Employment Protection, Exit, and Macroeconomic Dynamics

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Abstract

The literature on employment protection has largely ignored the influence that such policies may have on macroeconomic dynamics. Also, the manner in which exit has been modelled heretofore may understate the effects of these policies. Finally, industrial subsidies to failing plants have largely been ignored as an important element of employment protection.

To address these issues, I develop a general equilibrium model with close attention to the quantitative importance of the exit margin, and ask whether economies with different levels of employment protection respond differently to shocks.

I find that steady-state policy analysis is adequate to capture the main welfare effects of these policies. Period length and the approach to exit are found to be important determinants of steady-state effects of dismissal costs.

Dismissal costs are found to smooth the economy's response to productivity shocks. Interestingly, this effect is irrespective of whether these shocks are positive or negative. Industrial subsidies, however, have no effect on short run macroeconomic dynamics. The exit margin is found *not* to be important for the dynamic behavior of the economy, even when changes in the determinants of exit are themselves part of the shock.

JEL Codes: E32, J63, L51

1 Introduction

There is an extensive literature that measures the welfare and effects of various regulatory policies, such as employment protection[1] and product market regulation[2]. The computational branch of this literature tends to measure the effects of these policies in steady state. However, the rationale for these policies presumably follows at least in part from their effects on the dynamic behavior of economies. This is the question I address herein.

[1] See for example Lazear (1990), Hopenhayn and Rogerson (1993) and Samaniego (2002).
[2] See Bertrand and Kramarz (2002), Ebell and Haefke (2003).

I develop a general equilibrium environment with heterogeneous establishments, and ask whether the economy behaves differently depending on the policies instituted.

A full stochastic business cycle model is computationally burdensome, especially since the model entails an elevated level of dimensionality. Hence, I instead focus on the shape of impulse response functions (IRFs). The IRFs of a model with heterogeneous establishments is of interest in its own right, and a valuable extension would be precisely to investigate its behavior in a stochastic environment. Campbell (1998) goes some way towards doing this, but – except for entry and exit – his IRFs are unrealistic, and he does not consider policy. Moreover, the IRF contains sufficient information to answer the question at hand.

I focus on two types of policy: dismissal costs and industrial subsidies. The former has recieved much attention in the literature, whereas the latter has not. As Leonard and Van Audenrode (1996) note, this is all the more puzzling considering that subsidies of various sorts to failing firms are at least as common a form of employment protection in Europe as dismissal costs. Samaniego (2002) finds that industrial subsidies of various forms can have significant effects on macroeconomic patterns of technical diffusion.

An important element of the model that sets it apart from the related literature is the approach to the exit margin. Related models in which exit is endogenous generally entail too much exit among the young, so that exit is not an important factor for older establishment dynamics. However, to the extent that exit is responsible for job destruction, penalties on job destruction will affect exit decisions and hence labor dynamics along transitions. Here, the exit margin will play an important role in calibration. I find that the costs of various policies are very sensitive to the manner in which exit is approached.

Section 2 outlines the structure of the model economy. Section 3 defines the equilibrium concept for the economy and discusses the calibration procedure. Section 4 compares the steady state response of the model economy in the face of dismissal costs to that of related papers. Section 5 follows by examining the IRFs after a shock for different policy regimes. Section 6 offers some empirical support for the predictions of the model. Section **??** repeats the experiment for industrial subsidies to failing establishments. Section 8 concludes.

2 Model Economy

2.1 Establishments

There is a continuum of heterogeneous plants of endogenous mass that course through discrete time. The productivity of a plant is stochastic, and varies across plants. Heuristically, an existing plant has two decisions to make:

1. how much labor to hire
2. whether or not to leave the market, an event denoted “exit”.

2.1.1 Output

At any point in time t a plant is characterized by an idiosyncratic productivity shock z_t, its capital input k_t and its labor input n_t. There is also an aggregate productivity shock s_t which is common across establishments. Its production function is

$$\gamma^t s_t z_t k_t^\alpha n_t^\beta$$

where $\gamma - 1$ is the exogenous rate of productivity growth. Idiosyncratic shocks follow a Markov process defined by $f(z_{t+1}|z_t)$. When born, the initial shock is drawn from a distribution $\psi(z)$. μ_t denotes the measure over individual establishment states at time t. It serves as one of the components of the aggregate state of the economy. The other will be the aggregate capital stock K_t.[3] The aggregate state will then be $x_t = \{K_t, \mu_t, s_t\}$. Let Γ be the law of motion for x_t, so that $x_{t+1} = \Gamma(x_t)$, the only stochastic element of which is that which relates to s_t.

The plant pays a wage $w(x_t)$ for each unit of labor that it hires, and $r(x_t)$ is the rental rate of capital. In the current model, $\alpha + \beta \leq 1$, so that equity-holders may earn positive income from the establishment.

2.1.2 Entry and the Managerial good

Households have access to a technology that produces an intermediate (managerial or entrepreneurial) good, with labor as its input. One unit of this good may be used to create a new establishment. It also has other uses that will be described in brief.

If a household spends m_t hours producing the managerial good, the resulting output of the intermediate good is given by a production function $A(m_t)$. Its price is $p(x_t)$

2.1.3 Exit

Every period, establishments are subject to a number of possible, mutually exclusive shocks aside from their productivity shock. These are uncertain payments that it must make that are not directly related to productivity itself, including any fixed costs of operation, lawsuits, etc. I refer to these shocks as "continuation shocks". Payments all involve purchasing an appropriate number of units of the intermediate good.

There is a set $\Phi \subset \mathbb{R}^+$ of possible such payments[4]. Let J be the number of elements of Φ, so that any particular payment value ϕ_j is indexed by $j < J$, so that $i < j \Rightarrow \phi_i < \phi_j$. To each shock value ϕ_j is associated a probability

[3] In principle there could be a non-degenerate distribution of capital across otherwise identical establishment. However, without frictions in the market for capital, this will not be an issue.

[4] Equal payments can without loss of generality be considered realizations of the same shock.

λ_j, where $\sum_{\phi_j \in \Phi} \lambda_j = 1$. The cost is paid in terms of the managerial good.[5] Thus, the inputs used to establish them are the same as those used to keep them running, as in Samaniego (2002).

At the begining of each period, before the realization of (s_t, z_t), an establishment draws some ϕ_j from Φ, and must pay $\phi_j p(x_t)$ in order to continue in operation – where draws are independently distributed across establishments and over time. Establishments whose continuation value is lower than $\phi_j p(\mu_t)$ may optimally choose to exit.

Again, there are many interpretations of the continuation shock. It could be a lawsuit, requiring the payment of lawyer's fees. It could also be a reorganization shock – accumulated organizational capital in the relevant industry could have become obsolete due to qualitative changes in technology, and payments to consultants are necessary for its implementation (see Samaniego (2002)).

The current framework is capable of absorbing the main alternatives as special cases. For instance, models with heterogeneous plants and endogenous exit tend to assume that there is a per-period cost to remaining in operation. In the present framework, this is equivalent to picking only one value for ϕ that occurs with certainty $(J = 1, \phi_1 < \infty, \lambda_1 = 1)$. However, the disadvantage of this structure is that exit is highly concentrated among the youngest establishments.

When the model is quarterly, as this one is, the implied differences between model behavior and the data are significant,[6] leading papers using quarterly periods such as Veracierto (1999) to impose the exogeneity of establishment exit. This is equivalent to setting $J = 1, \phi_1 = \infty, \lambda_1 < 1$. However, when the endogenous response of exit rates may be an important determinant of aggregate dynamics, exogeneity is restrictive.

Allowing $J > 1$ and $\sum_{\phi_j \in \Phi} \lambda_j \leq 1$. to differ from one and to be determined internally via calibration will allow us to allocate to some extent a differring role of exit in job destruction over time. In particular, it may be that ϕ_J is so costly that no firm regardless of productivity can survive. To the extent that exit is driven by such shocks, job destruction on the exit margin will not be directly affected by the firing tax. To the extent that it is driven by smaller shocks, it may.

The value function of the model economy is

$$V(z_t, x_t, t) = \max_{k_t, n_t} \left\{ \gamma^t s_t z_t k^\alpha n_t^\beta - w(x_t) n_t - r(x_t) k_t + \frac{1}{1+i} C(z_t, x_t, t) \right\}$$

where $C(z_t, s_t, \mu_t, K_t)$ is the expected continuation value of the firm, given by

$$C(z_t, x_t, t) = \sum_{\phi_j \in \Phi} \max \left\{ 0, \int \int V(z_{t+1}, x_{t+1}, t+1) \, dF_z(z_{t+1} | z_t) \, dF_s(s_{t+1} | s_t) - \phi_j \right\}$$

[5] The role of the intermediate good in the model is to ensure that payments increase geometrically along a balanced growth path. Other models either impose exogenous exit or imply that costs such as ϕ increase exogenously. The former does not account adequately for differential hazard rates among cohorts. The latter lacks an economic foundation.

[6] For example, almost all exit should occur within the first quarter of establishment life.

2.2 Households

There is a $[0,1]$ continuum of infinitely lived households. Preferences over streams of consumption $\{c_t\}_{t=0}^{\infty}$ and leisure $\{l_t\}_{t=0}^{\infty}$ take the form

$$
\begin{aligned}
& E\sum_{t=0}^{\infty}\eta^t\left\{\ln c_t + L(l_t)\right\} \\
l_t &\in [0,\xi], c_t \geq 0 \forall t
\end{aligned}
$$

where ξ is their individual per period time endowment.

Households are involved in several activities. They supply time in the form of labor to a competitive market, and spend additional time creating the managerial good as above, which also trades on a competitive market. Finally, using the income they derive from the above activities and the assets they already own, they purchase new assets (plants) and consumption goods. The price of the consumer good is normalized to equal one in each period. The per-period household budget constraint then becomes:

$$
\begin{aligned}
c_t + \iota_t + p(\mu_t)e_t &\leq \Pi(\mu_t,\chi_t,t) + w(\mu_t)h_t + p(\mu_t)A(m_t) + r(\mu_t)k_t \qquad (1) \\
k_{t+1} &\leq \iota_t + (1-\delta)\,k_t
\end{aligned}
$$

where

$$
\begin{aligned}
c_t &= \text{consumption} \\
\iota_i &= \text{investment} \\
k_t &= \text{household capital} \\
m_t &= \text{hours spent creating the managerial good} \\
h_t &= \text{hours spent working} \\
\Pi(\mu_t,\chi_t,t) &= \text{income from currently owned equity} \\
\chi_t &= \text{measure of household's portfolio of equity} \\
e_t &= \text{purchases of new equity}
\end{aligned}
$$

Symmetry of ownership across households is assumed[7].

There is an institutionally determined work week of length 1, so that all agents are either working time 1 or not working at all. Perfect unemployment insurance is assumed to be available[8]. This enables a recursive representation

[7] Since at the time of asset purchase a household cannot tell what its realized dividends will be, symmetry is a natural assumption. Moreover, consumer heterogeneity is not the focus of study.

[8] See Rogerson (1988) and Hansen (1985). This parsomonious formulation is consistent with values of the aggregate elasticity of intertemporal substitution of leisure that yield realistic labor dynamics in real business cycle models.

the household's utility function in the following manner, for a constant $\widehat{L} = L(\eta) - L(\eta - 1)$.

$$E \sum_{t=0}^{\infty} \eta^t \left\{ \ln c_t - \widehat{L}(h_t + m_t) \right\} \tag{2}$$

This allows the identification of $h_t + m_t$ as total employment. The fact that agents must be indifferent between labor and entrepreneurialism in equilibrium will play the role of a free-entry condition. Let W be the appropriately specified value function, maximizing the recursive form of equation (2) subject to constraint (1) with the appropriate laws of motion.

If E_t is the mass of plants established in period t, then market clearing requires that

$$E_t + \sum_{j \le J} \phi_j \lambda_j \int \left(1 - X\left(j, z_{t-1}, x_{t-1}\right)\right) d\mu_{t-1} \le A(m_t)$$

where $X\left(j, z_{t-1}, x_{t-1}\right)$ is the establishment's optimal exit rule assuming that it recieves shock j and has yet to observe (s_t, z_t).

3 Equilibrium

3.1 Balanced Growth

As specified, the economy is non-stationary due to the presence of exogenous growth. However, there exists a deflation of the economy a-la King, Plosser and Rebelo (1987) that allows the application of standard recursive solution methods[9]. The paper will focus on a balanced growth path in which there exist values of entry and labor inputs that remain constant, and values of w and p that increase by a factor $\gamma^{\frac{1}{1-\alpha}}$ over time. Hence, we can redefine the variables in question with respect this path.

Equilibrium is defined as a list of price functions, value functions and a law of motion for the measure that involve markets clearing at all dates, the value functions being solved given the price functions, and the l.

3.2 Calibration

Since we will be interested in transition dynamics of shocks of more or less business cycle frequencies, the period length is quarterly. For the experiments involving employment protection, labor is a state variable for the establishments: hence, I allow labor to be drawn from a grid of 400 values. The undistorted economy behaves the same regardless of whether this value is 200, 400 or 2000.

η is chosen to yield an annual interest rate of 4%, which is common in the real business cycle literature. Factor shares α and β are taken from the NIPA accounts. The value for β chosen is an intermediate value among those

[9]See King, Plosser and Rebelo (1987) and Stokey and Lucas (1989).

measured. The value of α assumes that 12% of GDP goes as direct profits to owners, and this is approximately what we observe adding profits, dividends and interest income in the National Income and Product Accounts. Depreciation δ is computed from the first order conditions using the equation

$$\delta = K/I + 1 - \gamma$$

The values used are drawn from Veracierto (1999).[10]

The disultility of labor $\widehat{L}$ was chosen so that employment was approximately 80%. The functional for for the managerial good is $A(x) = x^{\zeta}$. The value of ζ chosen leaves 1.25% of employment in the managerial form[11]. Values between 0.2 and 0.05 yield similar results.

The shocks z were taken over a grid of 30 points. Given a particular grid, multiplying it by any factor affects only the size and not the relative composition of the economy, so all that matters are the upper and lower bounds. The upper value was chosen to be one. The lower value was some number $\underline{z} < 1$.

The functional form for f is $\ln z_{t+1} = \nu + \rho \ln z_t + \varepsilon_{t+1}$, where $\varepsilon_t\tilde{}N(0, \sigma^2)$. First, note that ν is overspecified and cannot be pinned down, amounting to another normalization on the size of the economy. Hence, ν is chosen implicitly by the choice of the grid over shock values and the other parameters. Again, values for z are drawn from a grid over $[\underline{z}, 1]$, yielding $\nu = (1-\rho)E[\log z]$ =-0.0015, where the expectation is with respect to the stationary distribution of f.

Finally, ψ is chosen as a uniform distribution over the lower portion of the grid.

What about exit? I choose $J = 3$, $\Phi = \{0, \phi_1, \phi_2\}$. It is assumed, as noted, that ϕ_2 is so high that establishments do not survive it, so it is ignored for now until the section on industrial subsidies.

It happens that ρ^T will be the autocorrelation of the size of surviving establishments after T quarters. The Census of Manufactures yields $\rho^{20} = 0.93$, which pins down ρ.

The remaining six variables are chosen using an algorithm related to simulated annealing, trying to match certain statistics of the size-age distribution of plants. These variables are $\phi_1, \lambda_1, \lambda_2, \sigma, \bar{\psi}$ and $\underline{z}$. The statistics were

1. The 5-year exit rate
2. The 5-year exit rate of establishments aged 6 years or less
3. The proportion of establishments aged 6 or less under a certain size

[10] That paper works with annual data. One can proceed as follows. First, compute annuall depreciation via

$$\delta_{annual} = K/I + 1 - \gamma_{annual}$$

Then, for a quarterly figure,

$$\delta = 1 - (1 - \delta_{annual})^{\frac{1}{4}}$$

[11] Veracierto (1999) finds that a small value of ζ is necessary to generate realistic fluctuations at business cycle frequencies.

Parameter	Value
η	0.9952
α	0.25
β	0.63
δ	0.0143
$\underline{z}$	0.3215
ρ	0.9964
σ	0.0234
ψ	0.6491
λ_2	0.0119
λ_1	0.0161
ϕ_1	3.4345
ζ	0.1
$\widehat{L}$	1.0756

Table 1: Parameters used in Calibration

4. The proportion of employment that undergoes job creation in each quarter
5. The proportion of job creation due to birth
6. The proportion of job destruction due to exit

These statistics were chosen to ensure that there was a reasonable link between plant dynamics and job flows.

Table (1) lists the resulting parameter values. Table (2) displays the steady-state statistics displayed by the model economy. The matches are generally quite good. In particular, even though over slightly over half of all exit can be attributed to endogenous factors, the difference in exit rates between cohorts is about 3%, as it is in the data. I regard this as a success of the model in yielding more realistic dynamic behavior at the establishment level, particularly across cohorts. For example, the canonical Hopenhayn and Rogerson (1993) model displays a 64% hazard rate for young plants. The extent of exit due to shocks that are small enough that at least *some* establishments would survive them in steady state is almost exactly 50%.

4 Dismissal Costs

To be able to talk about dismissal costs, I modify the firm's value function. There is a firing tax that is equivalent to τ periods. The value functions must be modified as follows:

$$\begin{aligned} V\left(n_{t-1}, z_t, x_t\right) &= \max_{k_t, n_t} \Big\{ s_t z_t k^{\alpha} n_t^{\beta} - w\left(x_t\right) n_t - r\left(x_t\right) k_t \\ &\quad - \tau w\left(x_t\right) \max\left\{0, n_{t-1} - n_t\right\} + \eta C\left(z_t, x_t\right) \Big\} \end{aligned}$$

Statistic	US Data	Model Economy
Exit	36%	38%
Exit 0-6	39%	41%
Size 0-6	74%	71%
JC/Emp	5%	7%
JC Birth	8%	6%
JD exit	12%	15%
Emp	80%	80%
"Endog exit"	-	50.1%

Table 2: Sample Statistics

Statistic	**H-R Model**	**Veracierto**	**Current Economy**
Employment	-2.5%	-7.9%	-11.2%
Consumption	-4.6%	-6.0%	-10.0%
Output	-4.6%	-7.9%	-20.3%
CompVar	2.4%	2.9%	1.4%
New firm value	-	-	-9.7%
Establishments	-	-	-23.8%
Managers	-	-	-4.9%
Payments	-	-	+22.2%
Exit	-	-	-3.8%

Table 3: Table CaptionProtectionpolicy

$$C\left(z_t, x_t\right) = \sum_{\phi_j \in \Phi} \max \left\{ -\tau w\left(x_t\right) n_t, \int \int V\left(z_{t+1}, x_{t+1}\right) dF_z\left(z_{t+1}|z_t\right) dF_s\left(s_{t+1}|s_t\right) - \phi_j \right\}$$

The measure μ_t must also be defined over n_{t-1} now.

We will proceed in several steps.

1. First, we compare the behavior of the model under employment protection policies such as those contemplated previously in the computational literature.
2. Second, we study the IRF of the model when there is no heterogeneity, as a benchmark.
3. Third, we look at the IRF of the model with heterogeneity
4. Fourth, we examine the IRF of the model under employment protection.

In what follows, I refer to an economy in which employment protection is set to one year's wage payments ($\tau = 4$). This is the benchmark used in the literature, and is regarded as being within empirically relevant bounds although probably towards the high end.

The behavior of the model is qualitatively the same as that of Hopenhayn and Rogerson (1993). However, quantitively speaking, it is quite different.

The model differs in five important ways from Hopenhayn and Rogerson (1993). One is the manner in which exit is modelled. Another is the inclusion of an intensive margin for capital. The third is the fact that the grid of shocks is much finer. The fourth is the quarterly period length. The fifth is entry structure.

To find the source of this behavior, I recalibrated the model and ran experiments in which I removed each of these features. These results are reported in Table (**??**).

Model A is a version of the current model, but without capital nor endogenous exit. This is equivalent to the H-R setup which, although it has endogenous exit, exit is not an important margin of adjustment, either because of the manner in which exit is formulated or due to the fact that there are only 10 shock values. The compensating variation is about the same, but the response of the economy is larger. Model B has capital but no endogenous exit. The column labelled "Veracierto" posts the results of Veracierto (1999), which studies a model equivalent to Model B but with only 9 shock values[12]. The behavior of all three models is similar.

The final column, Model C, is the full model presented herein. the response of output is particularly strong compared to the other two. This is due to a large decrease in the number of operating establishments, survivors being larger and more long-lived.

Finally, the model differs from the H-R setup in that the indifference condition on entry involves a concave production function (equivalently, a convex cost function) rather than a linear cost function. Samaniego (2002) presents a quinquennial vintage capital model that has the current entry structure but which reduces to the H-R setup otherwise if the embodiment parameter is set to zero. The quantitative behavior of that model is very close to that of the H-R model.

To conclude, quarterly models appear to produce a much larger response to employment protection policies. Moreover, the exit margin appears to be crucial to the response of the economy to dismissal taxes. The reason for the former is presumably that quarterly models entail more small negative idiosyncratic shocks over time that are discounted less heavily than if nothing happened for 5 years.

Although entry decreases substantially, the resources spent on managerial work do not decrease as much. This is because payments to keep establishments in operation have increased, since the cost of firing the workforce and shutting down is higher with the tax.

[12] The entry structure is the same as here.

Statistic	Model A	Model B	Veracierto	Model C
Employment	-6.2%	-8.1%	-7.9%	-11.2%
Consumption	-6.9%	-8.4%	-6.0%	-10.0%
Output	-6.9%	-8.3%	-7.9%	-20.3%
CompVar	2.6%	2.1	2.9%	1.4%
Exit	0%	0%	0%	-3.8%

Table 4: Table Captionof Different Modelspolicy2

5 Impulse Response Functions

In order to compare the dynamic behavior of economies with different levels of employment protection, we subject them to shock. We study the behavior of the model economies after a persistent productivity shock of business cycle magnitude.

To be precise, suppose that s_t follows a stochastic process given by

$$\begin{aligned} s_{t+1} &= s_t^{\rho} e^{\varepsilon_t} \\ & \varepsilon_t \tilde{} N(0, \sigma_\varepsilon^2) \end{aligned}$$

I impose $\varepsilon_0 = 2\sigma_\varepsilon$, $\varepsilon_t = 0$ for $t > 0$, and apply no further shocks to the economy. This will yield a relatively large yet not unreasonably sized shock. The impulse response function thus generated is our object of study. As in Cooley and Prescott (1995), I set $\rho = 0.95, \sigma_\varepsilon = 0.007$. In the Figures below, the upper graph compares the two economies for a positive shock of two standard deviations, whereas the lower graph plots a negative shock of similar magnitude.

The results are quite striking. Figure (1) shows quite clearly that employment protection policies act quite effectively as automatic stabilizers. The maximum deviation from initial GDP in the benchmark economy after the shock is 2.6%, whereas it is about 1.8% for the distorted economy.

Interestingly, this is irrespective of whether the shock is positive or negative. Since dismissal costs operate on the exit margin, one would presume that they would have a larger impact in negative shocks.

This appears not to be the case. In fact, Figures (2) and (3) show that, althogh exit rates do respond to shocks, their response is very small.

It is interesting to note that, for a positive shock, the reaction of exit is delayed in the case of the distorted economy. It is also interesting that, in both cases, exit decreases initially, and then *increases*. This is due to consumption-smoothing.

In the face of a negative shock, behavior is quite different. In both cases there is an initial increase in exit rates, followed by a decrease. However, this decrease is much more prolonged in the case of the distorted economy.Nonetheless, the exit margin is quantitatively not important. Hence,the smoothing effect appears to be due to the fact that firms that do *not* exit are not very responsive to changes in productivity – as is visible in Figure (7). This is in spite of the fact

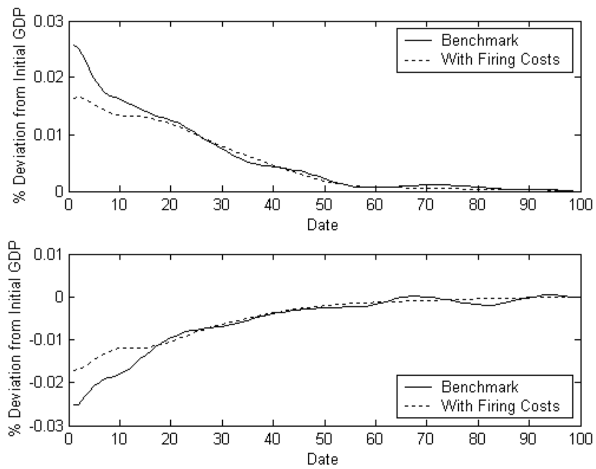

Figure 1: Deviations from Initial GDP

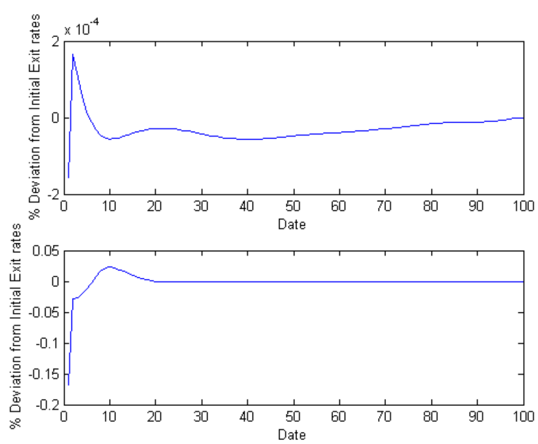

Figure 2: Exit rates, Positive shock

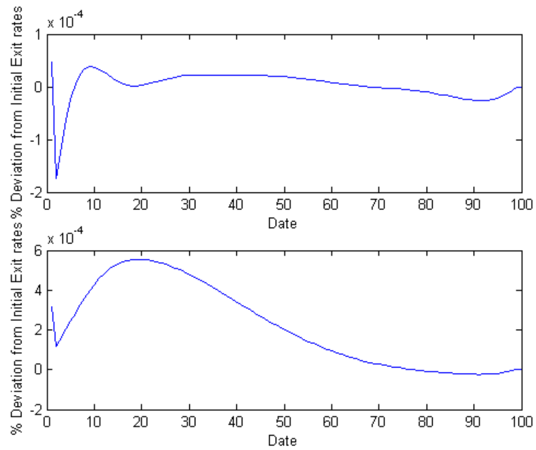

Figure 3: Exit rates, Negative Shock

that the exit margin plays a large role in the steady-state costs of dismissal costs.

Thus, it can be concluded that the stabilizing role of dismissal costs stems from the fact that it simply reduces the extent to which establishments adjust their employment in the face of any shocks, be they macroeconomic or idiosyncratic.

To assess the robustness of this conclusion, I repeated the same experiment with a simultaneous increase in λ_2. In other words, the productivity shock coincides with an "exit shock" so that the rate at which plants become unprofitable increases to coincide with the productivity shock. This shock is set so that the exit rate doubles in the face of a negative shock. The persistence of this shock is set to about 0.6, which is the persistence of exit rates displayed in the Longtitudinal Research Database. The IRF of output is essentially identical.

6 Empirical Predictions

There are two ways of looking for empirical evidence on cross-country differences in fluctuation amplitude. First, Cogley (1990) finds that, among a selection of OECD countries, fluctuations associated with business-cycle frequencies are generally smoother in countries other than the US. Since the US is on the low end of employment protection, this is consistent with the results presented above.

Second, there is some evidence of asymmetry in time series, but much of it concentrates on US data rather than cross-country comparisons – see for example McQueen and Thorley (1993). A notable exception is Bradley and Jansen (2000); they find evidence that, in some countries, economic growth tends to accelerate after recessions more than it decelerates after booms.

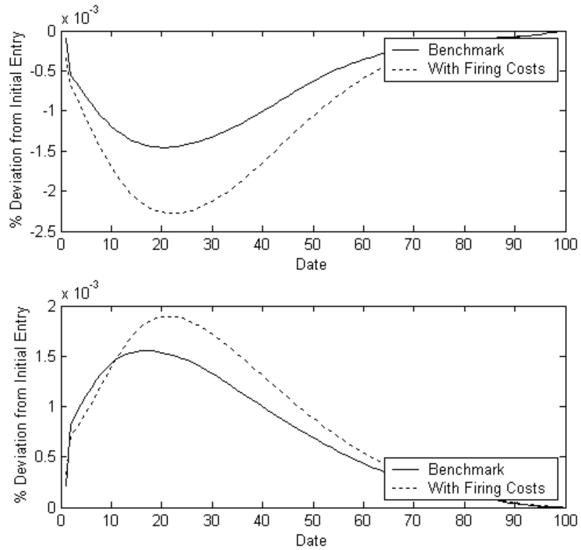

Figure 4: Entry in Transition

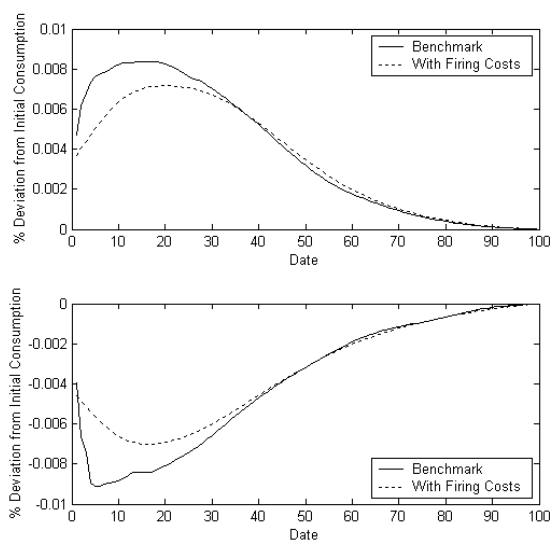

Figure 5:

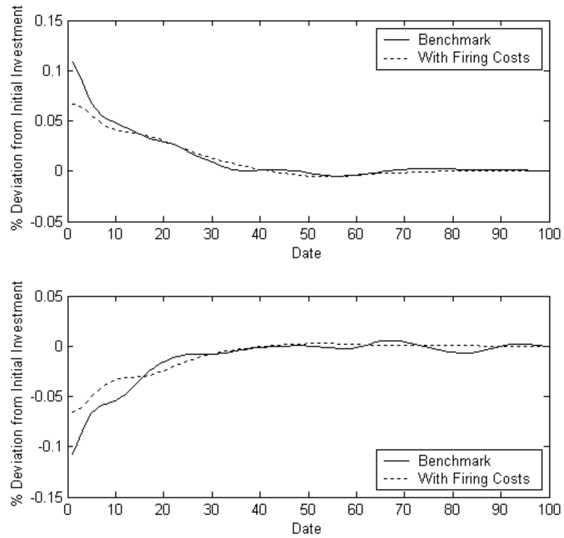

Figure 6:

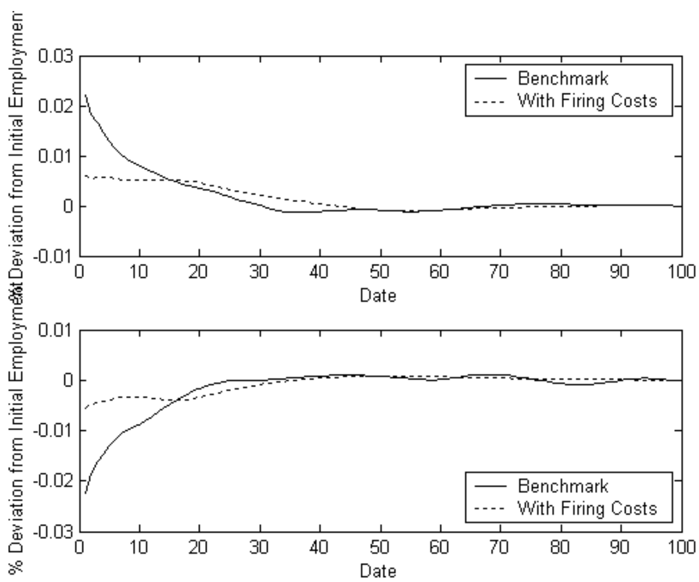

Figure 7: Employmenet changes

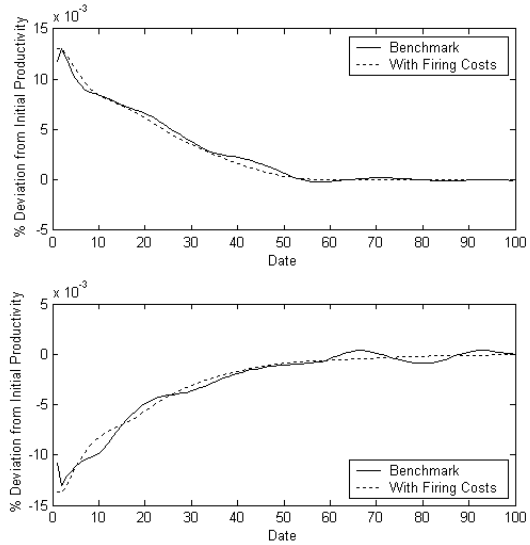

Figure 8:

Suppose that the nature of most shocks is common across countries, and that these asymmetric impulse response functions are due to the fact that shocks are – by nature – asymmetric. In that case, this effect will be most pronounced in countries in which employment protection is *weak*. To the extent that employment protection is in place, troughs should be ironed out, recessions should be less steep and hence there would be less room for an accelerated recovery. To the extent that there is noise in the data, evidence of asymmetry should be most clear in countries in which employment protection is low.

Figure (9) plots an index of dismissal costs[13] against whether or not non-linearity of this type was detected at a significant level – where a value of 1 is a positive answer, whereas 0 is negative.[14] The procedure used is the CDR ("current depth of the recession") model developed in Beaudry and Koop (1993). Although there is not enough data to draw strong conclusions, the Figure does suggest that asymmetry is wealky associated with dismissal costs. The mean dismissal cost for symmetric and asymmetric groups are 1.66 and 2.14 respectively.

[13] See Nicoletti et al (1999).

[14] The included countries are those mentioned in both papers. The countries that display asymmetry are (in order of increasing dismissal costs): US, France, Germany, Sweden and Japan. It is worth noting that Japanese data only indicate non-linearity when the model includes a structural break in 1974:1. Excluding Japan makes the plot even more suggestive.

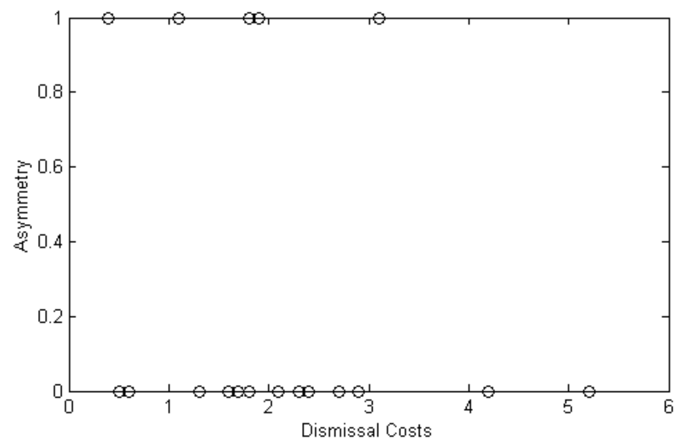

Figure 9: Dismissal costs and asymmetry in cross-country data.

7 Industrial Subsidies

This section studies the long run and dynamic effects of industrial support. Any meaningful policy experiment must focus on policies that are empirically relevant, requiring the consideration of three issues:

1. First, policy heterogeneity. The magnitude and form of industry support varies greatly across location and - to a lesser extent - across time. Ford and Suyker (1989) report that over the 1970s and 80s direct industrial subsidies varied from 0.5% of GDP in the US to 7.4% in Sweden. Using a broader definition to include tax concessions and subsidized loans, they report that the subsidy rate in the EEC (now EU) averaged 8.6% of industrial GDP over the 1980s. However, the relative prevalence of industrial subsidies and government ownership of plants in many European countries compared to the bulk of their OECD counterparts over the past 3 decades - particularly the United States - is clear. Although the regulatory climate is changing, such practices remained common well into the 1990s in Europe but were almost non-existent in the US. For this reason, the paper concentrates on industrial subsidies as were common in Europe in recent decades.

2. Second, the identification of the beneficiaries of these policies. The literature on European industrial support tends to describe its beneficiaries as "failing firms" or "failing plants", defined as firms or plants in industries that are "declining"[15]. Some of these funds were industry-specific and some general. Hence, in the context of a model, it is important to articulate a sensible notion of a "failing plant."

[15] See Leonard and Von Audenrode (1988), Ford and Suyker (1989) and OECD (1996).

These policies are, hence, along the lines of "too big to fail" policies. I implement them in the following manner. There is a clear definition in the present model of what it means for a plant to be "failing": it's expected continuation value as a firm is lower than its outside option. A "minimal subsidy" to a failing plant thus constitutes a transfer that is able to compensate for this deficiency in the continuation value.

This requires putting a value of ϕ^2. I set it so that it equals the value of the most productive plant in the undistorted economy plus 0.01%.

In order to articulate the notion of industrial income subsidies, the following scenario is envisioned. All plants are subject to a tax τ on revenue. The proceeds are distributed via a lump sum that covers the profit shortfall across failing plants with a certain probability.

This mimics Belgian industrial transfers as described in Leonard and Van Audenrode (1993), except in that measured industrial subsidies and taxes tended to be progressive.

Parameter τ is set so that the government balances its budget in every period, and gross redistribution amounts to 2% of GDP. The EEC average of gross industrial transfers in the 1980s was over 8%, but the proportion earmarked for direct income support was smaller - $\frac{2}{3}$, in the case of Belgium, the best documented case, and slightly more on average in the EEC[16]. Hence 2% is a conservative number.

Observe that all transfers are *between plants*. This feature, and budget balance, are in keeping with Leonard and Van Audenrode (1993) who note that, in most Western European countries, *net* transfers to corporations were close to zero.

7.1 Interim results

The results find that "too big to fail" industrial subsidies have huge steady state effects. Employment is negligibly affected. However, steady state consumption decreases by about 10%. Hence the welfare impact is larger than that of employment protection. This is significant since the level of industrial transfers is conservative, whereas that of employment protection is relatively high.

Interestingly, the dynamic response of the economy to productivity shocks is almost exactly the same as that of an undistorted economy. This is true for output, employment, productivity, etc. This suggests that these subsidies do not have any important effects on employment regardless of one's timeframe.

[16] See Murphy and Pretschker (1998).

8 Conclusion

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A Simulation Procedure

The simulation procedure will be as follows. Suppose that $t = 0$ is the date of shock impact. μ_0 and k_0 will equal their steady state values. After a shock, the aggregate state variable and hence value functions will eventually deviate negligibly from their steady state values after $\widehat{T}$ periods. Given a wage stream $\{w_t\}_{t=0}^{\widehat{T}}$, we can compute $\{r_t\}_{t=0}^{\widehat{T}}$ using the first order condition[17] $r_{t+1} = \frac{\gamma w_{t+1}}{\eta w_t} + \delta - 1$ and values for the value function back to $t = 0$. This yields decision rules, which in turn can be used to compute $\{\mu_t, k_t\}_{t=1}^{\widehat{T}}$. Labor demand and supply can be computed on the assumption that the capital market clears, and wages adjusted by decreasing or increasing them depending on whether there was excess demand or supply, until the labor markets cleared also. Note that there are no approximations: the computed transition path is exact.

Convergence is a problem with a complex model such as this one. Wages at different dates may converge at different rates, and the fact that a market clearing on one date depends on what is happening at other dates means that the economy gets stuck with oscillatory behavior that is not an equilibrium.

The way this was solved was by allowing wages at a particular date to adjust to clear the spot labor market, and filtering the resultant series so that the next iteration's wage stream is smooth. One approach to this is to choose a functional form for the wage stream: however, the non-linearities inherent in the model imply that this is potentially restrictive. Instead, what I did was to smooth the wage stream and some of the other streams of variables (such as interest rates, capital stocks and entry) at each iteration. At the end, I compared the streamed series with the one predicted by the model at the converged wage stream. They all deviated negligibly from their predicted values – for example, the maximum deviation between the smoothed interest rate and that predicted exactly by the wage stream was 0.2%.

The smoothing method used was the application of the Hodrick-Prescott filter, for which there are readily-available subroutines. An issue was the choice of smoothing parameter. Trial and error is the only guide here, since the use of the filter has nothing to do with the statistical properties of the filter or the series: it is simply an aid in the solution algorithm. As such, the only dangers are that the parameter be too small to make any difference, or so high that convergence is never achieved because the wage stream is too "flat". The number 100 was found to be adequate[18].

[17] There remains the problem of solving for r_0. It is simply adjusted independently to ensure that the market for capital clears.

[18] In reality, this number is imprecise over the first 10-15 periods due to "too much smoothing". However, lower values had trouble converging. Hence, the final few steps were done by manually adjusting the wage stream to achieve convergence.

In complex models of this type, especially those with endogenous exit, smoothing along the path is a reasonable solution strategy. The H-P filter is a good candidate, since it imposes no a-priori structure on the dynamics, allowing the model to speak for itself. I am not aware of this approach having been used previously in the literature.