>
<tr>
<td>Std($n^g$)/Std($n^p$)</td>
<td>0.52</td>
<td>0.54</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Table 1 also shows that the private employment is approximately as volatile as the GDP, although, the volatility has increased since 1980. As expected, the public employment is about half as volatile as the GDP. The same observation applies to the volatility of public employment and private employment. Lastly, the public employment to private employment ratio is approximately as volatile as the GDP in 1948-2011. There is variation within the period, though, so that the volatility is almost 25 percent higher in 1980-2011 period compared to the 1948-1979 period.

The data on wages is from the [National Income and Product Accounts](https://www.bea.gov/nipa/nipa.pdf) (NIPA) of the Bureau of Economic Analysis (BEA). Here, we use annual wage and salary accruals per full-time equivalent employees in the private and government sectors. The data is deflated with the [CPI](https://www.bls.gov/). The statistics are reported in table 2.

Private wages are strongly procyclical. The correlation between private wage and the GDP is higher in the latter period being 0.60 in 1980-2011. The public wage, on the other hand, has changed from mildly countercyclical in 1948-1979 to mildly procyclical in 1980-2011. The public wage premium is clearly countercyclical with correlation between the public-private wage ratio.
Table 2: US wages and salaries per employee (NIPA)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Corr($w^p, GDP$)</td>
<td>0.50</td>
<td>0.42</td>
<td>0.60</td>
</tr>
<tr>
<td>Std($w^p$)/Std($GDP$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corr($w^g, GDP$)</td>
<td>0.04</td>
<td>-0.15</td>
<td>0.31</td>
</tr>
<tr>
<td>Std($w^g$)/Std($GDP$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corr($w^g/w^p, GDP$)</td>
<td>-0.41</td>
<td>-0.49</td>
<td>-0.30</td>
</tr>
<tr>
<td>Std($w^g/w^p$)/Std($GDP$)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corr($w^g, w^p$)</td>
<td>0.66</td>
<td>0.69</td>
<td>0.68</td>
</tr>
<tr>
<td>Elas($w^g, w^p$)</td>
<td>0.95</td>
<td>1.34</td>
<td>0.74</td>
</tr>
<tr>
<td>Std($w^g$)/Std($w^p$)</td>
<td></td>
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</tbody>
</table>

and GDP being -0.41 in 1948-2011. The private and the public sector wages evolve hand in hand in the 1948-2011 period, the correlation being almost 0.70.

3. The Model

The model used in this paper is a close relative to and a mixture of the model used by Ardagna (2007), Fernandez-de-Còrdoba et al (2012) and Koskela and Viren (2000). The basic framework can be summarized as follows. The model economy consists of infinitely lived agents that are heterogeneous in terms of income. There are capitalists and workers. Capitalist own the firms and save in the form of public bonds. Their income consists of interest paid on the bonds and of the profits in the private sector firms. Workers operate in the private sector or in the public sector. Also involuntary unemployment is possible. Workers are paid a wage depending on the sector that he or she works in. The unemployed receive a lump sum transfer from the government. Households derive utility from privately produced goods. In every period workers consume all their disposable income. Private firms
demand labour as a function of real wage. There is a union in the private sector that maximizes the utility of its members and thus determining a wage rate. The private sector union sets the wage rate and the public sector wages mimic this realized process.

3.1. Households

The representative capitalist maximizes utility

$$\sum_{t=0}^{\infty} \beta^t u(c_t^k)$$

subject to his or her budget constraint

$$b_{t+1} + (1 + \tau_t^c)c_t^k = (1 + (1 - \tau_t^b)r_t^b)b_t + (1 - \tau_t^b)\pi_t,$$

where $b$ are the public bonds, $c^k$ consumption of the representative capitalist, $\pi$ denotes the profits of the private sector firms and $ls$ is the lump-sum transfers paid by the government. Throughout the paper we assume logarithmic preferences for both for the capitalist and for the labour union, thus, $u(x_t) = \log(x_t)$. The optimal consumption path is determined by:

$$u'(c_t^k) = \beta(1 + (1 - \tau_{t+1}^b)r_{t+1}^b)u'(c_{t+1}^k).$$

Following Gali et al. (2007), capitalists can be called Ricardian or optimizing consumers. Workers, on the other hand, are called rule-of-thumb or hand-to-mouth consumers. They derive utility from consumption of private goods and the level of consumption is equal to their disposable income. They do not intertemporally smooth their consumption at all, thus, changes in wage rate are immediately and fully reflected in the individual consumption. We have:

$$\begin{align*}
(1 + \tau_t^c)c_t^p &= (1 - \tau_t^n)w_t^p, \quad (4) \\
(1 + \tau_t^c)c_t^g &= (1 - \tau_t^n)w_t^g, \quad (5) \\
(1 + \tau_t^c)c_t^u &= u_t \quad (6)
\end{align*}$$

where $c^p, c^g, c^u$ denote the consumption of a private sector worker, public sector worker and an unemployed person, respectively. Consumption and labour income tax rate is denoted by $\tau^c$ and $\tau^n$, respectively. An exogenous unemployment benefit is denoted by $u$ and $w^p$ and $w^g$ denote the wage rate
in the private sector and public sector, respectively. Every period workers are randomly assigned to one of the employer categories. Workers are ex-ante identical, but ex-post heterogenous with respect to consumption and income which allows us to portray an income distribution in the analysis, although, in a rudimentary level. As workers consume all their disposable income, there is no wealth distribution that we need to keep track of which is a desirable property in the model, because we want to preserve a maximal amount of tractability.

3.2. Firms and Labour Unions

Firms produce a homogenous good using constant elasticity of substitution (CES) technology. Production of the final good, $y_t$, requires both public and private labour services. The technology is given by:

$$y_t = \frac{A_t \left[ \omega(B_t n_t^p)^{\eta} + (1 - \omega)(C_t n_t^g)^{\eta}\right]^{\alpha/\eta}}{\omega B_t n_t^p}.$$  \hspace{1cm} (7)

where $y$ is the output, $A$ a measure of total factor productivity (TFP), $B$ is a measure of private sector labour productivity, $C$ is a measure of public sector labour productivity, $n^p$ and $n^g$ denote private and public labour demand, respectively. The parameter $\omega$ measures the relative weight of private labour to public labour, $\eta$ indicates the elasticity of technical substitution between private and public labour and $\alpha$ is a measure for economics of scale. The (private) labour demand is solved from an equation that defines the marginal productivity of labour:

$$w_t^p = A_t \alpha [\omega(B_t n_t^p)^{\eta} + (1 - \omega)(C_t n_t^g)^{\eta}]^{(\alpha-\eta)/\eta} \omega B_t n_t^p \eta^{-1}.$$  \hspace{1cm} (8)

Firms make a positive profit which accrues to the capitalist:

$$\pi_t = y_t - w_t^p n_t^p.$$  \hspace{1cm} (9)

$$\pi_t = \left(1 - \frac{\alpha \omega B_t n_t^p}{\omega(B_t n_t^p)^{\eta} + (1 - \omega)(C_t n_t^g)^{\eta}}\right) y_t.$$  \hspace{1cm} (9)

The union maximizes the expected utility of its members:

$$\sum_{t=0}^{\infty} \beta^t \left(n_t^p u(c_t^p) + (n_t^w - n_t^p)u^R\right).$$  \hspace{1cm} (10)
subject to the labour demand equation (8) and taking the fiscal policy variables and member’s reservation utility as given. The resulting wage setting equation reads:

\[ u(c^p_t) = u^R_t - \left( (\eta - 1) + \frac{(\alpha - \eta)\omega(B_t n_t^p)^{\eta}}{\omega(B_t n_t^p)^{\eta} + (1 - \omega)(C_t n_t^g)^{\eta}} \right), \]  

(11)

where \( u^R \) is the members’ reservation utility i.e. the expected utility that a member receives when he or she is not employed in the private sector. It is given by:

\[ u_R^t = n^G_t w^G_t - n^P_t u(c^G_t) + n^U_t u(c^U_t). \]  

(12)

3.3. The Government

On the revenue side, the government collects taxes and issues bonds:

\[ \text{revenue}_t = \tau^b_t (n^P_t w^P_t + n^g_t w^g_t) + \tau^c_t (n^P_t c^P_t + n^g_t c^g_t + n^k_t c^k_t + n^u_t c^u_t) + \tau^b_t n^k_t (r^b_t b_t + \pi_t) + n^k b_{t+1}. \]  

(13)

On the expenditure side, the government has to pay interest on the bonds it issued in previous period. In addition, the government pays lump sum transfers and unemployment subsidies. The expenditure side is given by:

\[ \text{expenditure}_t = (1 + r^b_t) n^k_t b_t + w^g_t n^g_t + n^u_t u_t. \]  

(14)

As usual, revenue must equal expenditure at all times:

\[ \text{revenue}_t = \text{expenditure}_t. \]  

(15)

We simplify the analysis at this point by assuming that:

\[ \tau^b_t = \tau^c_t = \tau^a_t. \]  

(16)

The usual no-ponzi condition must hold for both the borrower and the lender. I follow [Quadrini and Trigari (2007)] in setting up the public sector labour market. In another words, government follows an exogenous rule for the public employment and for the public sector wage setting. There are two reasons

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4 The relevant Lagrangian for this problem is: \( \mathcal{L} = \left( \frac{n^p_t}{n^p_t} u((c^p_t) + \frac{n^w_t - n^P_t}{n^w_t} u^R) + \lambda (w^p_t - A_t (B_t n^p_t) + (1 - \omega)(C_t n^g_t)^{\alpha - \eta}) \right) \).
supporting a rule of this kind. Firstly we want to be able to exogenously alter the public sector’s policy response to different shocks. This will become apparent in the next section. Secondly we want to ensure the desired cyclical properties within the model. The public sector policy rules are the following:

\[
\log(n_t^g) = \log(\bar{n}_g) + \rho_n (\log(n_t^p) - \log(\bar{n}_p)) + \log(D_t), \tag{17}
\]

\[
\log(w_t^g) = \log(\bar{w}_g) + \rho_w (\log(w_t^p) - \log(\bar{w}_p)) + \log(E_t), \tag{18}
\]

where a bar over a variable denotes a steady state value. The interesting parameters are \(\rho_n\) and \(\rho_w\). The government’s employment policy is procyclical if \(\rho_n > 0\) and countercyclical if \(\rho_n < 0\). The same logic applies to \(\rho_w\) in the context of public sector wage setting.

### 3.4. Definition of Equilibrium

A competitive equilibrium is a sequence for an endogenous predetermined variable \(\{b_{t+1}\}\) and a sequence of endogenous variables \(\{c^k_t, c^g_t, c^u_t, n_t^p, n_t^g, n_t^u, y_t, w_t^p, w_t^g, \pi_t, \text{revenue}_t, \text{expenditure}_t, u_t\}\) that satisfy equations (2), (3), (4), (5), (6), (7), (8), (9), (11), (12), (13), (14), (15), (17) and (18) given the sequence of the exogenous predetermined variables \(\{n^k_t, n^p_t, n^g_t, n^u_t, u_t\}\) and given the initial value for \(b_t\). In addition, output equals aggregate consumption, or, the economy wide resource constraint holds at all times:

\[
y_t = c^k_t + c^g_t + c^u_t. \tag{19}
\]

### 4. Calibration

We calibrate our model to match certain features of our reference economy which is taken to be the United States\(^5\). When simulating the model, we need information on the parameters of the production function \((\alpha, \omega, \eta)\), on preference parameter \((\beta)\), on labour market parameters and variables \((n^k, n^w, n^g/n^p, w^g/w^p)\) and on policy parameters \((u, \tau^b, \tau^c, \tau^n, \rho_n, \rho_w)\). Data is taken from OECD Economic Outlook database, from Current Employment Statistics (CES), the Bureau of Labour Statistics (BLS) monthly employment survey and from National Income and Product Accounts (NIPA) of the Bureau of Economic Analysis (BEA). We follow Kydland and Prescott

\(^5\)We have also calibrated the model to the Nordic countries. The results of the model are qualitatively the same.
and set as many parameters as possible in advance based on a priori information. The baseline calibration is on the 1980-2011 period.

We set $\beta$ so that the steady state interest rate matches the average of the real long-term interest rate on government bonds. The average long-term interest rate minus the inflation rate was 6.94% in 1980-2011.

The capitalists, or, the firm owners, $n^k$, are taken to be the total number of self-employed which equals to 8.3% of the labour force in our calibration period. The amount of employees, $n^w$, is then 0.917 because the total population is normalized to 1.

There are a number of possibilities for the benchmark $w^g/w^p$ ratio. For example, the Bureau of Labour Statistics reports wages and salary, benefits and total average hourly compensation for June 2012 for state and locate government employees to be $26.57, $14.19 and $40.76, respectively. The corresponding numbers for all private workers are reported to be $19.91, $8.33 and $28.24. On the other hand, the corresponding numbers for private workers at companies with more than 500 employees are $26.86, $13.89 and $40.75. As is visible, there is a wide range of values already with these two estimates. We shall use the annual wage and salary accruals per full-time equivalent employees in the government and private sectors so that $\frac{w^g}{w^p} = 1.087$. This is higher than the number used by Quadrini and Trigari (2007) (1.0375), yet very close to the value of 1.0877 used by Ardagna (2007). Following Fernandez-de-Córdoba et al. (2012) we set the weight of public employment relative to private employment, $\omega$, to be the ratio of public/private employment for the period, thus, $(1 - \omega)$ equals 0.201; the private sector employment is approximately five times as big as the public sector employment.

The values for policy parameter $\tau$ is such that the public debt to output ratio matches the data. Although the public debt has grown to over 100% of GDP in the recent times, the 1980-2011 average is ”only” 65%. Unemployment benefit, $u_t$, is a share of private sector net wage. More specifically, $u_t = \bar{u}(1 - \tau)w^p_t$, where $\bar{u}$ is the replacement rate. We take the replacement rate from Van Vliet and Caminada (2012). The average net unemployment replacement rate for a single person in the US between 1980 and 2009 is estimated to be 0.61. The replacement rate is calculated for an age 40 worker in the beginning of his or her unemployment spell. This specification suits

$\tau = \tau^b = \tau^c = \tau^n$
a model of this kind well because the labour force is randomly allocated to employment or unemployment in the beginning of each period.

The values for $\rho^n$ and $\rho^w$ are taken from table 1 and table 2. The values for $\rho^n$ and $\rho^w$ are 0.68 and 0.11, respectively. The value for $\eta$ is set arbitrarily to 0.5. In section 6 we check the robustness of this assumption and see that the qualitative nature of the results holds given that $\eta \in (0, 1)$. We calibrate $\alpha$ to set the private demand for labour such that the steady state unemployment matches the data. As is known, the US unemployment rate has been historically rather low in comparison with many other developed countries. The 1980-2011 average unemployment is 6.4%. The calibration for the United States is summarized for the period of interest in table 3.

Table 3: Baseline calibration and parametrization for the US economy (1980-2011)

<table>
<thead>
<tr>
<th>Parameter or variable</th>
<th>Value</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>Economics of scale parameter ($\alpha$)</td>
<td>0.941</td>
<td>Calibrated to match $\bar{n}_u$</td>
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<tr>
<td>Relative weight of $n^p$ to $n^g$ ($1 - \omega$)</td>
<td>0.201</td>
<td>Data</td>
</tr>
<tr>
<td>Elasticity of substitution between $n^p$ and $n^g$ ($\eta$)</td>
<td>0.500</td>
<td>Ad hoc</td>
</tr>
<tr>
<td>Public to private employment ratio ($n^g/n^p$)</td>
<td>0.201</td>
<td>Data</td>
</tr>
<tr>
<td>Public to private wage ratio ($w^g/w^p$)</td>
<td>1.087</td>
<td>Data</td>
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<tr>
<td>Utility discount factor ($\beta$)</td>
<td>0.943</td>
<td>Calibrated to match $r_b$</td>
</tr>
<tr>
<td>Capitalists ($n^k$)</td>
<td>0.083</td>
<td>Data</td>
</tr>
<tr>
<td>Labour force ($n^w$)</td>
<td>0.917</td>
<td>$1 - n^k$</td>
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<tr>
<td>Replacement rate ($\bar{u}$)*</td>
<td>0.610</td>
<td>Van Vliet and Caminada</td>
</tr>
<tr>
<td>Universal tax rate ($\tau$)</td>
<td>0.121</td>
<td>Calibrated to match $b/y$</td>
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<tr>
<td>Elasticity of public employment to private employment ($\rho^n$)</td>
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<td>Data</td>
</tr>
<tr>
<td>Elasticity of public wages to private wages ($\rho^w$)</td>
<td>0.740</td>
<td>Data</td>
</tr>
</tbody>
</table>

* 1980-2009

5. Analysis of Shocks and Policy Changes

This section analyzes the effects of an unanticipated increase in (a) total factor productivity, (b) private sector labour productivity, (c) public sector labour productivity, (d) public sector employment and (e) public sector wage level. In addition we shall investigate the implications and optimality of
changing the public sector employment policies. We assume that the shocks follow a first-order autoregressive, AR(1), process:

$$log(X_t) = \rho_X log(X_{t-1}) + \epsilon_t^X,$$

where $X = A, B, C, D$ or $E$ and $\epsilon_t^X \sim N(0, \sigma_X)$.

5.1. Productivity shock

An increase in productivity of the economy as a whole (TFP), of the private sector employees or of the public sector employees (see equation (7)) all produce qualitatively identical results. As expected, a sudden increase in productivity raises output on impact. This immediately raises the demand for new private sector workers, thus, the private sector employment increases. The labour union now has better bargaining position and they are able to negotiate higher wages for their members so that also the wage rate must increase. An increase in wage rate has one to one correspondence with consumption as the workers consume all of their disposable income.

The public sector follows the private sector when deciding their employment and wage rate (see equations (17) and (18)) and as a result the public sector employment and wage rate also increase. This has three-fold effects. Firstly, because the tax rates are exogenously set and invariant in time, the total tax revenues increase. Secondly, the public sector expenditures decrease due to a decrease in unemployment rate. On the other hand, public sector wage bill increases increasing the expenditures. Thirdly, the only "free" variable left to equate equation (15) is the debt which must increase or decreases depending on the volume of the two aforementioned effects. It turns out that an increase in tax revenue is higher than an increase in expenditure, thus, the public debt increases implying that the capitalists save more than before. These results are qualitatively in line with empirical evidence and prove the logical coherence of the model. Next we analyse two tools that a politician has in his or her toolbox, namely discrete change in public employment or public sector wage level.

5.2. Public sector employment shock

The public sector employment shock becomes effective via equation (17). A sudden increase in public employment has two-fold effects. Public employment is a positive externality in production, thus, an increase in public employment contributes to higher output (see equation (7)). On the other
hand, increase in public employment raises the private wage rate as the private sector employees’ reservation utility increases (see equations (11) and (12)). The firms adjust to the increased private sector wage rate by demanding less labour than before. In another words individual private sector workers are better off than before, but there is also less of them.

Public labour demand increases and so does the public wage rate (and individual public sector employee’s consumption). Private wage rate increases (and individual private sector employee’s consumption), but the private employment decreases. Unemployment rate increases, but the unemployment benefit is exogenous variable, thus, it remains constant. The tax revenue decreases (until the shock wears out), thus, the government must consolidate its budget which basically means a sudden decrease in the demand for new debt (remember that public debt is the only vehicle for the government to balance its budget constraint). This, in turn, lowers the interest rate in the first period after which it returns to a slightly higher level until the shock wears out.

All in all the total output decreases because, even though the public employment increases, the private employment decreases. The profitability of firms, however, increases because the private sector wage bill decreases even more than output (see equation (9)). Even though profits go up, the saving of the capitalists goes down more due to lower return to their bond investment thus depreciating their consumption. Unemployment increases making the society worse off. On the other hand, increased wage rates in the public and private sector raise the consumption of workers making them better off. These results are consistent with Finn (1998) and Cavallo (2005) although the transmission mechanism is different.

5.3. Public sector wage level shock

An unanticipated increase in public sector wage level is not qualitatively similar to an unanticipated increase in public sector employment. Actually, what we see here is the worst outcome of all the possible shocks presented in this section.

Once again a persistent shock hits the equation (18). The public sector wage bill increases thus, ceteris paribus, the public sector cuts its debt in order to keep the intertemporal budget constraint in balance. Additionally, another channel of adjustment is a decrease in public employment which also realizes. Decrease in public employment lowers the aggregate production and as a result private labour demand decreases. Once again, the representative
labour union is not happy with this and maximizes its utility (given labour demand) in such a way that the wage rate goes up which in turn decreases the private labour demand even more.

All in all, an increase in the public wage rate diminishes the private demand for labour, decreases the public labour demand and depresses the profitability of firms. Employment decreases, unemployment increases and total consumption decreases. An increase in the public sector wage rate is equivalent to the economy entering a slump.

5.4. Public Policy and Welfare

Policy evaluation in a model used in this paper is not as easy as one would expect. This is because the optimal policy rule depends crucially on what the government’s objective function is. In another words, whether the the government wishes to maximize the total welfare of the economy with certain welfare weights\footnote{For example minimizing } or whether the government places explicitly value also on the distribution of income and employment.

Henceforth we assume that the optimal government policy is determined by the median voter theorem. In another words the desired policy is one which minimizes the welfare deviations from the steady state level. In an upturn, the government strives to prevent overheating of the economy and in a downturn the government wishes to minimize the welfare losses of the median voter.

In steady state, approximately $71\%$ of the population work in the private sector, thus, the median voter is easily found. Our measure of welfare is the following:

$$MW_p^t = \sum_{t=0}^{\infty} \beta^t \{ U_p(c^p_t) - U_p(\bar{c}^p) \}, \quad (21)$$

where $U_p$ denotes the utility function of the private sector employee (median voter). Table \footnote{In addition, 14\% work in the public sector, 8\% are capitalists and the rest are unemployed.} reports the 200 period sum of percentage deviations from steady state level of welfare of a representative private sector employee in response to a TFP shock.
Table 4: Private sector employee’s welfare ($MW^p_t$) in response to a TFP shock with various policy rules

<table>
<thead>
<tr>
<th>$\rho^w$</th>
<th>$\rho^n = -1$</th>
<th>$\rho^n = 0$</th>
<th>$\rho^n = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho^w = -1$</td>
<td>0.0829</td>
<td>0.0908</td>
<td>0.1003</td>
</tr>
<tr>
<td>$\rho^w = 0$</td>
<td>0.0931</td>
<td>0.0977</td>
<td>0.1027</td>
</tr>
<tr>
<td>$\rho^w = 1$</td>
<td>0.0996</td>
<td>0.1018</td>
<td>0.1041</td>
</tr>
</tbody>
</table>

The results are clear cut. The policy determined by the median voter advises to hire more public sector employees (increase public sector wage rate) in a downturn and, on the other hand, reducing the public sector employment (cutting up the public sector wage rate) in an upturn. This is an interesting result because, as discussed in section 2, the public sector employment and wage rate have been historically procyclical rather than countercyclical. This paper advises the government to change the policy from a procyclical one into a countercyclical policy.

The recommended policy can be politically rather challenging to carry out, especially in an upturn.

6. Robustness of Results

$\eta < 0.5, \eta > 0.5, \omega = 1$.

7. Conclusions

This paper studies the applicability of public employment as a fiscal policy tool. We develop a framework in which a capitalist maximizes his or her intertemporal utility. In addition, there are government employees, private sector employees and unemployed who consume all their disposable income in each period. We parametrize the model to the US economy and obtain a number of policy recommendations for the government’s labour market policies.

According to the results of this paper, the government has an active role in the labour market. The policy recommendation is actually quite close to a one proposed by the Nobel laureate Joseph Stiglitz (cf. Stiglitz (2010) ch.

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$^9$We are located in the top left corner of table 4
3). To our knowledge, there hasn’t been a framework explicitly analyzing Stiglitz’s proportion before. This is one of the contributions of this paper.
References


Cooley


