Macroeconomic Implications of Size-Dependent Policies

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*Review of Economic Dynamics, 2008*

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9/03/2010
Motivation

- The Aim of the paper is to evaluate policy distortions that depend on establishment size (*size-dependent policies*).
- Analyze 2 types of policies:
  - Restrict production of large establishments.
  - Encourage production of small ones.
- Questions to answer:
  - How costly are these policies?
  - Impact of these policies on productivity.
  - Effects on size distribution of establishments
- Introducing distortions,
  - ↑ in the number of establishments in equilibrium.
  - ↓ in the average establishment size.
- They use this property to run the quantitative excercises.
  Policies will be such that size decreases in 10% or 20%
Background: Why is this interesting?

- Large establishments account for a disproportionate fraction of output and employment in industrialized countries.
- The size distribution differs significantly across countries of similar levels of development.
- Restrictions on size in the retail sector might be of special importance.
  - Substantial productivity growth in retail sector in the US.
  - Low productivity level of retail sector in Europe and Japan compare to the US.

Focus on 3 cases:

- Regulation of the retail sector in Japan and France.
- Employment protection in Italy.
- Subsidies for small and medium size enterprises in Korea.
Households

- Based on Lucas (1978) span-of-control framework.
- There is a single representative household who lives infinitely. Household has a continuum of members at time $t$, $L_t$. Population growth at $g_L$. Utility:

$$\sum_{t=0}^{\infty} \beta^t L_t \log \left( \frac{C_t}{L_t} \right)$$

- **Endowments** $=(z, 1, K_0)$ where $z$ are the managerial abilities with cdf $F(z)$, pdf $f(z)$ and support in $Z = [0, \bar{z}]$. 1 and $K_0$ are the endowments of time and initial capital respectively.
- Depending on $z$ each household member will be a manager or a worker.
Household selects \( \{ C_t, K_{t+1}, \hat{z}_t \}_0^\infty \) to maximize utility subject to:

\[
C_t + K_{t+1} = I_t(\hat{z}_t, W_t, R_t) L_t + R_t K_t + K_t(1 - \delta)
\]

\( K_0 > 0 \)

where \( I_t(\hat{z}_t, W_t, R_t) = W_t F(\hat{z}_t) + \int_{\hat{z}_t}^Z \pi(z, W_t, R_t) f(z) dz \) is the per-capita income from managerial and labor services.

The FOC are:

\[
\frac{1}{C_t/L_t} = \beta(1 + R_{t+1} - \delta) \frac{1}{C_{t+1}/L_{t+1}}
\]

\[
W_t = \pi(\hat{z}, W_t, R_t) f(z) dz
\]

The first equation is the standard Euler Equation. The second equation gives us the value of \( \hat{z}_t \) for which a person is indifferent between being a manager and a worker.
Firms

- The output of a manager of type $z$ is given by:
  
  $$y = z^{1-\gamma} A(g(k, n))^\gamma,$$

  where $g(k, n) = k^\nu n^{1-\nu}$. $A$ is common to all production units and its growth rate is $g_A$.

- A manager of type $z$ maximizes profits:
  
  $$\max_{n, k} [z^{1-\gamma} A(g(k, n))^\gamma - W n - R k]$$

- FOC associated with this problem are:

  $$Az^{1-\gamma} \gamma (1 - \nu) (k^\nu n^{1-\nu})^{\gamma-1} (k^\nu n^{-\nu}) = W$$

  $$Az^{1-\gamma} \gamma \nu (k^\nu n^{1-\nu})^{\gamma-1} (k^{\nu-1} n^{1-\nu}) = R$$
Equilibrium

Market clearing conditions:

\[
N^*_t = L_t \int_{\hat{z}_t}^{\bar{z}} n(z, W^*_t, R^*_t) f(z) \, dz \quad \text{where} \quad N^*_t \equiv L_t F(\hat{z}^*_t)
\]

\[
K^*_t = L_t \int_{\hat{z}_t}^{\bar{z}} k(z, W^*_t, R^*_t) f(z) \, dz
\]

\[
L_t \int_{\hat{z}_t}^{\bar{z}} y(z, W^*_t, R^*_t) f(z) \, dz = C^*_t + K^*_{t+1} - K^*_t + \delta K^*_t
\]

Definition A competitive equilibrium is a collection of sequences \( \{ C^*_t, K^*_{t+1}, W^*_t, R^*_t, \hat{z}^*_t \}_0^\infty \), such that (i) given \( \{ W^*_t, R^*_t \}_0^\infty \), the sequences \( \{ C^*_t, K^*_{t+1}, \hat{z}^*_t \}_0^\infty \) solve the household problem; (ii) the markets for capital and labor services clear for all \( t \); (iii) the market for good clears for all \( t \).
Along a competitive balanced growth path per capita consumption and output, wages and managerial profits grow at \(1 + g = \left(1 + g_A\right)^{1/(1-\gamma_v)}\), and the threshold \(\hat{z}_t^*\) is constant. Aggregate output, consumption and capital grow at \((1 + g_L)(1 + g)\).

The competitive equilibrium is unique and coincides with the Planner’s solution if there are no distortions. So any policy affecting size will be distorting.

The rental rate of capital is constant across steady states.
Calibration

They calibrate parameters in order to match observations in SS, both at the aggregate and at the cross-sectional level. They consider the US as a distortion-free economy.

Model period: One year

Stock Capital: Business equipment and structures, business inventories and business land. The flow of output consistent with this notion of capital they get it from NIPA, U.S Department of Commerce (2005).

They choose $f(z)$ and $\gamma$ so they are consistent with data on fraction of establishments at $\neq$ employment levels, and the share of total employment accounted by large establishments.

Data on establishments come from the 1997 U.S. Economic Census.

They assume that log-managerial ability is distributed according to a truncated normal distribution with mean $\mu$ and variance $\sigma^2$. 
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth rate ( (g_L) )</td>
<td>0.0110</td>
</tr>
<tr>
<td>Productivity growth rate ( (g) )</td>
<td>0.0255</td>
</tr>
<tr>
<td>Depreciation rate ( (\delta) )</td>
<td>0.040</td>
</tr>
<tr>
<td>Importance of capital ( (\nu) )</td>
<td>0.406</td>
</tr>
<tr>
<td>Returns to scale ( (\gamma) )</td>
<td>0.802</td>
</tr>
<tr>
<td>Mean log-managerial ability ( (\mu) )</td>
<td>-0.367</td>
</tr>
<tr>
<td>Dispersion in log-managerial ability ( (\sigma) )</td>
<td>2.302</td>
</tr>
<tr>
<td>Highest managerial ability level ( (z_{\text{max}}) )</td>
<td>3360.2</td>
</tr>
<tr>
<td>Mass highest managerial ability level ( (f_{\text{max}}) )</td>
<td>0.00144</td>
</tr>
<tr>
<td>Discount factor ( (\beta) )</td>
<td>0.9357</td>
</tr>
<tr>
<td>Statistic</td>
<td>Data</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Mean size</td>
<td>17.09</td>
</tr>
<tr>
<td>Aggregate capital share</td>
<td>0.317</td>
</tr>
<tr>
<td>Capital output ratio</td>
<td>2.325</td>
</tr>
<tr>
<td>% of establishments at</td>
<td></td>
</tr>
<tr>
<td>0–9 employees</td>
<td>70.7</td>
</tr>
<tr>
<td>10–19 employees</td>
<td>14.0</td>
</tr>
<tr>
<td>20–49 employees</td>
<td>9.4</td>
</tr>
<tr>
<td>50–99 employees</td>
<td>3.2</td>
</tr>
<tr>
<td>100+ employees</td>
<td>2.6</td>
</tr>
<tr>
<td>Share of employment at</td>
<td></td>
</tr>
<tr>
<td>100+ employees</td>
<td>44.95</td>
</tr>
</tbody>
</table>

*Note. This table reports the performance of the model when parameters are selected to match the reported aggregate and cross-sectional features of the data.*
Restrictions on Capital Use

- One is to tax enterprises that exceed the capital limit \( k \) level by the exceeded capital. In this case the cost of capital will be: 
  \[ Rk + R(1 + \tau)(k - k) \].

- The other is to tax the hole capital use by enterprises that exceed the capital limit \( k \). In this case the cost of capital will be: 
  \[ R(1 + \tau)k \text{ if } k > k \text{ and } R \text{ if } k < k \].

- In the first case total cost of capital is continuous and we can find thresholds for managerial ability \( z^- \) and \( z^+ \). We have 3 types of establishments: (i) Establishments with \( z \in (\hat{z}, z^-) \) are unconstrained; (ii) Establishments with \( z \in (z^-, z^+) \) have marginal product of capital between \( R \) and \( R(1 + \tau) \) and so choose \( k = k \); (iii) Establishments with \( z > z^+ \) which are large establishments.

- Results of implementing taxes on capital which restrict size can be seen in table 3.
In the process there is an increase in the number of small establishments. The ones not affected expands. Some of the large establishments will now demand $k$. Because of this there is a redistribution of production from high skill managers to low skill managers.

Finally, in the new SS the wage is lower, which decreases the incentives to work since the rent of $K$ is constant.
Discussion

What are the consequences of taxing uniformly the use of capital?

- The average size is unaffected since the tax is now paid by every establishment. As a result the tax rate to be paid is much smaller (10.2 and 5.9)

- Output effect are substantially smaller.

What is the quantitative importance of the decline in capital stock in generating large effects on output and consumption?

- In the absence of capital accumulation and associated price adjustments the resulting effects on output are much lower. Accounting for changes in the capital stock is crucial to assess the effects of restrictions on capital use.

How big are the distortions that they impose on the model in the quantitative exercises? They are not large.
**Restrictions on Labor Use**

- There is a threshold $n$ after which enterprises should start paying a tax $\tau$.
- There is a first order effect on the labor market. Establishments substitute labor for capital, while total output produced declines. The result is a decline in the eqm. wage rate across SS larger than before. This again gives incentives for changing from worker to managers.
- Output per worker fall less than in the previous case.
- Effects on aggregate output are smaller.
- This policy is less costly than the one that restricts capital.
Table 6
Size-dependent restrictions on labor use

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Benchmark</th>
<th>10% Reduction in average size</th>
<th>20% Reduction in average size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggr. output</td>
<td>100.00</td>
<td>99.89</td>
<td>99.47</td>
</tr>
<tr>
<td>Capital</td>
<td>100.00</td>
<td>99.89</td>
<td>99.47</td>
</tr>
<tr>
<td>Consumption</td>
<td>100.00</td>
<td>99.89</td>
<td>99.47</td>
</tr>
<tr>
<td>Output per worker</td>
<td>100.00</td>
<td>97.52</td>
<td>94.74</td>
</tr>
<tr>
<td>Output per establishment</td>
<td>100.00</td>
<td>90.59</td>
<td>94.74</td>
</tr>
<tr>
<td>Output per efficiency units</td>
<td>100.00</td>
<td>98.67</td>
<td>96.89</td>
</tr>
<tr>
<td>Average managerial quality</td>
<td>100.00</td>
<td>91.95</td>
<td>83.38</td>
</tr>
<tr>
<td>Number of establishments</td>
<td>100.00</td>
<td>110.31</td>
<td>123.51</td>
</tr>
<tr>
<td>Median size</td>
<td>5.25</td>
<td>5.33</td>
<td>5.38</td>
</tr>
<tr>
<td>Coefficient of variation</td>
<td>2.74</td>
<td>2.67</td>
<td>2.53</td>
</tr>
<tr>
<td>Implicit tax (%)</td>
<td>–</td>
<td>5.87</td>
<td>13.76</td>
</tr>
<tr>
<td>Welfare (%)</td>
<td>–</td>
<td>0.08</td>
<td>0.43</td>
</tr>
</tbody>
</table>
Cross-Country Differences in Size

Figure 4. Restrictions on capital (a) and labor (b) use.
Size-Dependent Subsidies

They consider subsidies to the use of capital. If an establishment uses $k \leq k_0$ the cost per unit of capital is $R(1 - s)$, whereas if $k > k_0$ the cost is $R$.

Subsidies are finance with a consumption tax.

This policy directly increases the returns to operate small establishments $\Rightarrow \uparrow K^d, \uparrow N^d, \downarrow N^o$. This leads in the SS to a higher wage rate and lower output of large establishments.

Net result: Lower output and constant capital stock across SS. Also consumption falls. Output per worker increases, but the other productivity meausures fall.

The number of small establishments increases across SS and the number of large establishments decreases.

Welfare cost are non-trivial (0.63% and 1.8%)
Conclusions

- Restrictions on capital are more costly in terms of welfare than restrictions on labor but less costly than size-dependent subsidies.
- The three policies bring welfare costs.
- In the 3 cases the number of small establishments increases while the number of large establishments decreases.
- With capital and labor restrictions the median size increases while with size-dependent subsidies the median size decreases.