Three Essays in Macroeconomics

by

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Abstract

Chapter 1 focuses on corporate governance and business cycles. The delegation of control to insiders fosters initiative but it also gives them the opportunity to expand their firm beyond the profit-maximizing size. When goods markets are imperfectly competitive, firms are too small relative to the social optimum. In such circumstances, insiders' tendency to increase investment, employment and output are at once costly for shareholders and beneficial for the economy. Under plausible assumptions, I show that firms find it optimal to delegate control when demand is high, and that delegation choices provide a powerful amplification mechanism. Finally, the model predicts that an increase in firm volatility can decrease aggregate volatility and I present evidence consistent with this prediction.

Chapter 2 studies the implications of higher product market competition and capital market integration for unemployment in Europe. These changes are likely to increase efficiency and output in the long run, but it may take time for economic actors to fully understand them and adapt. In the presence of collective bargaining and slow learning by unions, these changes can generate first a rise, then a decline in unemployment. This fits the general evolution of unemployment in Europe since the 1970s. The speed of learning by unions is likely to depend on the degree of trust between labor and capital. The empirical evidence suggests that countries where trust was lower have had more of an increase, and a later turnaround, in unemployment.

Chapter 3 compares the impact of shocks to U.S. interest rates and emerging market bond spreads on domestic interest rates and exchange rates across several emerging market economies with different exchange rate regimes. Consistent with conventional priors, the results indicate that interest rates in Hong Kong react much more to U.S. interest rate shocks and shocks to international risk premia than interest rates in Singapore. The results are less clear-cut in the comparison of Argentina and Mexico: while interest rates in Mexico seem to react less to U.S. interest rate shocks, they react about the same to bond spread shocks, in addition to a significant impact on the exchange rate.

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Chapter 1

Corporate Governance and Aggregate Volatility

1.1 Introduction

The question of who controls the firm is a central one in corporate finance. While the chain of formal authority is fairly well defined (running from the investors to the board, from the board to the CEO, and so on), effective control depends on how much of this formal authority is retained and on how much of it is delegated. This paper argues that control is tightened when business conditions deteriorate and that this has quantitatively important implications for the business cycle.

The paper analyzes the following trade-off. Authority (i.e., the right to make discretionary decisions) can be delegated to people inside firms. Delegation allows insiders to use their specific skills and expertise, which enhances productivity. The cost of delegating control is that it creates room for opportunistic behavior. If one does not delegate and instead asks people to go by the book, specific skills and expertise are partly lost, but so is egregious misbehavior.

To go further, one needs to be more specific about the costs and benefits of delegation. I follow Aghion and Tirole (1997) and Burkart, Gromb and Panunzi (1997) by assuming that delegation fosters initiative and non-contractible investments. These investments translate into higher productivity at the firm level. I model the costs of delegation as in Jensen (1986) and Hart and Moore (1995), and argue that managers who enjoy discretionary control tend to expand their firms beyond the profit-maximizing size.

The first insight of the paper is to notice that "empire building" behavior can have very different implications at the firm level and in the aggregate. When goods markets are imperfectly competitive, firms are too small relative to the social optimum. In this case, managerial tendencies to increase investment, employment and output are at the same time costly for shareholders and beneficial for the economy. On the other hand, other forms of managerial misbehavior, such as stealing and spending on non-productive activities, are socially wasteful.

Building on the idea that there is an important distinction between productive and non-productive deviations from profit maximization, the paper proposes a simple model to study the implications of firms' governance choices for the business cycle. I assume that, at every period, each firm must decide whether or not to delegate control to insiders. When control is delegated, productivity is high but two distortions appear. First, output is too high. Second, there is excess overhead labor. When control is not delegated, productivity is lower but profit maximization can be strictly enforced. Because delegation increases productivity, the benefits of delegation are higher the higher the demand for the firm's product. On the other hand, the costs of delegation do not increase one for one with the firm's demand. It is therefore optimal for the firms to delegate more when demand is high.

The main result of the paper is that these governance choices amplify aggregate fluctuations. When a negative shock hits the economy, some firms switch to a more conservative mode of governance because insiders' initiatives become relatively less valuable than cost cutting. This has three consequences, two of which amplify the initial shock: first, some specific expertise is lost when control is tightened and this leads to a drop in productivity; second, output goes back to the monopolistic level. The third consequence (less overhead labor) dampens the negative shock by freeing resources that were previously misallocated. The simulations below show that, at least for small initial deviations from profit maximization, the first two effects dominate the third one. The net consequence is, therefore, an amplification of the initial shock, which, in turn, leads other firms (suppliers or customers of the downsizing firms, for instance) to tighten their governance strategy.

I consider two classes of aggregate shocks: technology shocks and labor supply shocks[1]. Governance choices amplify technology shocks by a factor of 1.5, and labor supply shocks by a factor of

[1]Labor supply shocks provide a convenient way to introduce aggregate shocks that do not directly affect the technological frontier of the economy. They can be interpreted, for instance, as nominal spending shocks that interact with nominal wage rigidities. See Chari, Kehoe and McGrattan (2002).

1.9. In the case of labor supply shocks, the model without the endogenous governance mechanism predicts counter-cyclical real wages. The aggregate labor demand schedule is fixed and therefore the wage has to fall in booms for firms to be willing to hire more labor. This prediction is counterfactual. However, the governance model that I calibrate predicts weakly procyclical real wages even when the business cycle is driven by labor supply shocks. This is because a positive shock induces firms to delegate more control, which makes them at the same time more productive and more willing to hire for a given level of productivity. The aggregate demand for labor therefore shifts out and this increases the equilibrium wage.

Finally, I use the model to propose a new explanation for the recent decline in aggregate volatility. The amplification mechanism emphasized in this paper is based on the idea that firms adapt their mode of governance to market conditions. But market conditions are affected by both idiosyncratic and aggregate shocks. I document the fact that firm level risk has increased over the past 40 years. There are two ways to capture this increase in firm level risk within the framework of this paper. The first is to spread out the distribution of firm level shocks. The second is to increase the degree of competition in the goods market. In this case, the fundamental firm level shocks are unchanged, but their consequences for output and employment are larger because customers are more willing to shift their spending across firms proposing similar products. The interesting insight is that the same increase in competition can also explain the decrease in aggregate volatility. When I calibrate the model using the actual increase in firm level risk (modelled either by spreading out the distribution of idiosyncratic shocks, or by increasing the degree of competition in the goods market), I find that the model can account for 40% to 50% of the actual decrease in aggregate volatility.

The paper is organized as follows. Section 2 discusses the related literature. Section 3 describes the economy. Section 4 discusses firms' governance decisions. Section 5 presents the intuition for the amplification mechanism. Section 6 discusses the empirical evidence and describes the calibration method. Section 7 presents the impulse responses of the model to technology and labor supply shocks. Section 8 compares the simulated economies with actual data. Section 9 presents evidence on the increase in firm volatility over the past 40 years and computes the implied decrease in aggregate volatility for the calibrated model. Section 10 concludes. Derivations and technical details are in the appendix.

1.2 Related Literature

This research is related to the microeconomic literature on governance conflicts between managers and shareholders. Jensen (1986) emphasizes the idea that managers tend to expand their firms beyond the profit-maximizing size. This "empire building" behavior also plays a key role in Hart and Moore (1995). The idea that delegation fosters initiative and non-contractible investments is presented in Aghion and Tirole (1997) and Burkart, Gromb and Panunzi (1997). Scharfstein and Stein (2000) provide a model where preferences for large firms arise endogenously from the interaction between two layers of agency. I will discuss the empirical literature about governance conflicts in detail when I turn to the calibration of the model.

The importance of imperfect competition for the business cycle has been emphasized by Blanchard and Kiyotaki (1987), and Rotemberg and Woodford (1992) among others. The empirical finding that markups of prices over marginal costs are counter-cyclical[2] is relevant for my paper because a firm operating on its demand curve can expand its output only by lowering its markup. One expects to see lower markups when insiders control because they put more weight on sales and employment relative to profits than outsiders do. Counter-cyclical markups could then be driven by procyclical delegation of control to insiders.

Finally, this research is related to the literature that studies the macroeconomic implications of financial frictions: Bernanke, Gertler and Gilchrist (1999), Kiyotaki and Moore (1997). The frictions that I emphasize are different in the sense that, in my model, firms do not suffer from liquidity constraints.

1.3 Model

Consider an infinite horizon stochastic general equilibrium model. The consumers maximize

$$\max_{K_{t+1},L_t,C_t,u_t} E_0 \left[\sum_t \beta^t \left(\log (C_t) - \frac{1}{Z_t} \frac{\phi}{\phi+1} L_t^{\frac{\phi+1}{\phi}} \right) \right] \tag{1.1}$$

[2] See Rotemberg and Woodford (1999) for a survey, and Bils and Kahn (2000) for recent evidence.

subject to the budget constraint

$$(1+g)\,K_{t+1} = (1-\delta(u_t))\,K_t + W_t L_t + u_t R_t K_t + \Pi_t - C_t - \frac{\gamma}{2}\frac{(K_{t+1}-K_t)^2}{K_t} \tag{1.2}$$

R_t is the rental price of capital services, u_t is the rate of utilization of the existing stock of capital K_t, Π_t are aggregate profits, g is the trend growth rate of labor productivity and γ captures adjustment costs for investment as in Hall (2002). Z_t is an aggregate labor supply shock[3]. The cost of higher utilization is captured by an increase in the depreciation rate $\delta(u_t)$ as in King and Rebelo (1999).

The economy produces a final good using differentiated inputs. The final good is produced competitively and it can be used for consumption and investment. The differentiated goods are produced by a continuum of mass N of firms indexed from 0 to 1. N will be determined in equilibrium by a free entry condition. The production function for the final good is

$$Y_t = N \times \left(\int_0^1 h_{it}^{\frac{1}{\sigma}} y_{it}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{1.3}$$

and the final good producers solve

$$\max_{y_{it}} P_t Y_t - N \times \int_0^1 p_{it} y_{it}$$

where y_{it} is the production of intermediate good i at time t and h_{it} is an exogenous firm specific shock. The distribution of these shocks is time invariant and the mean is normalized to one: $\int_0^1 h_{it} = 1$. These shocks can be interpreted as relative productivity shocks from the point of view of final good producers, or as relative demand shocks from the point of view of intermediate goods producers.

Equation (1.3) implies that each producer i faces an isoelastic demand curve:

$$y_{it} = h_{it} \times \frac{Y_t}{N} \times \left(\frac{p_{it}}{P_t}\right)^{-\sigma} \tag{1.4}$$

The price level, P_t, is such that $\int_0^1 h_{it}\left(\frac{p_{it}}{P_t}\right)^{1-\sigma} = 1$. This is also the zero profit condition for the

[3] Chari, Kehoe and McGrattan show how a model with nominal wage rigidities and monetary shocks can produce such shocks. More generally, I am interested in non-technological disturbances, and the simplest way to introduce them is through shocks that affect households' marginal rate of substitution between consumption and leisure.

final good producers. There is monopolistic competition in the differentiated goods sector. The production function for intermediate good i is characterized by constant returns to variable factors and some fixed costs. The variable factors are the flow of capital services k_{it} and labor l_{it}. The production function for good i at time t is:

$$y_{it} = \theta_t \, q_{it} \, k_{it}^{1-\alpha} l_{it}^{\alpha}$$

θ_t is an aggregate technology shock and q_{it} is the firm's idiosyncratic productivity. The fixed costs for firm i are Φ units of final good and an amount l_{it}^* of overhead labor. The (real) profits of firm i are therefore:

$$\pi_{it} = \frac{p_{it}}{P_t} y_{it} - W_t \left(l_{it} + l_{it}^* \right) - R_t k_{it} - \Phi$$

The simplest way to model the governance choice is to see it as a choice among two technologies. At every period, each firm i must choose to delegate control to its insiders of not. I describe this choice with the dummy variable $D_{it} \in \{0, 1\}$. This choice is made after all the shocks (Z_t, θ_t, h_{it}) have been observed.

The first mode of governance, which I will call the conservative mode, has no delegation of control to insiders ($D_{it} = 0$). Productivity is low $\left(q_{it} = \underline{q} < 1 \right)$ but there is no overhead labor ($l_{it}^* = 0$) and profit maximization is strictly enforced. Formally, when $D_{it} = 0$, the program of the firm is

$$\max_{k,l} \pi_{it}$$

subject to (1.4) and $y_{it} = \theta_t \, \underline{q} \, k^{1-\alpha} l^{\alpha}$. The resulting profits are $\pi_{it}(0)$.

The second mode of governance, which I will call innovative, delegates control to the insiders ($D_{it} = 1$). The innovative mode has a high productivity, $q_{it} = 1 > \underline{q}$, but it has two distortions. First, there is excess overhead labor, $l_{it}^* = l^* > 0$, and, second, the objective function of the firm is to maximize a weighted average of sales and profits. The weight the insiders put on sales is $\eta^* \geq 0$. When $D_{it} = 1$, the program of the firm is

$$\max_{k,l} \eta^* \, p_{it} y_{it} + (1 - \eta^*) \, \pi_{it}$$

subject to (1.4) and $y_{it} = \theta_t \, k^{1-\alpha} l^{\alpha}$. The resulting profits are $\pi_{it}(1)$.

Finally, I assume that delegation is chosen to maximize the profits of firm i at time t.

$$D_{it} = \arg \max_{D \in \{0,1\}} \pi_{it}(D)$$

A rational expectations equilibrium for this economy is a set of stochastic processes for the exogenous technology and labor supply shocks $\{\theta_t, Z_t\}$ and for the endogenous prices and quantities. $\{D_{it}, l_{it}, k_{it}, p_{it}\}_i$ solve the intermediate firms' program described above, $\{Y_t, y_{it}\}$ are determined by (1.3), and consumers maximize (1.1) over $\{K_{t+1}, C_t, L_t, u_t, \}$. All the agents take $\{P_t, W_t, R_t\}$ as given, and the following market clearing conditions hold:

$$\begin{aligned} Y_t &= C_t + I_t + N \times \Phi \\ u_t K_t &= N \times \int_0^1 k_{it} di \\ L_t &= N \times \int_0^1 (l_{it} + D_{it} \times l^*) \, di \end{aligned}$$

This definition of equilibrium is conditional on the number of firms, N, which is constant. To pin down N, I impose that a free entry condition holds in the non-stochastic steady state of the economy (see Rotemberg and Woodford, 1999 and the appendix).

1.4 Governance Choice

There are many ways to motivate the reduced form used above and a formal model is presented in the appendix. Before discussing the interpretation of the reduced form, I describe how firms choose among the two modes of governance.

Assumption 1: $\kappa(\eta^*) > \underline{q}^{\sigma-1}$ where $\kappa(\eta) \equiv \frac{1-\sigma\eta}{(1-\eta)^{\sigma}}$

Assumption 1 ensures that delegation is sometimes desirable. The function κ is concave and reaches a maximum of one for $\eta = 0$. It reflects the profit losses coming from the fact that firms in the innovative mode deviate from the objective of profit maximization. For given factor prices (W and R), and demand conditions (h and Y), the cash flows generated by firm i (before overhead costs are paid) are proportional to $\kappa(\eta) \times q^{\sigma-1}$. In the innovative mode, this becomes $\kappa(\eta^*) \times 1$ and in the conservative mode, $1 \times \underline{q}^{\sigma-1}$. Assumption 1 ensures that the gains from innovative efforts outweigh the losses from excessive production. Proposition 1 describes the optimal governance choice for firm i at time t.

Proposition 1 *Firm i will choose the innovative mode of governance at time t if and only if*

$$h_{it} > h_t^*$$

where

$$\begin{aligned} h_t^* &= \frac{W_t}{A_t} \frac{l^*}{\kappa(\eta^*) - \underline{q}^{\sigma-1}} \\ A_t &\equiv \left(\frac{\mu}{\theta_t}\left(\frac{R_t}{1-\alpha}\right)^{1-\alpha}\left(\frac{W_t}{\alpha}\right)^{\alpha}\right)^{1-\sigma}\frac{Y_t}{\sigma N} \end{aligned} \tag{1.5}$$

Proof. In the innovative mode of governance, the choice of production is made to maximize $\eta^* p_{it} y_{it} + (1-\eta^*)\,\pi_{it}$. The resulting profits are $\pi_{it}^* = A_t\, h_{it}\, \kappa^* - W_t\, l^*$, where κ^* is defined in assumption 1 and l^* is excess overhead labor. In the conservative mode, profits are simply $\pi_{it} = A_t\, h_{it}\, \underline{q}^{\sigma-1}$. Comparing the two levels of profits completes the proof. ■

The economic intuition is fairly straightforward. Because delegation increases initiative, delegation is more valuable when the demand for the firm's product is high. On the other hand, the costs of delegation do not increase one for one with the firm's demand. Thus, the choice of governance mode takes the form of a simple cutoff rule: firms that do well (high h) choose the innovative mode and firms that do poorly (low h) choose the conservative mode. The cutoff h_t^* depends on the overhead labor distortion and on the aggregate conditions in the economy. It is relatively more costly to delegate when the real wage is high, because of overhead labor costs. The effects of aggregate demand, Y_t, and of the marginal cost of production, $\frac{1}{\theta_t}\left(\frac{R_t}{1-\alpha}\right)^{1-\alpha}\left(\frac{W_t}{\alpha}\right)^{\alpha}$, are standard. As Y_t increases, delegation becomes relatively more valuable, and the opposite happens for an increase in the rental price or in the real wage (independently of the overhead labor cost).

The assumption that some of the delegation costs become relatively smaller when the firm does well is crucial for the result that delegation is more valuable in a boom. I will argue below that this is an empirically plausible assumption.

I can now discuss two interpretations of the model. The first one follows closely Burkart, Gromb and Panunzi (1997) and Aghion and Tirole (1997). In their model, a principal chooses to delegate more or less control to an agent. There are many such relationships inside firms, but, for concreteness, one can think of the principal as the board of directors and the agent as the CEO. The board can decide how much it wants to interfere with the CEO's decisions. Freedom fosters productive initiatives ($q = 1$) but the CEO then has some discretion concerning the corporate objective. In particular, she has a preference for large firms ($\eta^* > 0$) and for overhead labor ($l^* > 0$). The two key assumptions in this setup are that the CEO has some empire building tendencies, and that selective intervention is not an option. More precisely, delegation can improve CEO's incentives to make firm-specific investments precisely because delegation is a commitment not to intervene ex-post. In this case, the "innovative" governance mode can be seen as a solution to the hold-up problem.

The second interpretation is more mechanical. Suppose that the agent makes hiring and investment propositions to the principal, who can either rubber-stamp the propositions, or decide to investigate. Investigation is time consuming and there is always a probability that the investment opportunity will disappear before the investigation is finished. Without investigation, the principal cannot discover whether the agent is spending too much or not (l^* and η^*). The key mechanism is once again that the opportunity cost of monitoring is higher in booms because booms are times when profit opportunities should not be missed, even if that means rubber-stamping projects that are marginally too large or too fancy. In recessions, on the other hand, the principal is more willing to stick to the old projects and focus on cutting costs.

The basic point is that governance should be designed in such a way as to leave more discretion to insiders when times are good. A separate issue is how to implement this in practice. One way would be to use the firm's financial structure. Equity holders are more likely than debt holders to rubber-stamp the decisions of the manager. Thus the model is consistent with the fact that equity holders control in good times and debt holders in bad times. However, I would like to point out a crucial difference with existing models of financial structure, like the one in Hart and Moore (1995). The difference is that I do not assume that aggregate shocks are unobservable. This is important because models of liquidity constraints usually share the feature that observable shocks should be contracted upon, which would make them irrelevant. In the context of a debt contract for instance, these models predict that interest payments should be contingent on the state of the economy. Firms would have to pay back more in good times, less in bad times and the fraction of firms that suffer from liquidity shortages would not vary with the business cycle. To justify the use of non-contingent debt and make sure that liquidity matters in the aggregate, one typically needs to assume that firms cannot contract on the state of the economy, even implicitly. If giving more liquidity to firms in bad times could substantially increase their value, it is hard to imagine that the financial markets would have been unable to create the appropriate instruments. In the model I propose, everybody knows that firms are short of cash and forced to cut their spending in bad times, but this is privately optimal for the investors. Of course, this result follows from the assumption that there are increasing returns in the delegation technology.

1.5 Amplification

The main result of the paper is that firms' delegation choices amplify aggregate shocks. Before turning to the simulations of the model, it is useful to present the intuition for this result. From the definition of the aggregate price level and from the pricing decisions of the intermediate goods producers, one can obtain the following equation

$$\mu \times c_t = \left[J\left(h_t^*\right) \times \left(\frac{1}{1-\eta^*}\right)^{\sigma-1} + \left(1 - J\left(h_t^*\right)\right) \times \underline{q}^{\sigma-1} \right]^{\frac{1}{\sigma-1}} \tag{1.6}$$

where

$$c_t = \frac{1}{\theta_t} \left(\frac{R_t}{1-\alpha}\right)^{1-\alpha} \left(\frac{W_t}{\alpha}\right)^{\alpha}$$

is the marginal cost associated with the Cobb-Douglas production function. $J\left(h_t^*\right) = \int_{h_t^*}^{\infty} h\, f\left(h\right) dh$ and $f\left(.\right)$ is the distribution function of the idiosyncratic shocks h. Equation (1.6) is shared by all general equilibrium models of imperfect competition where the pricing behavior of firms is described by $\frac{p_{it}}{P_t} = \mu_{it} \times c_{it}$. Most models focus on the symmetric equilibrium where all firms have the same marginal cost $c_{it} = c_t$ and the same markup $\mu_{it} = \mu$. In a symmetric equilibrium, one would get the simple condition: $\mu \times c_t = 1$. In my model however, firms differ in both their marginal costs and their markups. Firms that choose to delegate control have higher productivity $q_{it} = 1$ and lower markups $\mu_{it} = (1 - \eta^*) \times \mu$ than other firms. Equation (1.6) can be seen either as defining the aggregate markup as a weighted average of the firms' markups or as defining the aggregate marginal cost as a weighted average of the firms' marginal costs. The weight on the innovative firms is $J\left(h_t^*\right)$. Because the markup choices are correlated with firms' idiosyncratic productivity, one cannot in general disentangle the aggregate markup from the aggregate marginal cost. But one can consider a few special cases.

- $l^* = 0$. In this case, we know from proposition 1 that $h_t^* = 0$. Since $J(0) = 1$, we get $(1 - \eta^*)\mu \times c = 1$. In this symmetric equilibrium, all firms charge the same price but they deviate from the profit maximizing markup μ by a factor $1 - \eta^*$.

- $\eta^* = 0$. In this case, all firms charge the profit maximizing markup but productivity levels differ across firms. This case is isomorphic to a model with increasing returns at the firm level. To see why, interpret $W_t l_t^*$ not as a cost of delegation due to managerial misbehavior, but as a fixed cost of operating a high productivity technology. Firms choose this technology only when they face a high demand. The aggregate marginal cost decreases when the weight of high productivity firms increases.

Using the definition of the cutoff (1.5) together with equation (1.6), I get

$$\frac{h_t^*}{J(h_t^*) \times \left(\frac{1}{1-\eta^*}\right)^{\sigma-1} + (1 - J(h_t^*)) \times \underline{q}^{\sigma-1}} = \frac{W_t}{Y_t} \frac{\sigma N l^*}{\kappa(\eta^*) - \underline{q}^{\sigma-1}}$$

In this equation, the LHS is increasing in h_t^*. The RHS increases with W and decreases with Y. We can now understand the amplification mechanism. Consider the case of a positive technology shock. Following the shock, output will increase but so will the real wage. If factor supplies are elastic, output will increase more than the real wage and this will push the cutoff h_t^* to the left and lead some firms to switch to the innovative mode of governance. These firms will then hire more capital and labor and increase their output. Again, if factor supplies are elastic, this will increase output more than it will increase the wage and h_t^* will move further to the left[4]. We therefore expect the amplification mechanism to be stronger when factor supplies are elastic. This is why the presence of capacity utilization is important in this model. It is well understood that capacity utilization makes the standard RBC model more responsive to shocks (King and Rebelo 1999). Here, this will also apply to the amplification factor over and above what the RBC would predict.

[4]This suggests that the model could have multiple equilibria. For the parameter values that I estimate however, idiosyncratic risk is high enough to remove this possibility.

1.6 Calibration

I will now describe briefly the calibration procedure. All data are detrended using the HP filter. I consider the impact of labor market disturbances, captured by the parameter Z_t and aggregate technology shocks θ_t.

There are three non-standard parameters in the model described above: η^*, l^* and q. A key feature is that these parameters will have different effects on profits, sales and employment, respectively. η^* captures over-expansion. It increases sales and employment and decreases profits. l^* captures non-productive expenses. It has no impact on sales and employment, and a negative impact on profits. Finally, productive initiatives q are going to increase sales, profits and employment. The following table summarizes the predictions.

Effect of parameters on:	Profits	Sales	Employment
η^*	-	+	+
l^*	-	0	0
q	+	+	+

Berger and Ofek (1999) show that the amount of unallocated expenses is a strong determinant of corporate refocusing programs. Lichtenberg and Siegel (1990) focus on ownership changes and show that employment growth is much lower in establishments changing owners than in those not changing owners, and that the effect is stronger for auxiliary establishments than for production establishments. This is consistent with my assumption that l^* is strictly positive. Berger and Ofek (1999) also show that disciplinary events (shareholder pressure, financial distress, management turnover) usually occur before refocusing takes place and are followed by average cumulative abnormal returns of 7%. Denis and Kruse (2000) show that the corporate restructuring following declines in performance involves major cost cutting efforts, plant closing, asset sales and layoffs. These restructuring efforts increase shareholder value (see also Gilson, 1998). Denis and Denis (1995) show that, following a normal retirement of the CEO at age 65, the median firm experiences an employment decline of 7%, suggesting that the firm was previously too fat. Similarly, Kaplan (1989) finds that MBOs are followed by declines in employment, sales and investment, and by increases in profits.

These results suggest that both η^* and l^* are positive. Suppose that a firm has $\eta = 3\%$ and that the elasticity of substitution between goods is $\sigma = 4$. Then a disciplinary event that brings η down to 0 will be associated with a drop in sales and employment of 9% because sales and employment are proportional to $(1-\eta)^{1-\sigma}$. But note that this will have very little impact on the firm's profits since $\kappa(3\%) \approx 1$ by the envelope theorem. This suggests that $l^* > 0$ is needed to explain significant effects on profits without unrealistically large changes in sales. Indeed, a simultaneous decline in η^* and l^* can simply be interpreted as a firm that downsizes its activities by closing its less productive plants first. To see why, suppose that the firm has two plants with fixed capacity and fixed productivity. Profits would be maximized by closing the less productive plant but the manager is reluctant to do so. When a bad shock hits the firm, the manager is forced to close the plant. Profits go up and production goes down.

One can also obtain evidence from the literature that studies the effects of leverage on firms' behavior. As I have explained above, one can think of implementing the delegation mechanism with a debt contract. Empirically, one sees that more highly leveraged firms charge higher prices and respond more quickly and more strongly to shocks: Phillips (1995), Sharpe (1994), Chevalier and Scharfstein (1996). Kovenock and Phillips (1997) confirm the results in Kaplan (1989) that LBO firms decrease their investment and show that this effect is stronger in highly concentrated industries. Opler and Titman (1994) show that firms in financial distress experience large drops in sales and employment beyond what one would expect from the direct effects of the shock. The distressed firms lose market shares to their competitors. The idea that leverage can be used to put pressure on insiders is also directly supported by the fact that boards increase the leverage of their companies in response to an increase in unions' power (Gary Gorton and Frank Schmid (2000) for Germany, Stephen Bronars and Donald Deere (1991) for the US). Finally, it is important to emphasize that debt contracts are almost never contingent on aggregate shocks. Since corporate profits are strongly procyclical, this means that effective debt constraints are counter-cyclical and this provides support for the idea that insiders enjoy more freedom in booms than in recessions.

First, I choose h^* such that, in steady state, half of the firms are in the conservative governance mode and half of the firms are in the innovative mode. Based on the empirical evidence discussed above, I set $\eta^* = 3\%$ and $1 - \underline{q} = 1\%$. I use $\sigma = 4$ as a benchmark for the elasticity of substitution between goods. This implies a value-added markup of 1.33 consistent with Rotemberg and Woodford (1999). These values for η^* and σ imply that for half of the firms, sales are 9% higher than they would be under strict profit maximization (holding productivity constant). The profit losses from this deviation are very small ($1 - \kappa^* = 0.6\%$). The value of $\underline{q}$ implies that the penalty for downsizing is a temporary productivity loss of one percent.

The adjustment cost parameter γ is set to 4 (at quarterly frequency), following Hall (2002). The elasticity of depreciation with respect to utilization is 0.2 consistent with King and Rebelo (1999). The labor supply elasticity ϕ is 4 as in the benchmark RBC model (see for instance King and Rebelo 1999).

μ	ϕ	η^*	$\underline{q}$	ϕ	γ	$\frac{\delta''(1)}{\delta'(1)}$
1.33	4	3%	.99	4	4	0.2

The steady state is computed to match the standard ratios $(\frac{C}{GDP}, \frac{WL}{GDP}, \frac{K}{GDP})$. Recall that free entry drives the profits to 0 on the balanced growth path. This pins down N and Φ. The implied value for l^* is such that the average excess overhead labor is less than 1% of the employed population. The total ex-ante losses from all governance conflicts combined are 2.27%

$$\frac{E[l^*]}{L} = 0.82\%$$

$$\frac{E[\pi | q = 1, l^* = 0, \eta^* = 0] + R\frac{K}{N}}{E[\pi] + R\frac{K}{N}} - 1 = 2.27\%$$

Finally, the distribution of idiosyncratic shocks (h) is such that the 4-quarters standard deviation of the growth rate of sales across firms is 12%, which is the empirical value in the first half of the sample period[5] (see below).

The model can then be log-linearized around its balanced growth path. I describe here the calibration with the labor supply shock. $log(Z_t)$ is specified as an AR(1) process:

$$z_t = \rho z_{t-1} + \varepsilon_t$$

The model has one state variable (capital stock) and one exogenous driving process (z). Note however that z is not observable in the data and that ρ is not known. The calibration procedure follows the strategy used by King and Rebelo 1999. I make an initial guess for ρ. Given this guess,

[5] This is assuming that the h shocks are *iid* at the annual frequency. I have also experimented with an $AR(1)$ process for h. The results were quantitatively similar.

I solve the model using rational expectations. The solution takes the form

$$\widehat{y}_t = \beta_{yk} \times \widehat{k}_t + \beta_{yz} \times \widehat{z}_t$$

The coefficient β_{yk} and β_{yz} are complex functions of all the parameters of the model and of ρ. This equation for output can be inverted into $\widehat{z}_t = \frac{1}{\beta_{yz}} \times \widehat{y}_t - \frac{\beta_{yk}}{\beta_{yz}} \times \widehat{k}_t$. Using actual values for $\widehat{y}_t$ and $\widehat{k}_t$, one can create a series for $\widehat{z}_t$. One can then compute the AR(1) coefficient for this series. It is, in general, different from the original ρ. This value is then used as a new starting point. The procedure is repeated until convergence. The estimated value of ρ is .89 (I estimated essentially the same values for z and for θ).

1.7 Impulse Responses

The intuition for the amplification mechanism is the following. Firms that have a low demand $h_{it} < h_t^*$ are in the conservative governance mode: they have no overhead labor, low productivity and high markup. Following a positive aggregate shock, output Y_t and factor prices R_t and W_t are going to increase. To the extent that the labor supply is elastic and that capacity utilization can accommodate the increase in the demand for capital services, the rise in factor prices will not undo the initial rise in output and h_t^* will decrease. Some firms will therefore switch to the innovative mode of governance. They will reduce their markups, increase their productivity but also hire excess overhead labor. The net effect of these actions for the economy is positive and this leads other firms to follow the same path.

1.7.1 Technology Shocks

Figure 1 shows the response of the model to a positive technology shock. The shock is the dotted line. GDP is the solid line. The third line represents the fraction of firms that choose the conservative mode compared to the steady state value of 50%. Over time, the economy accumulates capital and the initial shock fades away. This drives up the wage relative to output, making it more costly for firms to have excess overhead labor. As h_t^* increases, some firms tighten control and output is pushed below its steady state value.

Figure 2 shows the impulse responses of different models to a positive technology shock (θ).

The exogenous shock (θ) is the same as in figure 1. The dotted line is the textbook RBC. Above is the RBC with capacity utilization and adjustment costs for investment. This model provides much stronger amplification than the basic RBC. The dashed line is the governance model with only the productivity channel, $\underline{q} < 1$ and $\eta^* = 0$. In this model, firms that switch from conservative to innovative governance are more productive but they have excess overhead labor. As explained in section 5, this case can be interpreted as an economy with some increasing returns at the firm level. This flattens the aggregate marginal cost curve and creates amplification. The solid line is the model with $\underline{q} < 1$ and $\eta^* > 0$. In this model, the innovative firms are not only more productive, but they also expand output beyond the profit-maximizing size. This second channel of amplification works like in other models of counter-cyclical markups (Rotemberg and Woodford, 1999).

1.7.2 Labor Supply Shocks

Figure 3 shows the impulse response of the model with respect to aggregate labor supply shocks, Z_t. The results are similar to the ones obtained with technology shocks but the amplification compared to the augmented RBC model (with capacity utilization and adjustment costs) is larger. This is because a positive labor supply shock will, all other things equal, tend to decrease the real wage. This decreases the costs of excess overhead labor and makes delegation more attractive.

Figure 4 compares the impulse responses of GDP to a positive labor supply shock for different models. The governance model delivers strong amplification by two channels, productivity and markup. The model with only the productivity effect delivers substantially less amplification. Finally, as in the case of technology shocks, we see that capital utilization plays an important role.

1.8 Simulations

I now turn to the comparison of the simulated models with actual US data.

1.8.1 Technology Shocks

Figure 5 shows the governance amplification in the model driven by technology shocks. Amplification can be seen in two ways. In the top panel, the governance model is calibrated to fit the GDP series (the solid line). Then the structural technology shocks (θ) from this model are put into the augmented RBC model and into the standard RBC model. The figure shows that output would have been less volatile without the governance mechanism. The amplification is 1.5 compared to the augmented RBC and 3 compared to the textbook RBC.

In the bottom panel, the same result is shown in a different way. This time, both the RBC and the governance model are independently calibrated. The figure shows the path of the technological driving process θ implied by the two models. The shock implied by the augmented RBC is one and a half times more volatile than the one implied by the governance model.

1.8.2 Labor Shocks

Figure 6 shows the overall fit of the governance model driven by labor shocks. There is nothing impressive about the way the model fits the GDP series. This is a mechanical consequence of the calibration procedure. The model should only be judged based on how well it fits the other series.

Figure 7 shows the governance mechanism at work. In a boom, more firms are in the innovative mode and aggregate productivity is higher. The bottom panel shows that the model is able to replicate the behavior of the (uncorrected) Solow residual. In fact, this is entirely due to the presence of fixed costs and capacity utilization. The correct technological residual (defined over gross output and controlling for utilization) looks nearly constant compared to the Solow residual. In other words, a model without endogenous governance but with the same average markup would also fit the Solow residual. However, the model without governance conflicts would need much larger labor shocks and would make counter-factual predictions concerning the behavior of the real wage, as one can see on the next two figures.

Figure 8 shows the labor shocks implied by the different models. The governance mechanism provides an amplification of 1.9 compared to either the RBC model or the imperfect competition model with exogenous markups and productivity.

Figure 9 shows that the models without endogenous governance predict a counter-cyclical real wage. The governance model reverses this prediction. This is a well known result from the literature on counter-cyclical markups (see Rotemberg and Woodford, 1999).

1.9 The rise in idiosyncratic risk and the fall in aggregate volatility

The decline is aggregate volatility was first described by Kim and Nelson (1999) and McConnell and Perez-Quiros (2000). Both papers conclude that the decline happened in the first quarter of 1984.

Blanchard and Simon (2000) interpret the same finding as evidence of a downward trend in the post-war period, interrupted by a period of high instability in the 1970s. Stock and Watson (2002) present a very detailed study of the phenomenon. They provide new evidence on the quantitative importance of various explanations for the increased stability of the economy and reach mixed conclusions: "Taken together, we estimate that the moderation in volatility is attributable to a combination of improved policy (20-30%), identifiable good luck in the form of productivity and commodity price shocks (20-30%), and other unknown forms of good luck that manifest themselves as smaller reduced form forecast errors (40-60%)."

I will now propose a tentative explanation for the "unknown forms of good luck." First, I will document the fact that the decrease in aggregate volatility coincided with a large increase in firm level volatility. Second, I will show that the model presented above can rationalize the two facts, and that it suggests a unified explanation.

Campbell, Lettau, Malkiel and Xu (2001) show that individual stocks have become more volatile. The increase is very large: individual stocks volatility was multiplied by more than two between the 1960s and the 1990s. My first task is to document the same fact using "real" (as opposed to financial) data on employment and sales. Chaney, Gabaix and Philippon (2002) look at firm level data using COMPUSTAT. Define the growth rate of the sales of company i between time t and time $t+1$:

$$s_{it} = \frac{\frac{p_{it+1}}{P_{t+1}} y_{it+1} - \frac{p_{it}}{P_t} y_{it}}{\frac{p_{it}}{P_t} y_{it}}$$

Let N_t be the number of companies in the sample at time t, and define firm level volatility at time t as:

$$\tilde{\sigma}_t^2 = \frac{\sum_i s_{it}^2}{N_t} - \left(\frac{\sum_i s_{it}}{N_t} \right)^2$$

If one does this exercise on the full sample, one sees an enormous increase from 1960 to 2001 (figure 10). But, of course, there is entry in the panel and entrants are smaller and more volatile (there are many more "small" firms in COMPUSTAT in 2001 than there were in 1960). The results also hold controlling for firm size (in real terms), but this is only half convincing since, with technological progress, the same real sales in 2001 represent a smaller firm than in 1960. So I also computed the volatility using only firms with more than 1000 employees. The trend is still very large in this sub-sample (figure 11). A simple way to summarize the results is to compute the size weighted standard deviation, which is similar to what Campbell et. al. did for stock prices. Let ω_{it} be the weight of firm i at time t :

$$\omega_{it} = \frac{p_{it} y_{it}}{\sum_j p_{jt} y_{jt}}$$

Define the average sales growth as

$$\overline{s}_t = \sum_i \omega_{it} s_{it}$$

and define the size weighted volatility as

$$\sigma_t^2 = \sum_i \omega_{it} \left(s_{it} - \overline{s}_t \right)^2$$

The size weighted volatility is the answer to the following question: suppose you pick at random a "chunk" of sales in the sample; what would its volatility be? The results of this exercise are shown on figure 12[6]. The aggregate GDP volatility is computed using a 15 quarters rolling window. The two series have been scaled to fit on the same figure. Size weighted firm level volatility is 12% on average before 1984, and it is 20% on average after 1984.[7]

The governance model suggests a mechanism through which an increase in firm level volatility can lead to a decrease in aggregate volatility. In fact, the model suggests two such mechanisms.

The first and most straightforward mechanism is an increase in the standard deviation of the h distribution. This will mechanically increase firm level risk. It will also decrease aggregate volatility. The reason is that firms in the tails of the distribution do not change their governance after an aggregate shock. Firms with very low h are conservative in booms, and firms with high h are innovative in recessions. As I have explained above, the aggregate multiplier is a function of how many firms switch for a given aggregate shock. This fraction is smaller when the distribution of the h shocks is more spread out. This leads to less aggregate volatility. I will go a step further and ask *what decline in aggregate risk the model predicts based on the actual increase in firm level risk.* The model was calibrated using a value for firm level risk of 12%, which corresponds to the pre-1984 period[8]. I will therefore increase the volatility of h by exactly the amount required to create a theoretical volatility of 20% (the post-1984 average), keeping all other parameters constant. The

[6] I removed outliers by truncating at the 4th and 96th percentiles of the distribution of growth rates.

[7] There are still many issues with these data. Perhaps most important is the issue of Mergers and Acquisitions. We try to correct for these biases in Chaney, Gabaix and Philippon (2002), but the most convincing evidence against a purely M&A driven phenomenon is that Campbell et. al. document the same fact using daily stock returns.

[8] And a log-normal distribution for h.

results are summarized in the following table. The actual decline is from 2.71 to 1.5%. The model predicts a decline from 2.74 to 2.1%

2 Periods are: 1964 – 84, 84 – 2001.	Standard Deviation of Cyclical GDP (HP filtered)
Actual Change in Volatility	2.71 down to 1.5%
Implied by increase in $h - shocks$	2.74 down to 2.1%

The second mechanism attempts to explain both fact by an increase in σ, or equivalently, a decrease in the average markup. The increase in σ leads to more competition in the goods market. This will amplify the effects of the firm specific shocks, q and η, and lead to an increase in firm level volatility. On the macroeconomic front, a decrease in the average markup also implies a less volatile markup. This will stabilize the economy. The results are summarized in the following table.

2 Periods are: 1964 – 84, 84 – 2001.	Aggregate Volatility	Firm Volatility
Actual Changes	2.71 down to 1.5%	12 up to 20%
Implied by increase of σ from 4 to 7	2.74 down to 2.2%	12 up to 20%

Finally, the last figure shows how the implied labor shocks change once one controls for the increase in firm level volatility. The top panel is the calibrated innovation of the process for the labor supply shock using the benchmark model. The bottom panel shows the same series for the pre-1984 period and shows the innovations calibrated using the economy with large idiosyncratic risk for the post-1984 period. On the top panel, one can clearly see the decrease in volatility starting in 1984. On the bottom panel, the "break" in volatility is much less obvious. In other words, some of the decline in aggregate volatility would have happened even without the decline in the volatility of the "structural" shocks, simply because the economy is now more stable.

1.10 Conclusion

The main goal of this paper was to study the macroeconomic consequences of the governance conflicts that have been emphasized in the corporate finance literature. The theoretical insight is that governance conflicts amplify aggregate shocks. The mechanism is intuitive. When times are good, insiders enjoy more control over the decisions of their firms, which leads to more hiring and more investment spending. These hiring and investment decisions feed-back into the aggregate and amplify the boom.

The quantitative investigation reveals three interesting properties. The first is that relatively small governance conflicts can lead to substantial aggregate volatility. The calibrated model implies an amplification factor of 1.5 for technology shocks and 1.9 for non-technology shocks, for agency costs of 2.2% of firm's value. The second result is that insiders' discretion leads to an outward shift in the labor demand curve in good times, which can explain why real wages do not fall in booms without assuming exogenous technological improvements. Finally, the model also led me to consider a new explanation for the recent decrease in aggregate volatility. Firm level volatility seems to have increased substantially since the 1960s. The model offers two ways to relate the evolution of aggregate volatility to the evolution of firm level risk. The first approach is to treat the increase in firm volatility as a mean-preserving spread of the distribution of idiosyncratic shocks, while remaining agnostic about the deep causes of the phenomenon. In this case, the reason for the decline in aggregate volatility is that, when idiosyncratic shocks are large, relatively few firms change their governance in response to aggregate shocks. Based on the actual increase in firm level risk, the model predicts roughly 50% of the actual decrease in aggregate volatility. The second approach tries to explain both the increase in firm level risk and the decline in aggregate volatility with the same structural change. I have suggested that increased competition in the goods market is a natural candidate. It leads to more volatility at the firm level because small differences in productivity between firms lead to large differences in equilibrium quantities. It also leads to a decrease in aggregate volatility because it makes markups less counter-cyclical. When I calibrate the increase in competition that would explain the increase in firm level risk, the model predicts roughly 40% of the decrease in aggregate volatility.

Appendix

A. Delegation

The model describes governance choices as technology choices. The purpose of this section is to provide simple micro-foundations for the reduced form used in the paper. The micro-foundations are based on a Burkart, Gromb and Panunzi (1997). At every period, a principal (he) and an agent (she) must decide which business plan the firm should adopt. The specific expertise of the agent allows her to learn which business plan is good, and which one is bad. There is always a good business plan, with productivity $q = 1$, a status quo project with productivity $\underline{q} < 1$, and many bad projects, with productivity less than than $\underline{q}$. If the agent exerts low effort, she discovers only the status quo. If the agent exerts high effort, she discovers all the projects. The principal cannot discover the projects by himself, but he has a monitoring technology that allows him to learn exactly what the agent learns. I will assume that the principal tries to maximize the value of the firm and that the principal always has formal authority. The timing within each period is the following:

1. Market conditions are observed. These include the aggregate shocks (Z_t and θ_t) as well as the firm specific shock (h_{it})

2. The principal chooses to monitor or not: $m_{it} = 1$ or 0. There are no monitoring costs. If the principal decides to monitor, he will know exactly what the agent knows. If he does not monitor, he will know nothing

3. The agent decides to exert effort or not: $e_{it} = 1$ or 0. If the agent exerts effort, she finds out which business plan has the high productivity $q = 1$. If she does not, she only finds out the status quo. Effort costs $\gamma(e_{it})$ and is normalized such that $\gamma(0) = 0$

4. The business plan is implemented. The principal always has formal authority at this stage.

    (a) If $m_{it} = 1$, the principal is informed, and the agent is useless and receives no compensation. If the agent had made the effort to acquire information, the principal implements the good project ($q = 1$). If not, he implements the status quo ($q = \underline{q}$).

    (b) If $m_{it} = 0$, the principal is not informed and only the agent can implement the business plan. However, the agent will implement the business plan on a larger scale than what is needed. She will seek to maximize $\eta py + (1-\eta)\,\pi$ instead of π, and she will hire overhead labor l^*. She derives private benefits B from doing so.

Assumption 2: $B > \gamma(1)$ and the agent does not respond to monetary incentives

Proposition 2 *Under assumption 1, the principal monitors if and only if* $h_{it} < h_t^*$

Proof. *If the principal monitors, the agent expects to be held up ex-post and she chooses the low effort. In this case, only the status quo can be implemented. If the principal does not monitor, the agent expects to receive* B*. Since* $B > \gamma(1)$*, she chooses to exert high effort and the high productivity project is implemented, with high overhead labor and high output. This setup is isomorphic to the technology choice described in the text. QED* ■

Burkart, Gromb and Panunzi (1997) discuss the robustness of the result that delegation fosters initiative. In particular, they show that the result holds with monetary incentives and under more general monitoring technologies.

B. Aggregate Setup: Technology and Preferences

The setup takes into account both capacity utilization (u) and adjustment costs (γ). I use $\overrightarrow{C}$ to denote the fact that C has a trend (to be removed as soon as all the FOCs are derived). Consumers maximize:

$$\max_{L_t, C_t} \sum_t \beta^t \left(\log\left(\overrightarrow{C}_t\right) - \frac{1}{Z_t}\frac{\phi}{\phi+1} L_t^{\frac{\phi+1}{\phi}} \right)$$

Subject to the budget constraint

$$\overrightarrow{K}_{t+1} = (1-\delta(u_t))\,\overrightarrow{K}_t + \overrightarrow{W}_t L_t + u_t R_t \overrightarrow{K}_t + \overrightarrow{\Pi}_t - \overrightarrow{C}_t - \frac{\gamma}{2}\frac{\left(\frac{\overrightarrow{K}_{t+1}}{(1+g)} - \overrightarrow{K}_t\right)^2}{\overrightarrow{K}_t}$$

I can obtain the Euler equation, the labor supply, and the utilization decision

$$L_t^s = \left(\frac{Z_t \overrightarrow{W}_t}{\overrightarrow{C}_t}\right)^{\phi}$$

$$\frac{1}{\overrightarrow{C}_t} = \lambda_t$$

$$\lambda_t \left(1+\gamma \frac{\frac{\overrightarrow{K}_{t+1}}{(1+g)}-\overrightarrow{K}_t}{\overrightarrow{K}_t}\right) = \beta E_t \left[\lambda_{t+1}\left(1+u_{t+1}R_{t+1}-\delta_{t+1}+\gamma \frac{\frac{\overrightarrow{K}_{t+2}}{(1+g)}-\overrightarrow{K}_{t+1}}{\overrightarrow{K}_{t+1}}\right)\right]$$

$$\delta'(u_t) = R_t$$

Note that the term $\left(\frac{\frac{\overrightarrow{K}_{t+1}}{(1+g)}-\overrightarrow{K}_t}{\overrightarrow{K}_t}\right)^2$ that should appear on the RHS of the Euler equation is negligible in practice and was omitted. Gross output of the final good is

$$\overrightarrow{Y}_t = N \times \left(\int_0^1 h_{it}^{\frac{1}{\sigma}} \overrightarrow{y}_{it}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

And the relative shocks are normalized so that $\int_0^1 h_{it} = 1$. There is perfect competition in the final good sector and final good producers solve:

$$\max_{y_{it}} p_t \overrightarrow{Y}_t - N \int_0^1 p_{it} \overrightarrow{y}_{it}$$

So that the demand for good i is

$$\frac{p_{it}}{p_t} = \left(\frac{N\overrightarrow{y}_{it}}{h_{it}\overrightarrow{Y}_t}\right)^{-\frac{1}{\sigma}}$$

And the price level must be such that

$$\int_0^1 h_{it}\left(\frac{p_{it}}{p_t}\right)^{1-\sigma} = 1$$

There is monopolistic competition in the intermediate goods markets. The production function is:

$$\overrightarrow{y}_{it} = q_{it}\,\theta_t\,\overrightarrow{k}_{it}^{1-\alpha}\left((1+g)^t l_{it}\right)^{\alpha}$$

Note that k denotes the flow of capital services (including the u term) and l is labor used for production. θ_t is an aggregate productivity shock, q_{it} is firm's idiosyncratic productivity. $(1+g)$ is the Harrod-neutral trend growth. The profits are

$$\overrightarrow{\pi}_{it} = \frac{p_{it}}{p_t}\overrightarrow{y}_{it} - \overrightarrow{W}_t l_{it} - R_t \overrightarrow{k}_{it} - \overrightarrow{\Phi}_{it}$$

$$\overrightarrow{\Phi}_{it} = \overrightarrow{\Phi} + \overrightarrow{W}_t l_{it}^*$$

There is a fixed cost in terms of goods $\left(\overrightarrow{\Phi}\right)$ indexed on aggregate productivity to keep the number of firms constant in steady sate. There is also some overhead labor l_{it}^{*}. I now remove the trend $(1+g)^t$. Define for the wage (and similarly for all other trending variables):

$$W_t = \frac{\overrightarrow{W}_t}{(1+g)^t}$$

So the marginal cost of firm i is

$$\begin{aligned} c_{it} &= \frac{\chi_t}{q_{it}} \\ \chi_t &\equiv \frac{1}{\theta_t}\left(\frac{R_t}{1-\alpha}\right)^{1-\alpha}\left(\frac{W_t}{\alpha}\right)^{\alpha} \end{aligned}$$

But the objective function of the firm is to maximize a weighted average of sales and profits. The weight on sales is η_{it}. This can be written

$$\max\left(\frac{p_{it}}{p_t} - (1-\eta_{it})\, c_{it}\right) y_{it}$$

This program leads to $\left(\text{introducing the notation } \mu \equiv \frac{\sigma}{\sigma-1}\right)$

$$\begin{aligned} y_{it} &= h_{it}\frac{Y_t}{N}\left(\frac{1}{\mu}\frac{1}{(1-\eta_{it})\, c_{it}}\right)^{\sigma} = \frac{Y_t}{N(\mu\chi_t)^{\sigma}}\, h_{it}\,(1-\eta_{it})^{-\sigma}\, q_{it}^{\sigma} \\ \frac{p_{it}}{p_t} &= (1-\eta_{it})\frac{\mu\chi_t}{q_{it}} \\ l_{it} &= \frac{y_{it}}{\theta_t q_{it}}\left(\frac{1-\alpha}{\alpha}\frac{W_t}{R_t}\right)^{\alpha-1} \\ k_{it} &= \frac{y_{it}}{\theta_t q_{it}}\left(\frac{1-\alpha}{\alpha}\frac{W_t}{R_t}\right)^{\alpha} \end{aligned}$$

The profits of the firm are:

$$\begin{aligned} \pi_{it} &= A_t h_{it} q_{it}^{\sigma-1}\kappa(\eta_{it}) - \Phi_{it} \\ A_t &\equiv (\mu\chi_t)^{1-\sigma}\frac{Y_t}{\sigma N} \\ \kappa(\eta_{it}) &\equiv \frac{1-\sigma\,\eta_{it}}{(1-\eta_{it})^{\sigma}} \end{aligned}$$

The price level condition becomes

$$\int_0^1 h_{it} \left(\frac{q_{it}}{1-\eta_{it}} \right)^{\sigma-1} = (\mu \chi_t)^{\sigma-1}$$

And the aggregate demands for capital and labor are:

$$\begin{aligned}
L_t^d &= \int_0^N l_{it} + l_{it}^* \\
L_t^d &= \left(\frac{1-\alpha}{\alpha} \frac{W_t}{R_t} \right)^{\alpha-1} \frac{\Psi_t}{(\mu \chi_t)^\sigma} \frac{Y_t}{\theta_t} + N\, l_t^* \\
K_t^d &= \int_0^N k_{it} \\
K_t^d &= \left(\frac{1-\alpha}{\alpha} \frac{W_t}{R_t} \right)^{\alpha} \frac{\Psi_t}{(\mu \chi_t)^\sigma} \frac{Y_t}{\theta_t} \\
\Psi_t &\equiv \int_0^1 h_{it} \left(1-\eta_{it}\right)^{-\sigma} q_{it}^{\sigma-1}
\end{aligned}$$

The equilibrium condition for the labor market is

$$\frac{L_t}{K_t^d} = \frac{\alpha}{1-\alpha} \frac{R_t}{W_t} + \frac{N\, l_t}{K_t^d}$$

and for the capital market

$$K_t^d = u_t K_t$$

C. Complete Model

Governance decisions lead to:

$$\left\{ \begin{array}{c} \eta_{it} = \eta^* \\ l_{it} = l^* \end{array} \right\} \Longleftrightarrow h_{it} > h_t^* = \frac{W_t}{A_t} \frac{l^*}{\kappa^* - \underline{q}^{\sigma-1}}$$

Where I have defined

$$\begin{aligned}
\Psi_t &\equiv \int_0^1 h_{it} \left(1-\eta_{it}\right)^{-\sigma} q_{it}^{\sigma-1} \\
&= \left(1-\eta^*\right)^{-\sigma} J\left(h_t^*\right) + \underline{q}^{\sigma-1} \left(1 - J\left(h_t^*\right)\right) \\
&= \underline{q}^{\sigma-1} \left(1 + J\left(h_t^*\right) \left[\left(1-\eta^*\right)^{-\sigma} \left(\frac{1}{\underline{q}} \right)^{\sigma-1} - 1 \right] \right)
\end{aligned}$$

So I get

$$
\begin{aligned}
\Psi_t &= \underline{q}^{\sigma-1} Inter2\left(h_t^*\right) \\
Inter2\left(h_t^*\right) &= 1 + J\left(h_t^*\right)\left[\left(1-\eta^*\right)^{-\sigma}\left(\frac{1}{\underline{q}}\right)^{\sigma-1} - 1\right]
\end{aligned}
$$

Where

$$
\begin{aligned}
J\left(h_t^*\right) &= \int_{h_t^*}^{\infty} h f(h)\, dh \\
J(0) &= 1\,;\ J(\infty) = 0
\end{aligned}
$$

And for the marginal cost I get:

$$
\begin{aligned}
\chi_t &= \frac{1}{\mu}\left[\int_0^1 h_{it}\,\left(1-\eta_{it}\right)^{1-\sigma}\ q_{it}^{\sigma-1}\right]^{\frac{1}{\sigma-1}} \\
\chi_t &= \frac{\underline{q}}{\mu}\left[Inter\left(h_t^*\right)\right]^{\frac{1}{\sigma-1}} \\
Inter\left(h_t^*\right) &= 1 + J\left(h_t^*\right)\left[\left(1-\eta^*\right)^{1-\sigma}\left(\frac{1}{\underline{q}}\right)^{\sigma-1} - 1\right]
\end{aligned}
$$

So the complete model is described by the following equations:

- Labor supply and labor demand:

$$
\begin{aligned}
L_t &= \left(\frac{Z_t W_t}{C_t}\right)^{\phi} \\
\frac{L_t}{u_t K_t} &= \frac{\alpha}{1-\alpha}\frac{R_t}{W_t} + \frac{N\, l_t^*}{u_t K_t}
\end{aligned}
$$

- Euler equation

$$
\frac{1}{C_t}\left(1+\gamma\frac{K_{t+1}-K_t}{K_t}\right) = \frac{\beta}{1+g} E_t\left[\frac{1}{C_{t+1}}\left(1 + u_{t+1}R_{t+1} - \delta_{t+1} + \gamma\frac{K_{t+2}-K_{t+1}}{K_{t+1}}\right)\right]
$$

- Utilization

$$
\delta'\left(u_t\right) = R_t
$$

- Capital accumulation

$$(1+g)\,K_{t+1}=Y_t+(1-\delta(u_t))\,K_t-C_t-N\,\Phi-\frac{\gamma}{2}\frac{(K_{t+1}-K_t)^2}{K_t}$$

- Capital demand

$$\begin{aligned} u_tK_t &= \left(\frac{1-\alpha}{\alpha}\frac{W_t}{R_t}\right)^{\alpha}\frac{\Psi_t}{(\mu\chi_t)^{\sigma}}\frac{Y_t}{\theta_t} \\ \Psi_t &= \underline{q}^{\sigma-1}Inter2\,(h_t^*) \end{aligned}$$

- Markup pricing. Usually we get $\frac{p_i}{p}=\mu c_i$ and we consider symmetric equilibria where all prices are the same and therefore $c=\frac{1}{\mu}$. This is what we have here, up to an aggregation factor because not all firms have the same markup.

$$\begin{aligned} \chi_t &= \frac{\underline{q}}{\mu}\left[Inter\,(h_t^*)\right]^{\frac{\mu}{\sigma}} \\ \chi_t &\equiv \frac{1}{\theta_t}\left(\frac{R_t}{1-\alpha}\right)^{1-\alpha}\left(\frac{W_t}{\alpha}\right)^{\alpha} \end{aligned}$$

- The aggregate factor for profits takes into account the aggregate demand (Y) as well as the factor prices

$$A_t\equiv(\mu\chi_t)^{1-\sigma}\frac{Y_t}{\sigma N}$$

- Finally the free entry condition says that (unconditional) expected profits have to be 0 . Overhead labor is equal to l^* times the measure of firms in the innovative mode.

$$\begin{aligned} E\left[\pi_{it}\right] &= 0 \\ l_t^* &= l^*\left(1-F\left(h_t^*\right)\right) \end{aligned}$$

D. Steady State

Let's define

$$\Theta\left(h_t^*\right)=\frac{\Psi_t}{(\mu\chi_t)^{\sigma}}=\frac{1}{\underline{q}}\frac{Inter2\,(h_t^*)}{\left[Inter\,(h_t^*)\right]^{\mu}}$$

Utilization is $u=1$ in steady state, and the shocks are also normalized: $\theta=1$ and $Z=1$. The zero profit condition for each of the N firms becomes

$$A \times E\left[h_i q_i^{\sigma-1}\kappa\left(\eta_i\right)\right] = E\left[\Phi_i\right]$$

Since

$$E\left[h_i q_i^{\sigma-1}\kappa\left(\eta_i\right)\right] = \underline{q}^{\sigma-1}\left[1 + J\left(\frac{x^*}{A}\right)\left(\kappa^*\frac{1}{\underline{q}^{\sigma-1}} - 1\right)\right]$$

I get

$$A \times \underline{q}^{\sigma-1}\left[1 + J\left(h^*\right)\left(\kappa^*\frac{1}{\underline{q}^{\sigma-1}} - 1\right)\right] = W \times \left[\frac{\Phi}{W} + l^*\left(1 - F\left(h^*\right)\right)\right]$$

Remember that

$$\frac{W}{A} = \frac{\kappa^* - \underline{q}^{\sigma-1}}{l^*}h^*$$

so

$$\frac{l^*\,\underline{q}^{\sigma-1}}{\kappa^* - \underline{q}^{\sigma-1}}\left[1 + J\left(h^*\right)\left(\kappa^*\frac{1}{\underline{q}^{\sigma-1}} - 1\right)\right] = h^* \times \left[\frac{\Phi}{W} + l^*\left(1 - F\left(h^*\right)\right)\right]$$

I can solve for h^*. In practice, I choose h^* such that, in steady state, half of the firms are conservative and the other half innovative.

I can get the equilibrium real interest rate from the Euler equation:

$$R = \frac{1 + g - \beta}{\beta} + \delta$$

I then get the wage from the markup pricing equation:

$$\begin{aligned}
\frac{\underline{q}}{\mu}\left[Inter\left(h^*\right)\right]^{\frac{\mu}{\sigma}} &= \left(\frac{R}{1-\alpha}\right)^{1-\alpha}\left(\frac{W}{\alpha}\right)^{\alpha} \\
W &= \left(\left[\frac{\underline{q}}{\mu}\left[Inter\left(h^*\right)\right]^{\frac{\mu}{\sigma}}\right]\alpha^{\alpha}\left(\frac{1-\alpha}{R}\right)^{1-\alpha}\right)^{\frac{1}{\alpha}}
\end{aligned}$$

and the capital output ratio from the capital demand

$$\frac{Y}{K} = \frac{1}{\Theta\left(h^*\right)}\left(\frac{1-\alpha}{\alpha}\frac{W}{R}\right)^{-\alpha}$$

The consumption capital ratio from the aggregate resource constraint

$$\frac{C}{K} = \frac{Y}{K} - g - \delta - \Phi \frac{N}{K}$$

From the labor demand equation, I obtain

$$\frac{N}{K} = \frac{1}{\left(1 - F\left(h^*\right)\right) l^*} \left(\frac{L}{K} - \frac{\alpha}{1-\alpha} \frac{R}{W}\right)$$

and I know l^* from the free entry condition

$$l^* = \frac{\frac{\Phi}{W}}{\frac{\underline{q}^{\sigma-1}}{\kappa^* - \underline{q}^{\sigma-1}} \left[1 + J\left(h^*\right)\left(\kappa^* \frac{1^{\sigma-1}}{\underline{q}^{\sigma-1}} - 1\right)\right] - 1 + F\left(h^*\right)}$$

So I can get a first equation in $\frac{C}{K}$ and $\frac{L}{K}$.

$$\frac{C}{K} = \frac{Y}{K} - g - \delta - \Phi \frac{1}{\left(1 - F\left(h^*\right)\right) l^*} \left(\frac{L}{K} - \frac{\alpha}{1-\alpha} \frac{R}{W}\right)$$

Then I use the fact that profits are 0 on the BGP to write

$$\begin{aligned} C + I &= WL + RK \\ I &= (g + \delta) \times K \end{aligned}$$

and to get a second equation

$$\frac{WL}{K} = \frac{C}{K} + g + \delta - R$$

Combining them, I get

$$\begin{aligned} \frac{WL}{K} &= \frac{Y}{K} - \Phi \frac{1}{\left[1 - F\left(h^*\right)\right] l^*} \left(\frac{L}{K} - \frac{\alpha}{1-\alpha} \frac{R}{W}\right) - R \\ \frac{WL}{K} &= \frac{\frac{Y}{K} + \Phi \frac{1}{\left[1-F\left(h^*\right)\right] l^*} \frac{\alpha}{1-\alpha} \frac{R}{W} - R}{\left(1 + \frac{\Phi}{W} \frac{1}{\left[1-F\left(h^*\right)\right] l^*}\right)} \end{aligned}$$

Then I use the labor supply equation

$$L = \left(\frac{ZW}{C}\right)^{\phi}$$

$$L = \left(\frac{Z\frac{WL}{K}}{\frac{C}{K}}\right)^{\frac{\phi}{1+\phi}}$$

I can get the capital stock using

$$K = \frac{W \times L}{\frac{WL}{K}}$$

I can get N from the labor demand equation

$$N = \frac{1}{\left[1 - F\left(h^*\right)\right] l^*}\left(\frac{L}{K} - \frac{\alpha}{1-\alpha}\frac{R}{W}\right)$$

Finally, I can get A from its definition

$$Inter\left(h^*\right)\ A = \underline{q}^{1-\sigma}\frac{Y}{\sigma N}$$

E. Numerical Solution

State variable: $\widehat{k}$

Control variables: $\widehat{x} = \left[\widehat{c}; \widehat{r}; \widehat{l}; \widehat{w}; \widehat{y}; \widehat{a}; \widehat{u}\right]$

Exogenous stochastic process: $\widehat{z}, \widehat{\theta}$

1. **Capital accumulation**

$$-gK_{t+1} + \left(1 - \delta\left(u_t\right)\right)K_t - C_t + Y_t - N\Phi - \frac{\gamma}{2}K_t\left(\frac{K_{t+1}}{K_t} - 1\right)^2 = 0$$

is log-linearized into:

$$-\left(1+g\right)\widehat{k}_{t+1} + \left(1-\delta\right)\widehat{k}_t - \frac{C}{K}\widehat{c}_t + \frac{Y}{K}\widehat{y}_t - R\widehat{u}_t = 0$$

2. **Labor demand**

$$L_t - \frac{\alpha}{1-\alpha}\frac{u_t R_t K_t}{W_t} - N\,l^*\left(1 - F\left(h_t^*\right)\right) = 0$$

$$\widehat{l}_t - \frac{\alpha}{1-\alpha}\frac{KR}{WL}\left(\widehat{k}_t + \widehat{r}_t + \widehat{u}_t\right) + \left(\frac{\alpha}{1-\alpha}\frac{KR}{WL} + \frac{Nl^*h^*}{L}f\left(h^*\right)\right)\widehat{w}_t - \frac{Nl^*h^*}{L}f\left(h^*\right)\widehat{a}_t = 0$$

3. **Labor supply**

$$L_t - \left(\frac{Z_t W_t}{C_t}\right)^{\phi} = 0$$
$$\phi\widehat{c}_t + \widehat{l}_t - \phi\widehat{w}_t - \phi\widehat{z}_t = 0$$

4. **Marginal cost/Markup**

$$\frac{1}{\theta_t}\left(\frac{R_t}{1-\alpha}\right)^{1-\alpha}\left(\frac{W_t}{\alpha}\right)^{\alpha} - \frac{\underline{q}}{\mu}\left[Inter\left(h_t^*\right)\right]^{\frac{\mu}{\sigma}} = 0$$
$$(1-\alpha)\,\widehat{r}_t + \left[\alpha - \frac{\mu}{\sigma}\widehat{Inter}\right]\widehat{w}_t + \frac{\mu}{\sigma}\widehat{Inter}\,\widehat{a}_t - \widehat{\theta}_t = 0$$

5. **Capital demand**

$$-u_t K_t + \left(\frac{1-\alpha}{\alpha}\frac{W_t}{R_t}\right)^{\alpha}\Theta\left(h_t^*\right)\frac{Y_t}{\theta_t} = 0$$
$$-\widehat{k}_t - \alpha\widehat{r}_t + \left(\alpha + \widehat{Inter2} - \mu\,\widehat{Inter}\right)\widehat{w}_t + \widehat{y}_t - \left(\widehat{Inter2} - \mu\,\widehat{Inter}\right)\widehat{a}_t - \widehat{u}_t - \widehat{\theta}_t = 0$$

6. **Definition of** A

$$Inter\left(h_t^*\right)A_t - \underline{q}^{1-\sigma}\frac{Y_t}{\sigma N} = 0$$
$$\widehat{Inter}\,\widehat{w}_t - \widehat{y}_t + \left(1 - \widehat{Inter}\right)\widehat{a}_t = 0$$

7. **Optimal utilization**

$$\delta'\left(u_t\right) = R_t$$
$$\widehat{r}_t - \xi\widehat{u}_t = 0$$

where ξ is the elasticity of the depreciation rate. For a discussion, see King and Rebelo, 1999.

8. **Euler equation**

$$\begin{aligned}
\frac{1}{C_t}\left(1+\gamma\left[\frac{K_{t+1}}{K_t}-1\right]\right)-\frac{\beta}{(1+g)}E_t\left[\frac{1}{C_{t+1}}\left(1+u_{t+1}R_{t+1}-\delta_{t+1}+\gamma\left[\frac{K_{t+2}}{K_{t+1}}-1\right]\right)\right] &= 0\\
E_t\left[\frac{R}{1+R-\delta}\widehat{r}_{t+1}+\gamma\widehat{k}_{t+2}-2\gamma\widehat{k}_{t+1}-\widehat{c}_{t+1}\right]+\widehat{c}_t+\gamma\widehat{k}_t &= 0
\end{aligned}$$

Note that $\delta'(1) = R$ simplifies this equation. In other words, because of the envelope theorem the capacity utilization does not appear in the Euler equation. And finally I have the parameters:

$$\begin{aligned}
\widehat{Inter} &= \frac{-h^* f(h^*)\left((1-\eta^*)^{1-\sigma}\left(\frac{1}{g}\right)^{\sigma-1}-1\right)}{Inter(h^*)}\\
\widehat{Inter2} &= \frac{-h^* f(h^*)\left((1-\eta^*)^{1-\sigma}\left(\frac{1}{g}\right)^{\sigma-1}-1\right)}{Inter2(h^*)}
\end{aligned}$$

Using a version of Uhlig's method for dynamic analysis, I define the matrices and then invert the system using rational expectations. There is one state variable $(\widehat{k})$, 7 endogenous variables and 2 driving process $(\widehat{z},\widehat{\theta})$.The format for the endogenous variables is $x=\left[\widehat{c};\widehat{r};\widehat{l};\widehat{w};\widehat{y};\widehat{a};\widehat{u}\right]$. Matrices have two letters. The first for the type of equation (F for forward looking, M for the law of motion and the other equations), the second refers to the type of variable (S for state, X for endogenous (jump) and Z for the shocks). Applied to the Euler equation:

$$\begin{aligned}
FX &= \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}\\
FX_1 &= \begin{bmatrix} -1 & \frac{R}{1+R-\delta} & 0 & 0 & 0 & 0 & 0 \end{bmatrix}\\
FS &= \gamma\\
FS_1 &= -2\gamma\\
FS_2 &= \gamma
\end{aligned}$$

And for the backward looking equations

$$MS_1 = \begin{bmatrix} -(1+g) \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}; MS = \begin{bmatrix} 1-\delta \\ -\frac{\alpha}{1-\alpha}\frac{KR}{W} \\ 0 \\ 0 \\ -1 \\ 0 \\ 0 \end{bmatrix}; MZ = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ -\phi & 0 \\ 0 & -1 \\ 0 & -1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix};$$

And

$$MX = \begin{bmatrix} -\frac{C}{K} & 0 & 0 & 0 & \frac{Y}{K} & 0 & -R \\ 0 & -\frac{\alpha}{1-\alpha}\frac{KR}{WL} & 1 & \frac{\alpha}{1-\alpha}\frac{KR}{WL}+\frac{Nh^*l^*f(h^*)}{L} & 0 & \frac{-Nh^*l^*f(h^*)}{L} & -\frac{\alpha}{1-\alpha}\frac{KR}{WL} \\ \phi & 0 & 1 & -\phi & 0 & 0 & 0 \\ 0 & 1-\alpha & 0 & \alpha-\frac{\mu}{\sigma}\widehat{Inter} & 0 & \frac{\mu}{\sigma}\widehat{Inter} & 0 \\ 0 & -\alpha & 0 & \alpha+\widehat{Inter}2-\mu\widehat{Inter} & 1 & -\widehat{Inter}2+\mu\widehat{Inter} & -1 \\ 0 & 0 & 0 & \widehat{Inter} & -1 & 1-\widehat{Inter} & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & -\xi \end{bmatrix}$$

With these matrices the system is simply

$$\begin{aligned} MS_1 \times s_{t+1} + MS \times s_t + MX \times x_t + MZ \times z_t &= 0 \\ E_t\left[FS_2\, s_{t+2} + FS_1\, s_{t+1} + FS\, s_t + FX_1\, x_{t+1} + FX\, x_t + FZ_1\, z_{t+1} + FZ\, z_t\right] &= 0 \\ z_{t+1} - ZZ \times z_t - \varepsilon_{t+1} &= 0 \end{aligned}$$

And I can invert it to get the 4 matrices $\widehat{S}, \widehat{SZ}, \widehat{X}, \widehat{XZ}$ such that.

$$\begin{aligned} s_{t+1} &= \widehat{S} \times s_t + \widehat{SZ} \times z_t \\ x_t &= \widehat{X} \times s_t + \widehat{XZ} \times z_t \end{aligned}$$

Note that in doing so I also need to check that the model does not have multiple equilibria. In practice there is enough idiosyncratic uncertainty to make sure this does not happen.

F. Firm level risk

The sales of firm i at time t are

$$\frac{p_{it}}{p_t} y_{it} = \frac{Y_t}{N\left(\mu\chi_t\right)^{\sigma-1}} h_{it} \left(\frac{q_{it}}{1-\eta_{it}}\right)^{\sigma-1}$$

Taking logs and removing the part that is common to all firms I get:

$$s_{it} = \log\left(h_{it}\left(\frac{q_{it}}{1-\eta_{it}}\right)^{\sigma-1}\right)$$

It is clear that the distribution of s_{it} is time-varying since the cutoff h^* moves at business cycle frequency. I will not attempt to capture the deformation of the distribution, because a casual look at the evolution of the empirical variance shows that there are very large year to year changes that are due to merger waves. It is not possible in COMPUSTAT to perfectly control for this problem. One might hope that the issue is less severe for the long run trend in volatility. So I evaluate the variance of the growth rate of sales on the BGP. Also in practice, I use the 4 quarters log growth rate to remove seasonal effects that may differ across firms. Since I have assumed that h shocks are *iid*:

$$var\left[s_{it+1} - s_{it}\right] = 2 \times var\left[s_i\right]$$

And

$$\begin{aligned} E\left[s_i^2\right] &= \int f_h(h)\, dh \int f_{q,\eta}(q,\eta\,|\,h)\left(\log\left(h\left(\frac{q}{1-\eta}\right)^{\sigma-1}\right)\right)^2 \\ &= \int \Xi(h,h^*)\, f(h)\, dh \end{aligned}$$

Where

$$\begin{aligned} \Xi(h,h^*) &= e\left(\frac{h}{h^*}\right)\log^2\left(h\left(\frac{1}{1-\eta\left(\frac{h}{h^*}\right)}\right)^{\sigma-1}\right) + \left(1-e\left(\frac{h}{h^*}\right)\right)\log^2\left(h\left(\frac{q}{1-\eta\left(\frac{h}{h^*}\right)}\right)^{\sigma-1}\right) \\ \eta\left(\frac{h}{h^*}\right) &= \eta^* \times (h > h^*) \\ e\left(\frac{h}{h^*}\right) &= 1 \times (h > h^*) \end{aligned}$$

The variance of the growth rate of firms' sales increases with the variance of h, the size of the deviation from profit maximization η^* and the difference in productivity $\frac{1}{\underline{q}}$.

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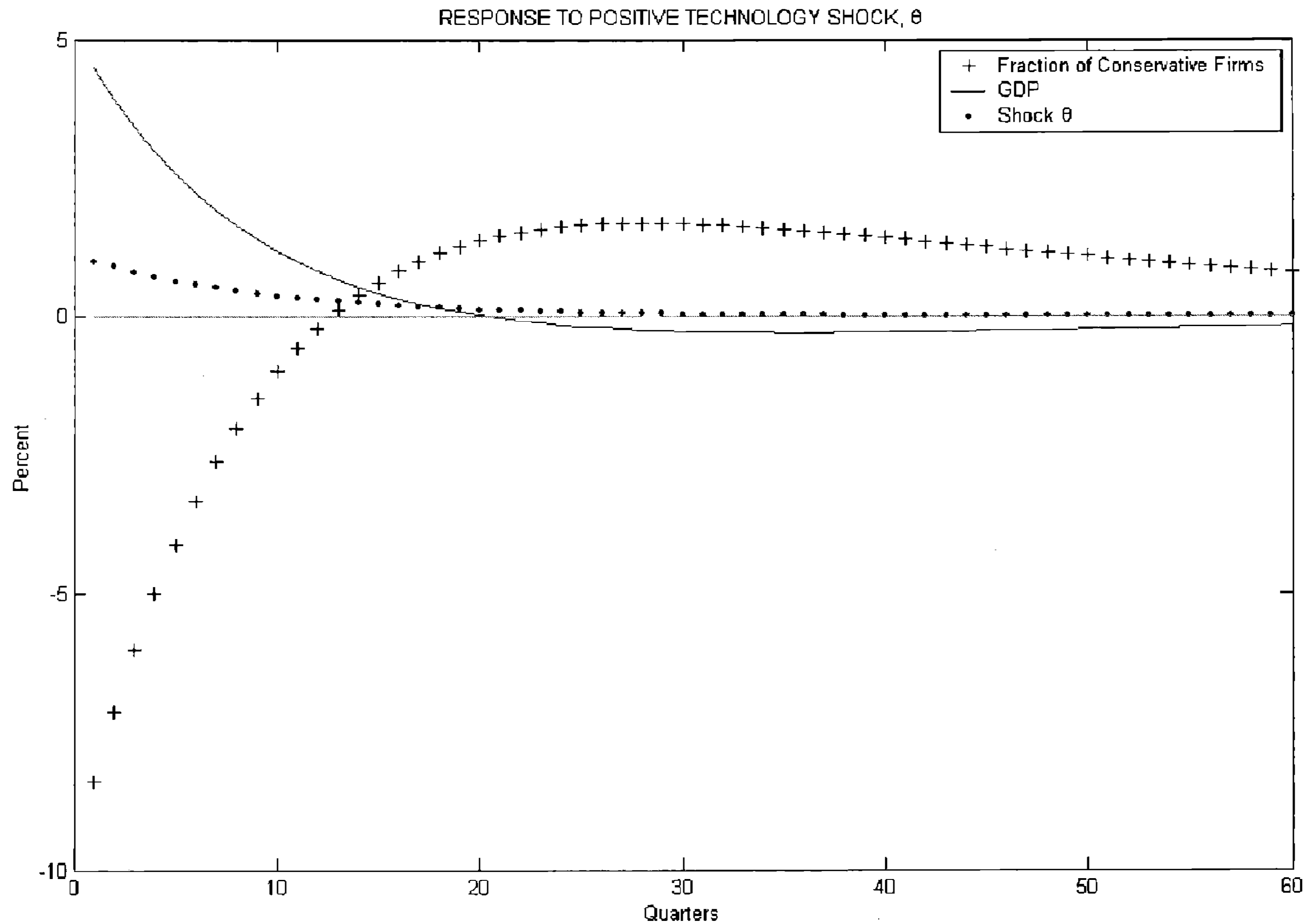

RESPONSE TO POSITIVE TECHNOLOGY SHOCK, θ
Fraction of Conservative Firms
GDP
Shock θ
Percent
Quarters
5
0
-5
-10
0
10
20
30
40
50
60

Figure 1

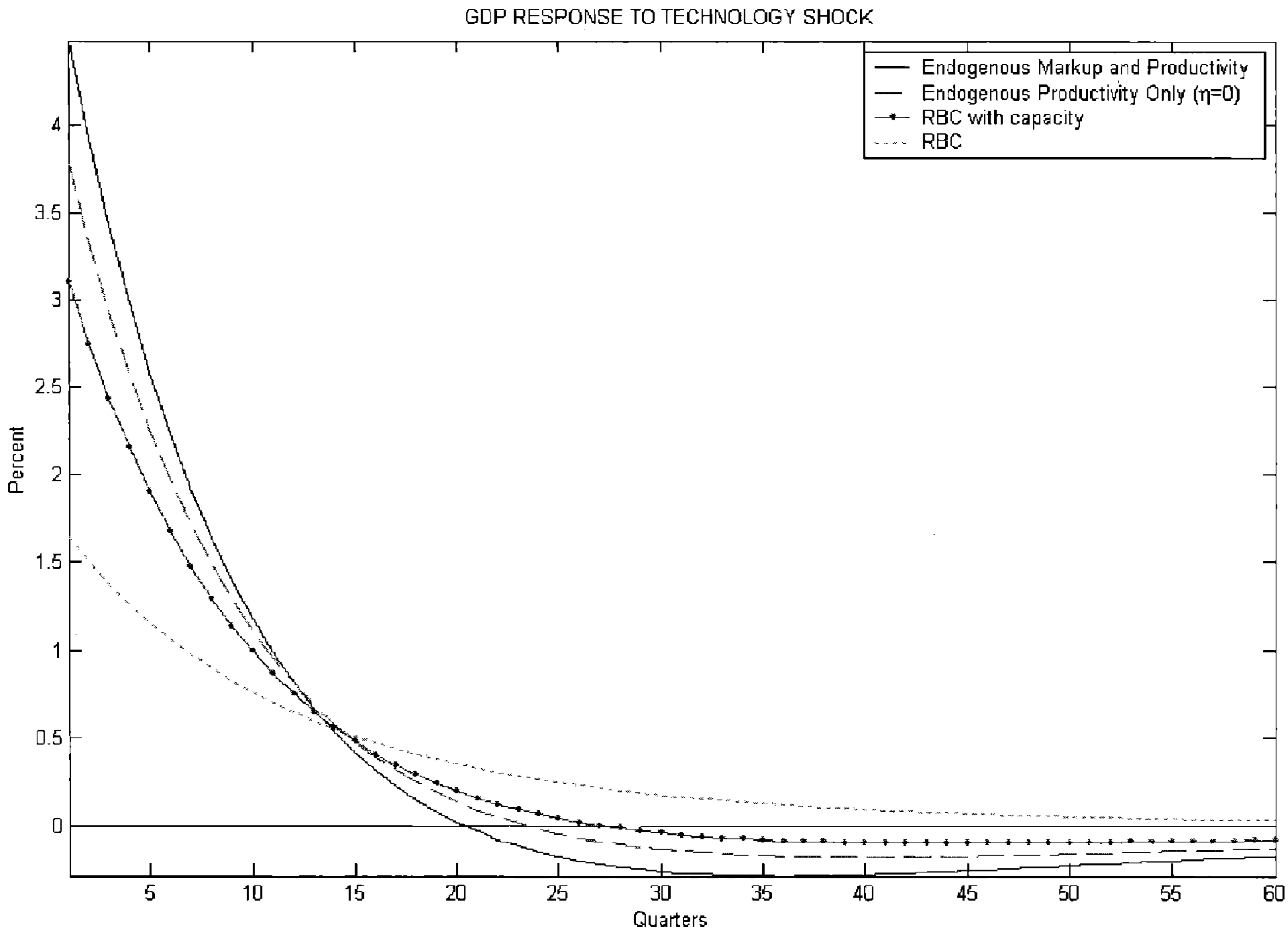

GDP RESPONSE TO TECHNOLOGY SHOCK
Endogenous Markup and Productivity
Endogenous Productivity Only (η=0)
RBC with capacity
RBC
Percent
Quarters
0
0.5
1
1.5
2
2.5
3
3.5
4
5
10
15
20
25
30
35
40
45
50
55
60

Figure 2

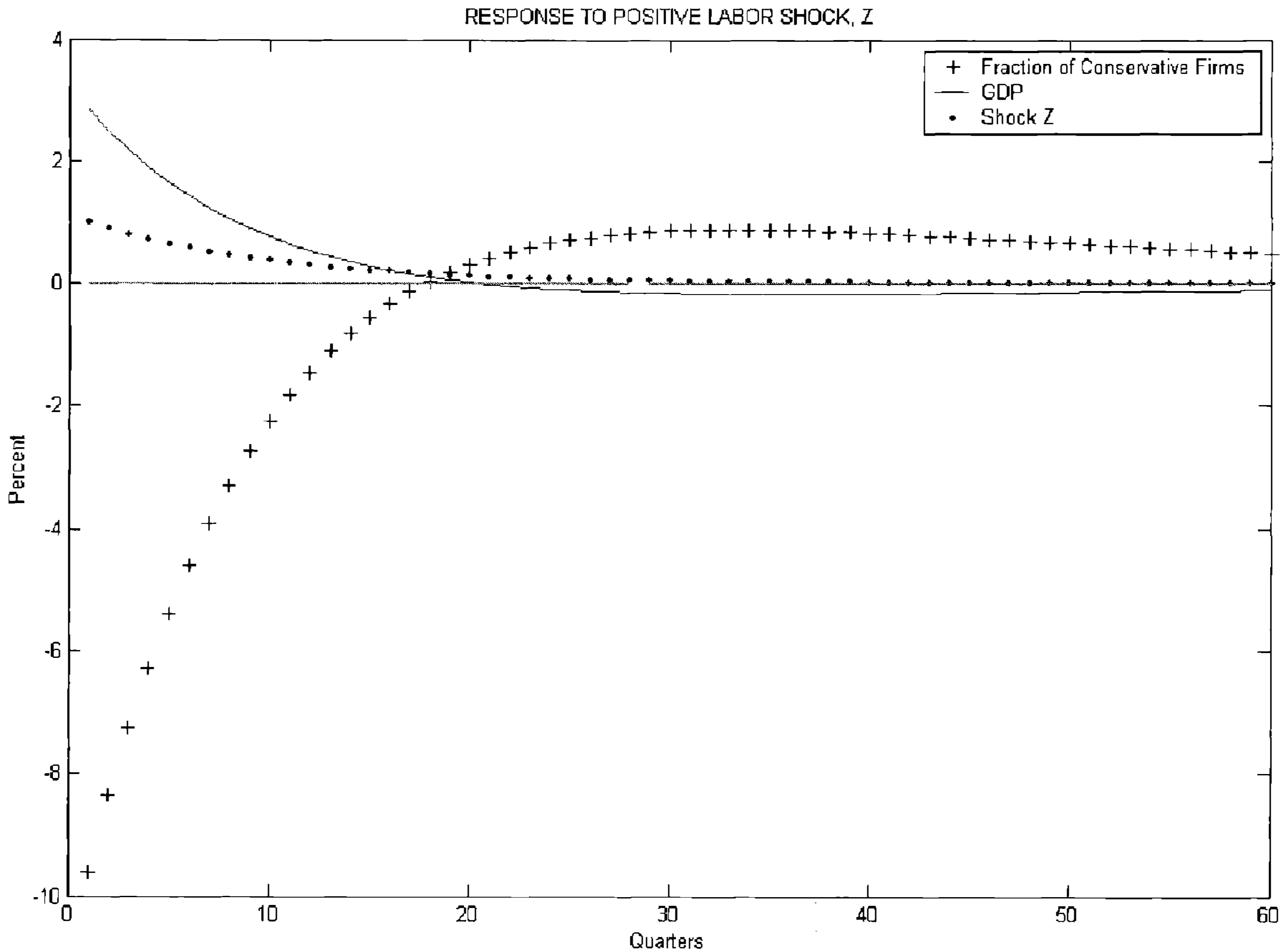

RESPONSE TO POSITIVE LABOR SHOCK, Z
Fraction of Conservative Firms
GDP
Shock Z
Percent
Quarters
4
2
0
-2
-4
-6
-8
-10
0
10
20
30
40
50
60

Figure 3

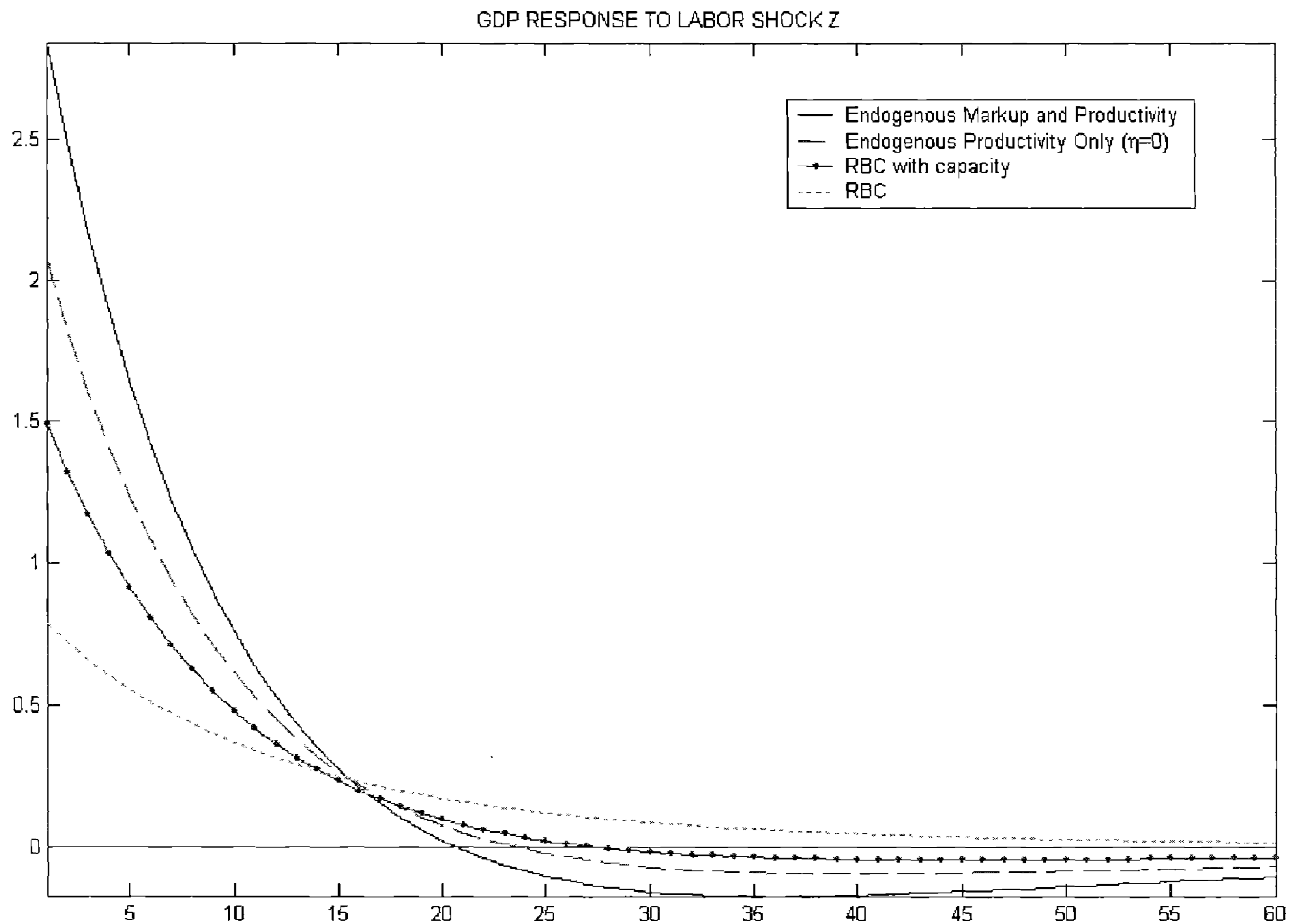

GDP RESPONSE TO LABOR SHOCK Z
Endogenous Markup and Productivity
Endogenous Productivity Only (η=0)
RBC with capacity
RBC
2.5
2
1.5
1
0.5
0
5
10
15
20
25
30
35
40
45
50
55
60

Figure 4

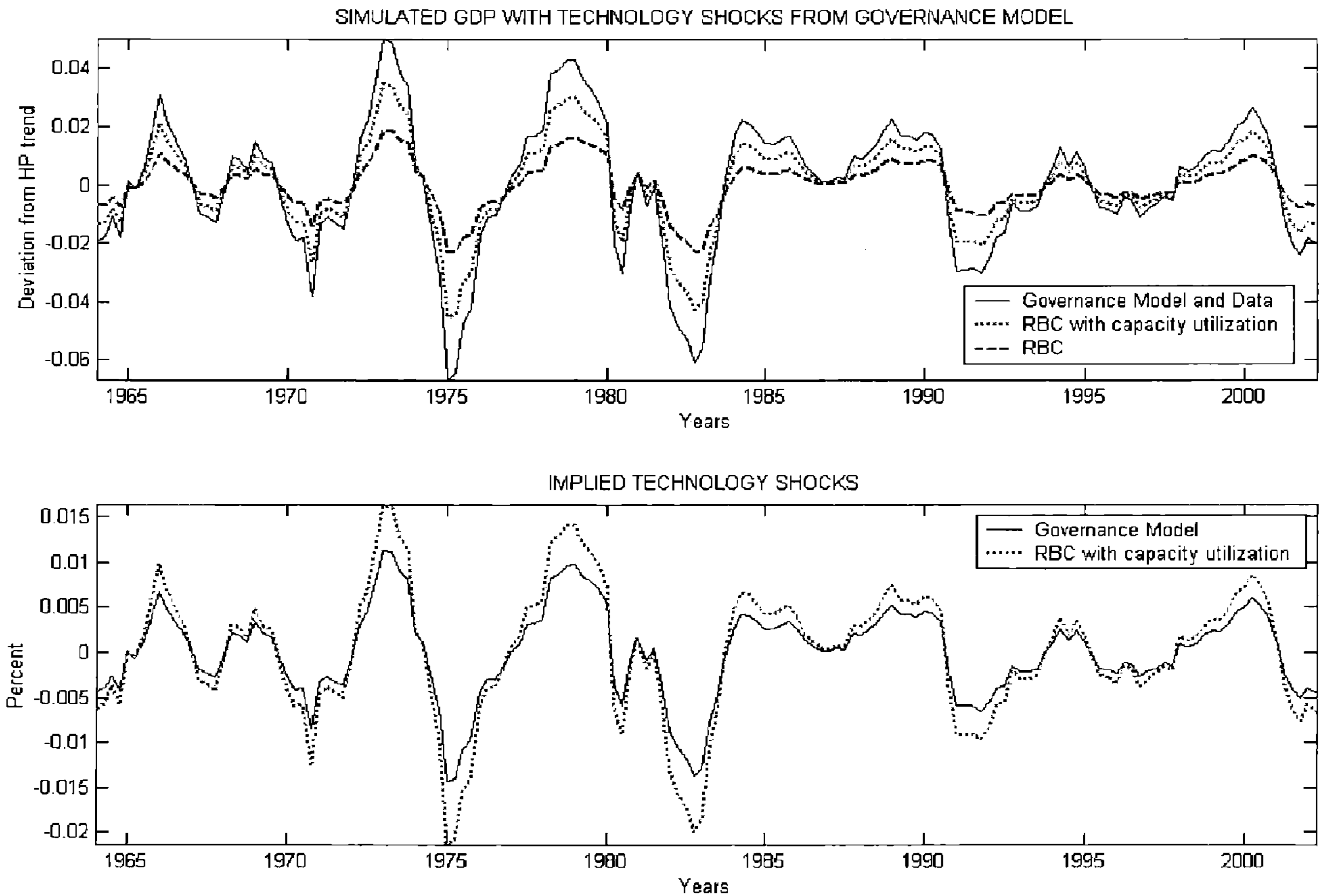

SIMULATED GDP WITH TECHNOLOGY SHOCKS FROM GOVERNANCE MODEL
Deviation from HP trend
0.04
0.02
0
-0.02
-0.04
-0.06
1965
1970
1975
1980
1985
1990
1995
2000
Years
Governance Model and Data
RBC with capacity utilization
RBC
IMPLIED TECHNOLOGY SHOCKS
Percent
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
1965
1970
1975
1980
1985
1990
1995
2000
Years
Governance Model
RBC with capacity utilization

Figure 5

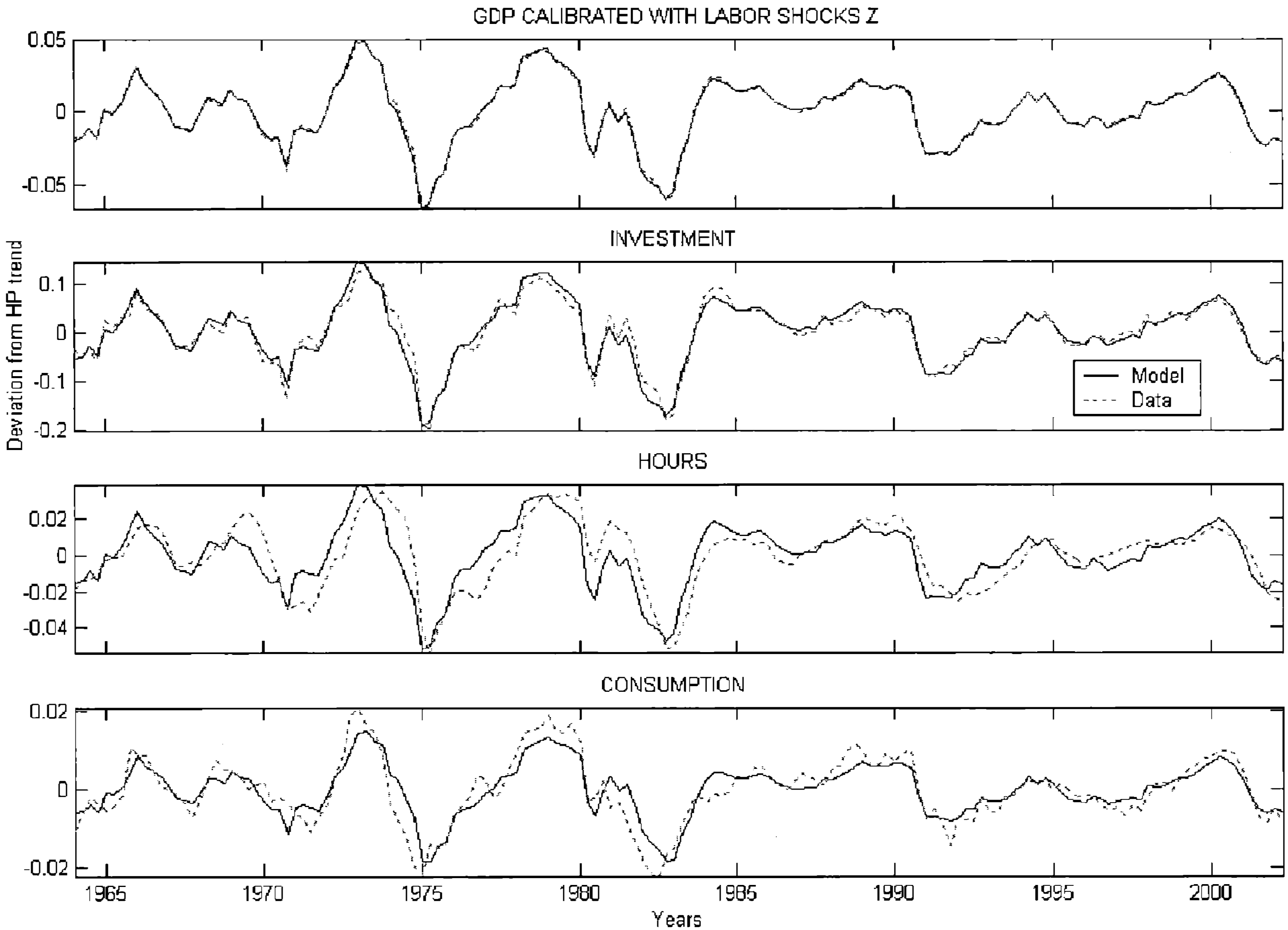
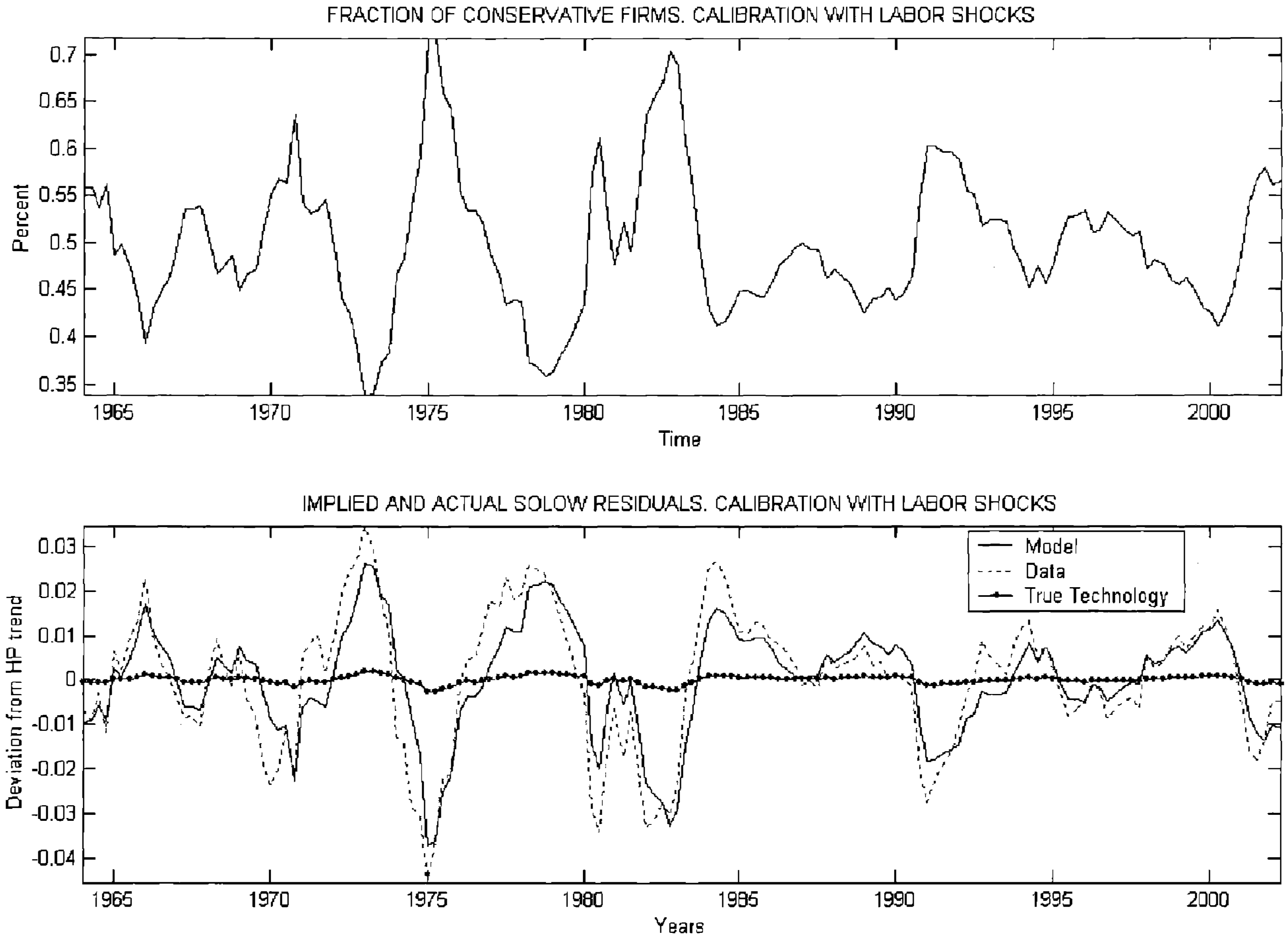

GDP CALIBRATED WITH LABOR SHOCKS Z
INVESTMENT
HOURS
CONSUMPTION
Deviation from HP trend
Model
Data
Years
0.05
0
-0.05
0.1
-0.1
-0.2
0.02
-0.02
-0.04
1965
1970
1975
1980
1985
1990
1995
2000

Figure 6



FRACTION OF CONSERVATIVE FIRMS. CALIBRATION WITH LABOR SHOCKS
Percent
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
1965
1970
1975
1980
1985
1990
1995
2000
Time
IMPLIED AND ACTUAL SOLOW RESIDUALS. CALIBRATION WITH LABOR SHOCKS
Deviation from HP trend
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
Model
Data
True Technology
Years

Figure 7

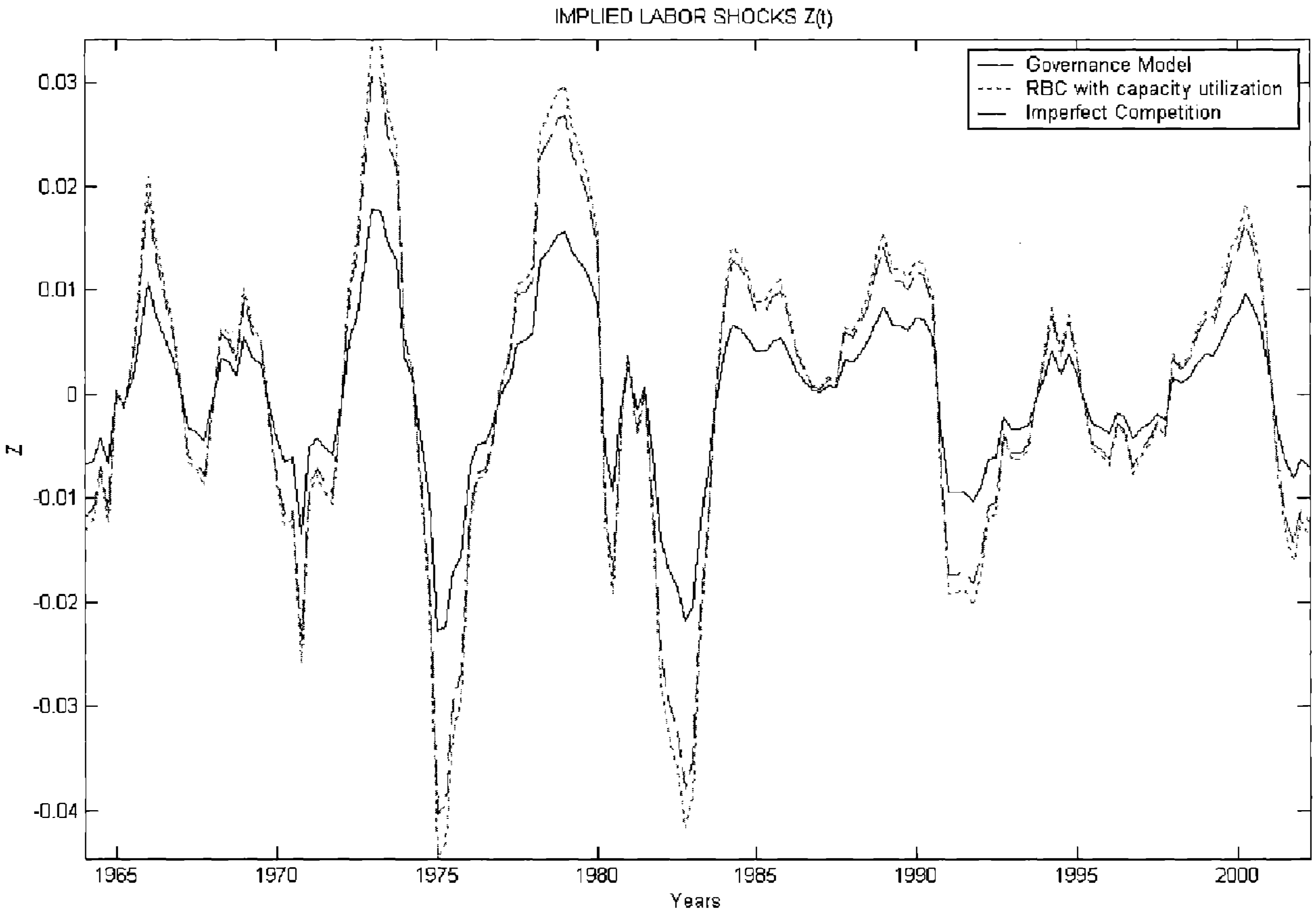
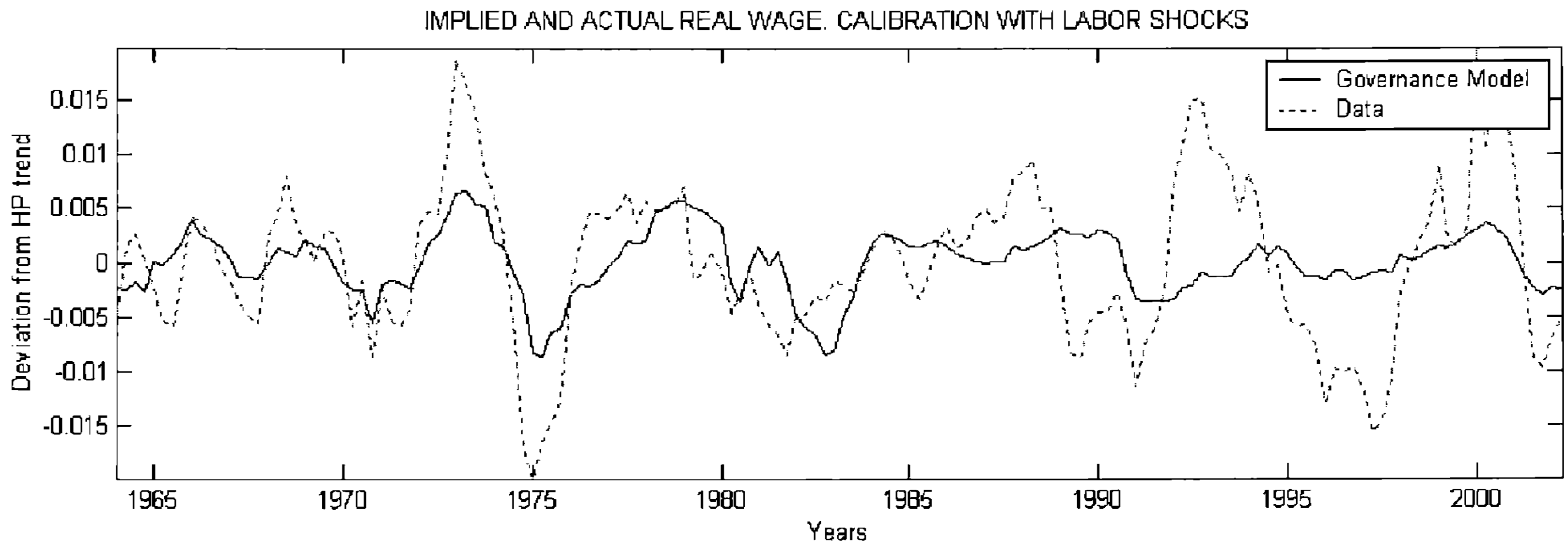
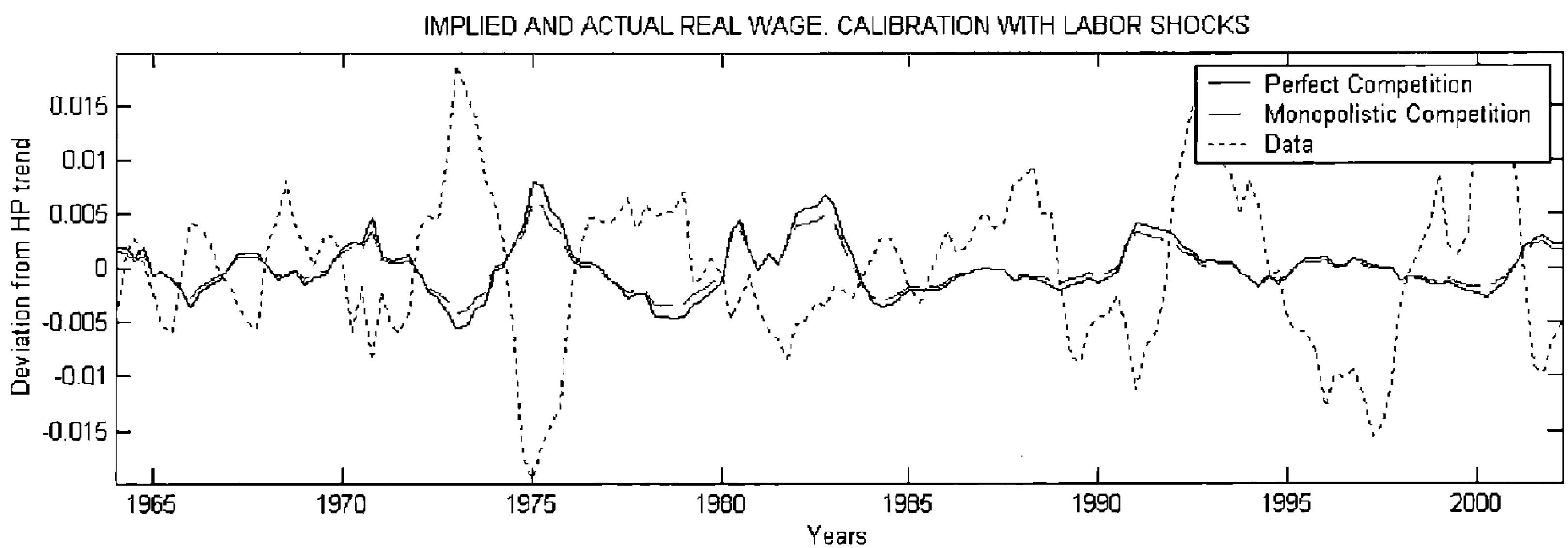

IMPLIED LABOR SHOCKS Z(t)
Governance Model
RBC with capacity utilization
Imperfect Competition
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
Z
1965
1970
1975
1980
1985
1990
1995
2000
Years

Figure 8

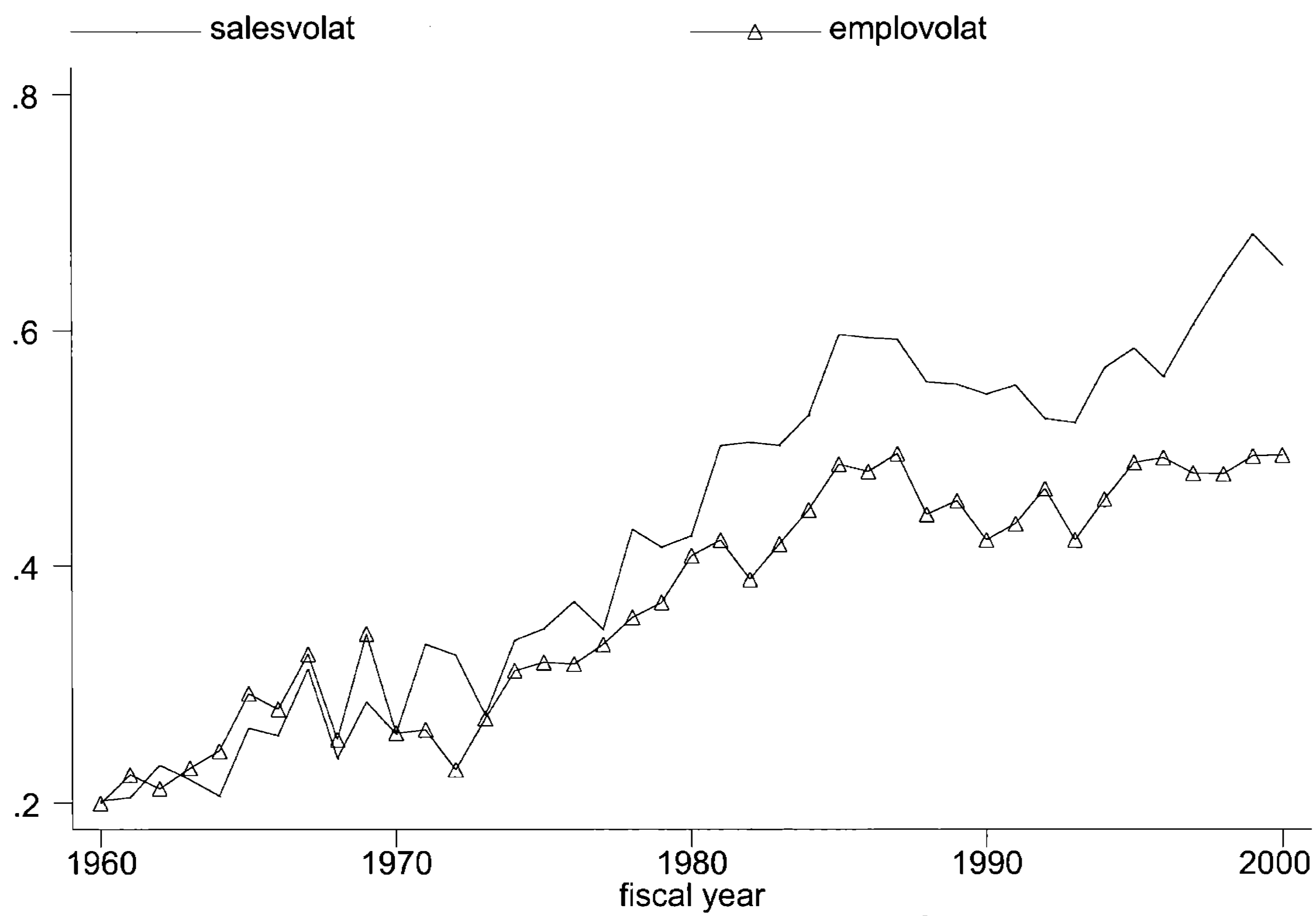


IMPLIED AND ACTUAL REAL WAGE. CALIBRATION WITH LABOR SHOCKS
Governance Model
Data
Deviation from HP trend
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
1965
1970
1975
1980
1985
1990
1995
2000
Years



IMPLIED AND ACTUAL REAL WAGE. CALIBRATION WITH LABOR SHOCKS
Perfect Competition
Monopolistic Competition
Data
Deviation from HP trend
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
1965
1970
1975
1980
1985
1990
1995
2000
Years

Figure 9



Firm level Volatility of Sales and Employment Growth, All Firms

Figure 10

Raw standard deviation of log growth rate

Annual Compustat files

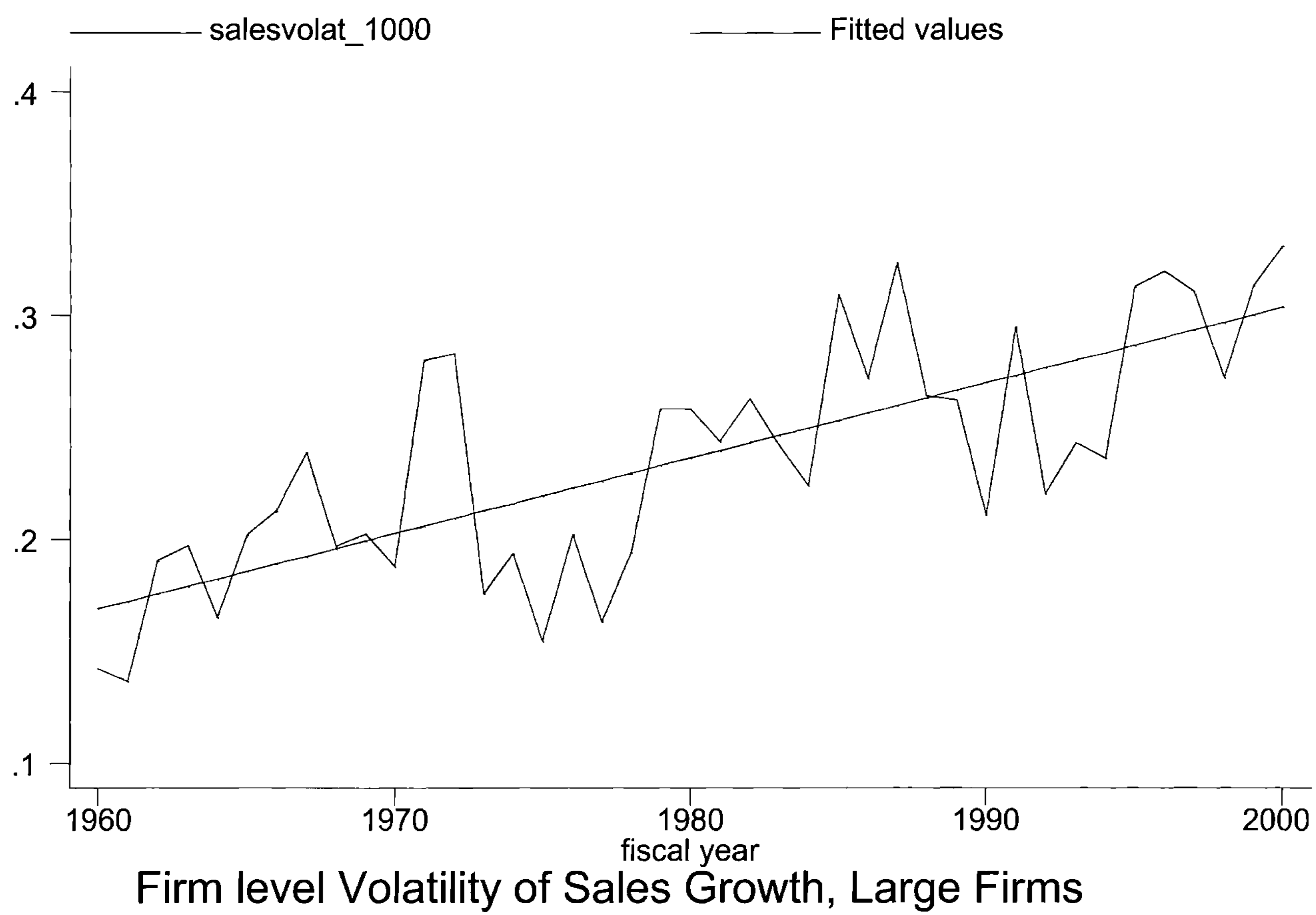


Figure 11

Raw standard deviation, firms with more than 1000 employees
Annual Compustat files

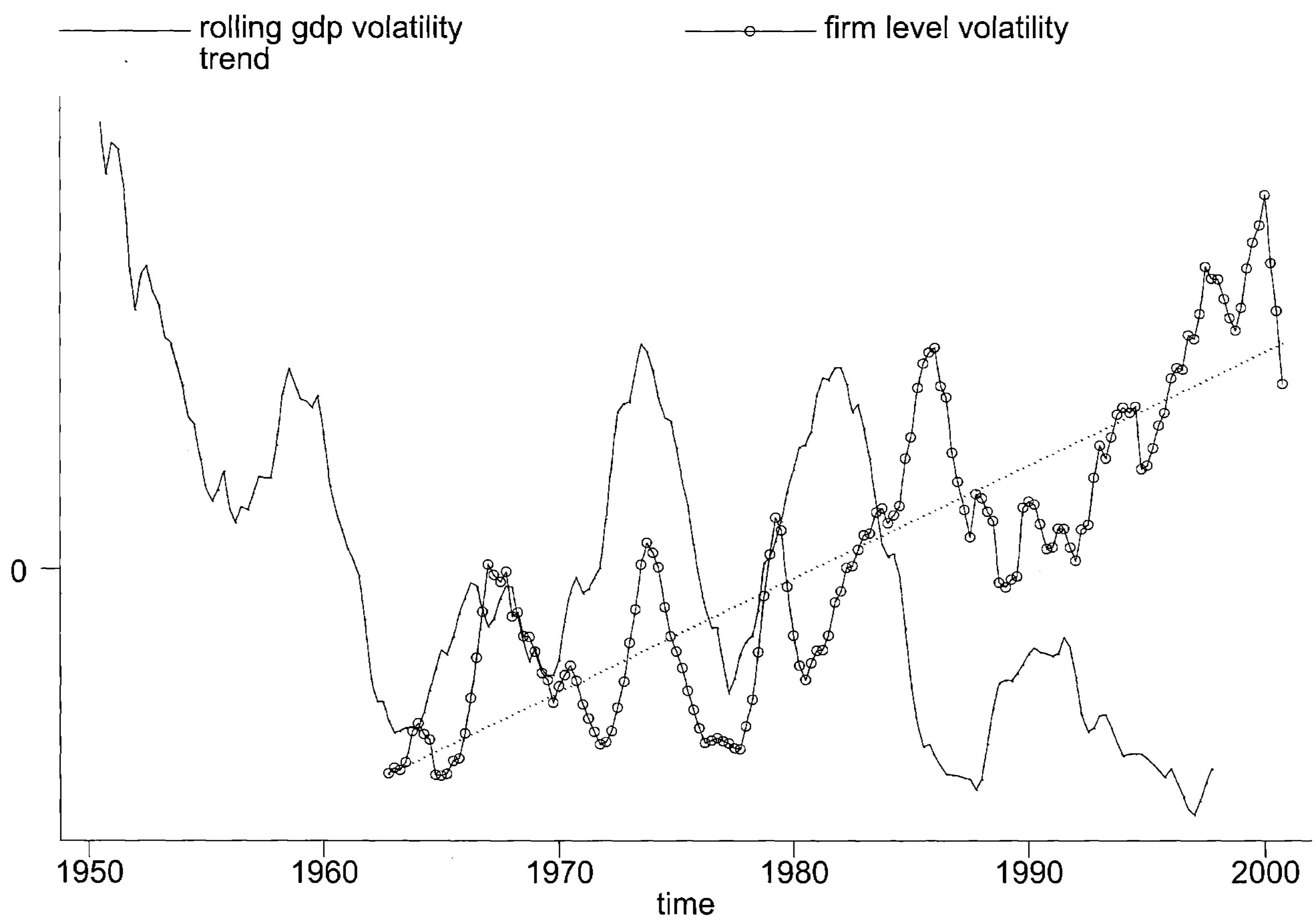


Figure 12

Aggregate rolling window Volatility
and size weighted Firm Level Volatility from Quarterly Compustat files
Scaled and demeaned to fit on figure

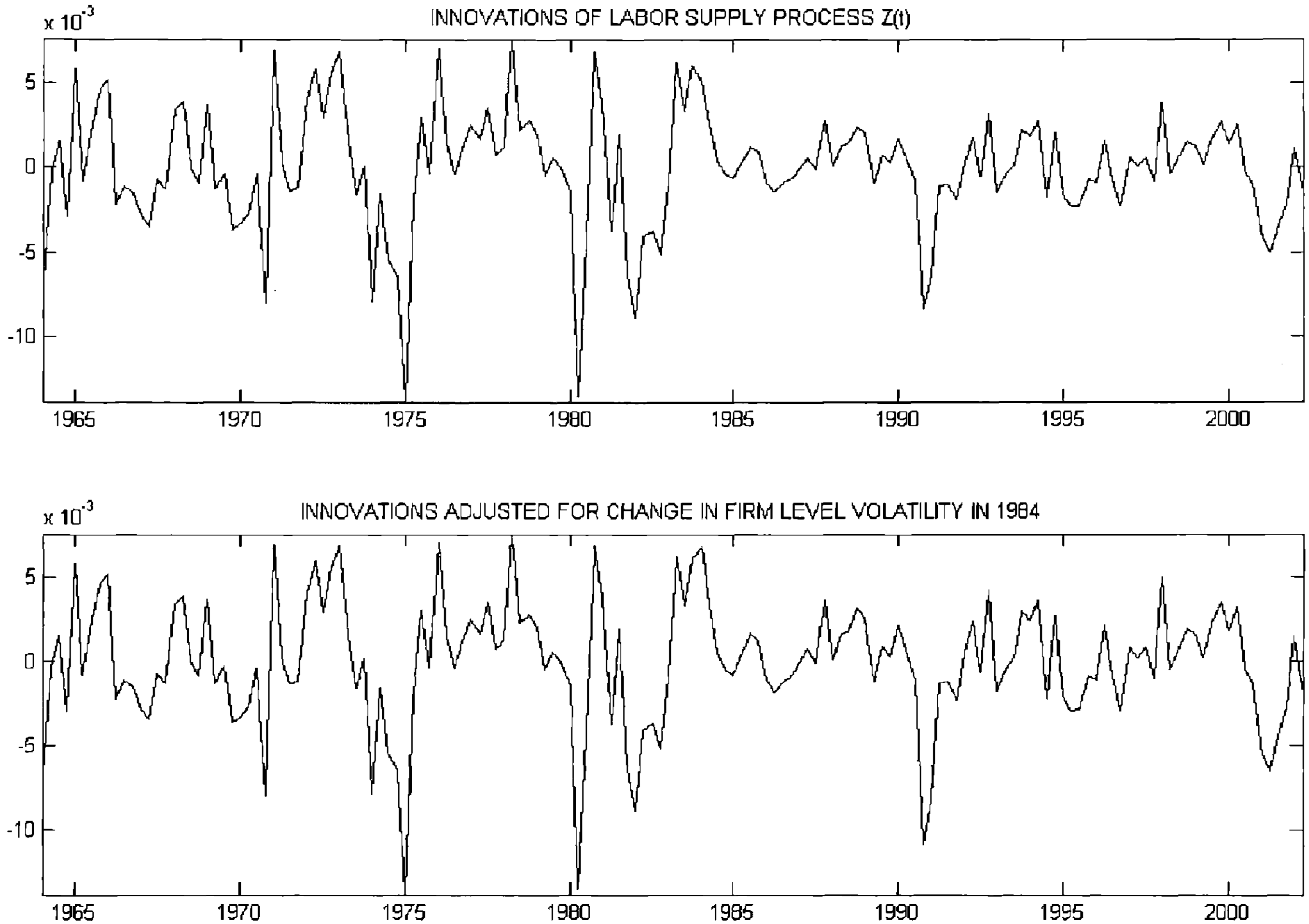

INNOVATIONS OF LABOR SUPPLY PROCESS Z(t)
x 10^-3
5
0
-5
-10
1965
1970
1975
1980
1985
1990
1995
2000
INNOVATIONS ADJUSTED FOR CHANGE IN FIRM LEVEL VOLATILITY IN 1984
x 10^-3
5
0
-5
-10
1965
1970
1975
1980
1985
1990
1995
2000

Figure 13

Chapter 2

The Decline of Rents and the Rise and Fall of European Unemployment

with Olivier Blanchard

Introduction

The motivation for our paper comes from listening to the rhetoric of different labor unions both within and across European countries:

Some unions speak of the need for a "partnership between labor and capital." While fighting for labor, they nevertheless insist on the need to maintain an adequate rate of return for capital, lest capital move away and employment suffer.[1]

Some unions instead have a view much closer to the old "class struggle" view of relations between capital and labor. They speak as if the fight over the distribution of income between wages and profits were a fight for rents, with few implications for employment.

It seems a-priori plausible that, in economies where collective bargaining plays an important role in wage determination, such attitudes on the part of unions might have a bearing on the evolution of unemployment. With this motivation, we explore, in this paper, the following hypothesis:

[1]Perhaps the best-known early statement along these lines is by Helmut Schmidt, then the Social Democratic Chancellor of Germany, in 1976: "The profits of enterprises today are the investments of tomorrow, and the investments of tomorrow are the jobs of the day after".

The last 30–40 years in Europe have seen a steady increase in both product market competition and capital mobility, and thus to a steady decline in rents[2]. These developments are eventually for the better, leading to higher efficiency, higher output, and perhaps also lower unemployment. But, to the extent that unions are slow to learn and adjust, this structural change may lead to a hump–shaped response of unemployment: First a rise, then, as learning takes place, a fall. This may explain the general evolution of unemployment in Europe during the period. And, to the extent that learning has taken place at different speeds across unions and across countries, it may also explain cross–country differences in the evolution of unemployment.

We start by looking, in Section 1, at the panel data evidence on goods market competition and capital mobility in Europe over the last 30–40 years. Obviously, neither is directly observable. But we can look at the evolution of variables which are likely to affect either competition or mobility, for example the extent of product market regulation, of the share of the business sector owned by the state. We can also look at variables which are likely to be correlated with competition or mobility, for example the volume of trade or the size of cross-country financial positions. The empirical evidence suggests that the process of capital market integration has been a steady one since at least the 1970s. Deregulation of the goods market appears more recent, becoming more important in the 1990s.

We turn, in Section 2, to the logic of the hypothesis itself. We construct a model with both monopolistic competition and imperfect capital mobility. Monopolistic competition generates rents; imperfect capital mobility generates quasi–rents.

We assume that wages are set by unions in collective bargaining. We then look at the effects of either higher product market competition or higher capital mobility on wages and unemployment, depending in particular on whether these changes are understood by unions as they take place. The model implies that one must make a distinction between higher competition and higher capital mobility:

Higher competition, coming for example from product market deregulation, is unlikely to generate an increase in unemployment, even if unions do not understand the change.

[2] By rents, we mean the profits that agents earn in excess of what they would earn if they were price takers in all markets. By quasi-rents, we refer more specifically to the rents that labor can extract from capital because capital is fixed in the short run.

Higher capital mobility, on the other hand, is likely to lead to lower unemployment if unions understand the change, but to higher unemployment if they do not. So, if unions learn only over time, higher capital mobility leads first to an increase in unemployment, then to a decrease to a lower level.

Thus, the model implies, if we want to explain the evolution of European unemployment—its increase in the 1970s and 1980s, and its more recent turnaround—the crucial factor must be increasing capital mobility, not increasing product market competition. If anything, product market deregulation, which has come late, is likely to be contributing to the recent decrease in unemployment.

With the model as a guide, we return to the evidence. We look, in Section 3, at the evolution of European unemployment and wages since the early 1970s. If we think of the increase in capital mobility as the underlying source of change, and of unions as learning and adapting to the change only over time, our model predicts a hump–shaped response of unemployment, together with (positive, but insufficient) wage moderation. We show that this is indeed the pattern in the data. The real wage (per efficiency unit) decreases from the early 1980s on. Unemployment steadily increases from the early 1970s on, and only turns around in the mid to late 1990s.

The focus on European unemployment as a whole hides however important cross country differences. While some countries, most notably the large European continental countries, have had increasing unemployment up to the mid-1990s and are still at high levels today, other countries turned around much earlier, and have very low unemployment today. The most interesting case may be the Netherlands, where, after increasing sharply, unemployment turned around in the early 1980s, and is below 3% today. We show that countries which have experienced the largest decrease in unemployment are also the countries where wage moderation has been the strongest. And that wage moderation can often be traced to an explicit change in the attitude of unions, for example the 1982 Wassenaar agreement in the Netherlands.

This finding raises however the question of why some countries have been more successful than others. We explore, in Section 4, the idea that this may be due to different speeds of learning of unions across countries. This leads us to look at the role of "trust" between labor and capital. It is plausible that in countries where there is more trust between social partners, unions will take firms' warnings more seriously, and thus will learn faster about changes in the economic environment. To explore this idea, we construct an (inverse) measure of trust based on the intensity of strike activity during the 1960s—that is, before the increase in unemployment. We then regress unemployment on a set of time effects interacted with this measure of trust, and show that, indeed, countries with lower measures of trust (low strike intensity) have had a much larger increase, and a later decrease, in unemployment. Indeed, differences in trust do a very good job of explaining differences in unemployment evolutions across European countries.

We believe that our hypothesis, with its focus on structural change, collective bargaining, and the attitudes of unions, is an important component of the European unemployment story. But it is surely not the only one. Section 5 relates our explanation to the body of research on European unemployment, and concludes.

2.1 Some empirical evidence

From the point of view of labor, there are two types of potentially appropriable rents. First, "pure rents", returns in excess of the required rate of return to capital, coming from monopoly power of firms in the goods market. Second, "quasi–rents", returns in excess of the required rate of return to capital, coming from inelastic capital supply in the short run, and possibly also—but to a lesser degree—in the long run. The distinction between the two will be important when we look at the effects of product market and capital market integration and deregulation on unemployment later on.

Neither pure nor quasi–rents are easily observable. The main reason is indeed one of the themes of this paper, which is that they may be partly appropriated by workers. Large monopoly rents may not show up as profits, but as higher wages for the workers in the firm. What is more easily observable however is the evolution of a number of variables which are either likely to affect these rents, such as measures of barriers to entry, public ownership in the business sector, or likely to be correlated with the degree of domestic or international competition, such as gross flows of goods or of financial capital across countries.

These are the variables we look at in this section. Our contribution here is only to put together measures constructed by others. We rely in particular on both published and unpublished data from the large OECD project on product market regulation.[3] Whenever feasible, we construct and present average measures for four sets of countries:

- The four large continental countries, France, Germany, Spain, and Italy (E4 in the figures below).
- Nine smaller continental countries, Austria, Belgium, Denmark, Finland, Ireland, the Netherlands, Norway, Portugal, and Sweden (S9).
- Four "Anglo–Saxon" countries, Canada, New Zealand, Australia, the United Kingdom, plus the United States (A4+US)
- All countries together (T18).

The differences in the unemployment experiences of these 18 countries motivate our classification: Unemployment rose more and has declined least in the first group. Unemployment turned around earlier and has declined more in the second group. Anglo-Saxon countries and the United States have a substantially different unemployment record than continental European countries.[4]

The rest of the section presents various measures of integration/deregulation, first for product markets and then for capital markets. The trend towards deregulation and higher integration will come as no surprise. What is more interesting for our purposes are the timing, and the differences across groups of countries.

2.1.1 Product market deregulation

The OECD International Regulation Database Project constructed a detailed cross section of many dimensions of goods market regulation as of the late 1990s for each OECD country. This database has been extended by [Nicoletti, Bassanini, Ernst, Jean, Santiago and Swain, 2001] to a panel data base for a number of countries, based on information from seven sectors (Electricity, Gas, Rail, Road Freight, Air transport, Post, and Telecoms), for the period 1975-1998.

Figure 1 shows the evolution of the index of "barriers to entrepreneurship " constructed by Nicoletti et al. The index is a composite of various dimensions of product market regulation, from

[3] We are very grateful in particular to Giuseppe Nicoletti for making available these data to us.
[4] For more on these differences, see [Blanchard, 2000].

legal barriers to entry, to antitrust exemptions given to some public enterprises.[5]. The index varies from 0 (no barriers) to 6. The index for each group of countries is an unweighted average of the indexes for each country in the group. We draw the following conclusions from the figure:

- There has been a clear decline in barriers to entrepreneurship since 1975.
- Deregulation started in the mid 1980s in Anglo-Saxon countries, and the index is now very low.
- In both large and small continental European countries, deregulation started in earnest only in the early 1990s, clearly under the influence of Bruxelles and the "One Market" initiative of the European Union, and the index has decreased less.

2.1.2 Product market integration

Another measure which is likely to be correlated with the degree of goods market competition is the level of foreign trade. Figure 2 plots the ratio of the sum of exports and imports to GDP, from 1960 to 1998, for each group of countries. We draw the following conclusions:

- Product markets have become steadily more integrated over time.
- The rate of growth of trade was high in the 1960s—3.2%, for the 18 countries taken together. It was then much lower in the 1970s and the 1980s—2.2% and 1.9% respectively. It increased again in the 1990s, when it has reached 3.2%.[6]
- For the larger continental European countries, the ratio has increased from 0.12 to 0.60. For the smaller and so naturally more open continental countries, the ratio has increased from 0.41 to 1.06. For the Anglo-Saxon countries, the ratio has increased from 0.26 to 0.41.

[5] The description of the index is given in [Nicoletti, Bassanini, Ernst, Jean, Santiago and Swain, 2001], p.18

[6] As is well known, over a longer time span, the evolution of the volume of trade is not a steady trend. The volume of trade relative to GDP increased sharply in the 19th century, and was high at the start of the 20th century ([Williamson, 2002]). An interesting question is whether some of the mechanims we focus on here were at work at that time. The main difference is probably in the nature of collective bargaining and the strength of unions, then and now.

2.1.3 Private versus public ownership

Turning now to quasi–rents, one relevant measure is the degree of state ownership of firms in the business sector. There is much evidence that state-owned firms do not respond in the same way as privately-owned firms to an increase in wages. Even if the rate of return on capital becomes very low, the state is more likely to continue investing, and maintain employment than would a private firm. (Think of state-owned mining firms, which, in nearly all countries, continue operating long after they have become major loss makers.)

With this in mind, we show in Figure 3 the evolution of an index of state ownership, constructed by Nicoletti (private communication), for the period 1975 to 1998. The index varies from 0 (no state ownership) to 10, based on the percentage of the value added in the business sector produced by state owned firms.

Figure 3 looks in many ways similar to Figure 1:

- There has been a clear decline in state ownership over time. Much of the decline has happened relatively late in the sample.
- State ownership was lower in Anglo-Saxon countries to start, started declining in the mid 1980s on, and has now reached a level similar to that of the United States.
- The decline in continental Europe has happened mostly in the 1990s, and has been more limited. There is no clear difference between large and small countries.

2.1.4 Capital market integration

A measure which is likely to be correlated with capital market integration, and thus with the size and the duration of quasi–rents is the size of gross financial flows between countries.

Figure 4 reports the evolution of an index of capital mobility. It is constructed for each country as the sum of the stock of FDI and equity assets held by a country plus the stock of its FDI and equity liabilities, divided by GDP, from 1980 to 1998, using the numbers constructed by [Lane and Milesi-Ferretti, 2001]. Because of missing data for the early years, data for the E4 includes only Germany, data for S9 includes only the Netherlands and Austria, data for A4 includes only the United Kingdom and Canada.[7]

[7]We constructed another, wider, index, which includes the stock of all foreign assets held by the country and all

We draw the following conclusions from Figure 4.

- There has been a steady increase in capital mobility at least from 1980 on. For the five countries we look at here, the average ratio increased from a low 0.10 in 1980 to 0.45 in 1998. (Given the initially low level of the ratio in 1980 in most countries, the increase must have been limited before 1980.)[8].

- Anglo-Saxon countries were more integrated to start with, and the relative increase has been more limited.

- The increase has been larger, both absolutely and relatively, in the small than in the large continental European countries.

The overall picture which comes out from looking at the evolution of these admittedly imperfect measures is a complex one. Simplifying a bit, we draw three main conclusions:

First, and foremost, there clearly has been an increase in both product and capital market competition since the early 1970s.[9]

Second, the increase in capital market competition appears to predate the increase in goods market competition. Clearly, for continental Europe, product market deregulation is largely a story of the 1990s, not earlier.

Third, except perhaps for the scope of capital market integration, there is no obvious difference between large and small European countries.

---

domestic assets held by foreigners. Its evolution is similar to that reported here.

[8]The earlier remark about the evolution of trade over a much longer time span applies to capital flows as well. The volume of capital flows was very high early in the 20th century, only to decline sharply later. [Obstfeld and Taylor, 2003]

[9]We constructed another potential measure of internal capital market integration, the standard deviation of profit rates across sectors. Using the OECD sectoral data base, we computed this standard deviation for each country and for each year, and then looked at the evolution of the average standard deviation for the group of countries taken together. This measure shows a sharp decrease over time, a finding consistent with increased internal capital mobility. But we suspect that the result may come also from incorrect measures of the initial capital stock, giving incorrect measured profit rates early on. As time passes, and the initial guess for the capital stock matters less, measured profit rates will then converge, even if true ones do not. For this reason, we do not show these results here.

2.2 A minimalist model

In constructing a model, we have in mind the following questions: What are the likely dynamic effects of higher competition in the goods market, and of higher capital mobility in financial markets? If wages are set in collective bargaining, how do these effects depend on how fast unions learn about these structural changes? What is likely to happen to unemployment?

To answer these questions, we construct the following minimalist model.[10]

Consider an economy with a continuum of firms on [0 1].

- The goods market is monopolistically competitive, and each firm faces demand given by:

$$\frac{Y}{\overline{\overline{Y}}} = p^{-\sigma}, \qquad \sigma > 1$$

  where bars denote aggregates, Y denotes the output of the firm, and p denotes the relative price of the firm. The parameter σ is the first important parameter here: The higher σ, the smaller the monopoly power, the lower the rents.

- The production function for each firm is given by:

$$Y = \min(K,\ N)$$

  This Leontief assumption implies a simple (trivial) link between capital accumulation and movements in employment—a central link in our story. It eliminates however movements in employment due to changes in the desired capital-labor ratio, which are probably an important part of the actual story of European unemployment.[11]

- The profit rate of each firm is therefore given by:

$$\pi \equiv \frac{pY - wN}{K} = p - w = (\frac{K}{\overline{\overline{K}}})^{-\frac{1}{\sigma}} - w$$

[10] [Blanchard and Giavazzi, 2002] looked at the dynamic effects of deregulation in the product and labor markets. This model can be seen as extending the analysis to explore the effects of deregulation in financial markets as well.

[11] For more on the evolution of the capital-labor ratio, see [Blanchard, 2000], Lecture 1.

The profit rate is decreasing in the capital stock of the firm relative to the aggregate capital stock, and in the wage.

- The supply of capital to the firm is given by:

$$K = (\frac{\pi}{r})^{\theta}$$

where r is the world interest rate. The parameter θ is the second important parameter, capturing the extent of quasi–rents. A value of 0 implies that capital is stuck in the firm (a caricature of state-owned firms). A value of ∞ implies no quasi–rents.[12]

Collective bargaining takes place at the level of the firm. Unions choose w to maximize the wage bill, wN, so:

$$w = \arg\max(wN)$$

where, from above, the relation between w and N is given by:

$$w = (\frac{N}{\overline{\overline{N}}})^{-\frac{1}{\hat{\sigma}}} - rN^{\frac{1}{\hat{\theta}}}$$

where we now introduce a hat to denote the unions' beliefs about the parameters σ and θ, which may or may not be the same as the actual parameters (We assume firms and suppliers of capital know the true parameters).

The assumption that the union maximizes the wage bill is for simplicity. The assumption of unilateral wage setting by the union is obviously too strong empirically. We make it to avoid a more complex issue, the nature of bargaining when the two sides do not have the same model of the economy (if σ and $\widehat{\sigma}$, or θ and $\widehat{\theta}$, are not identical.) Under our assumption, only what the unions believe matters for wage setting.

[12] Our model does not have other dynamics than the learning dynamics introduced later. Once the wage has been set, capital adjusts instantaneously. Thus, the model does not capture the notion that quasi–rents are higher in the short than in the long run. We explored specifications allowing for dynamics in the supply of capital. In particular we explored a specification where a given change in the profit rate leads to a decrease in capital by a given amount each period, but for a random number of periods (according to a Poisson parameter which determines whether the process stops each period, and thus determines the average long run elasticity of capital to profit.) In this world, it may take a long time for unions to realize that the Poisson parameter has changed; by then, capital, and by implication, employment, may have already decreased substantially. We leave these dynamics out here, as they do not change the basic conclusions below.

In short, our model has two central parameters, σ and θ, which capture the degree of goods market competition and capital mobility respectively. It takes (at least) four shortcuts. It is static; production is Leontief; it is symmetric, with no idiosyncratic shocks to firms; wage setting is unilateral. None of these shortcuts, we believe, is central to the basic results.

Solving for the wage chosen by a union in a given firm, and then imposing symmetry (i.e. $\overline{N} = N$, or equivalently, $p = 1$), the general equilibrium level of employment is given by:

$$N = K = (\frac{1-w}{r})^{\theta}$$

where the wage is given by:

$$w = \frac{\widehat{\sigma} + \widehat{\theta}}{\widehat{\sigma}(1+\widehat{\theta})}$$

So, replacing in the employment equation:

$$N = \left[(\frac{1}{r})(\frac{\widehat{\sigma}-1}{\widehat{\sigma}})(\frac{\widehat{\theta}}{1+\widehat{\theta}})\right]^{\theta}$$

Note the special case of a "pure rents economy": Assume that the actual parameters are known by unions so we can ignore the hats. Then, consider an economy where both σ is close to one (high monopoly power), and θ is close to zero (low capital mobility). In such a "high rents" economy, the wage w will be close to one, and so will N, the level of employment. In words, labor will want to appropriate all the rents, and will be able to do so at no cost in employment. Under our (too strong) assumption that the wage is set unilaterally, the unions will drive profit to zero, while employment will remain nearly the same. In a more realistic Nash bargaining framework, the unions would push the wage as far as their bargaining power allows them to, again with nearly no implication for employment.

This is obviously an unrealistic configuration of parameters. But it may have been less so in the past when goods markets were less competitive, and capital less mobile. And it is still prevalent in the rhetoric of some of unions and political parties in Europe.[13]

We now turn to the effects of higher product market competition, then to the effects of higher

[13] In the last French Presidential election, one of the candidates, Olivier Bezancenot, argued in favor of what he saw as an obvious solution to the problem of income inequality in France: redistributing the profits of firms to the poor.

capital mobility.

2.2.1 Higher product market competition

Consider an increase in σ, coming for example from product market deregulation. Then the equations above have the following implications.

- If unions understand that σ has increased, so $\widehat{\sigma} = \sigma$ (and $\widehat{\theta} = \theta$), then the increase in σ leads to a decrease in the wage, and (only) through this decrease in the wage, to an increase in employment.
- If unions do not understand that σ has increased so $\widehat{\sigma}$ remains constant, the wage does not change, nor does employment.

Thus, if understood by unions, product market deregulation leads to a decrease in unemployment. If not, it has no effect on unemployment.

These results, especially the second, may be surprising–and they are surely of little help if our goal is to explain the increase in unemployment in Europe as a result of product market deregulation... But they are in fact quite robust to variations in our assumptions. Indeed, in a more general model, product market deregulation is likely to *decrease* unemployment even if unions do not understand the change in the product market competition. The intuition is as follows:

In general, product market deregulation has two effects on employment.[14]

First, a direct effect through the decrease in the markup chosen by firms. Higher competition leads to a lower markup of price over marginal cost, or equivalently to a higher real wage at any given level of employment. Turning this around, it leads to a higher level of employment *for a given real wage*. Thus, even if unions do not understand the change in the goods market, and so do not change the wage, employment will increase. This effect is not present in our model, because of the Leontief assumption for the production function: given capital, the marginal cost curve is vertical, the decrease in the markup irrelevant.

Second, an indirect effect through wage moderation. To the extent that workers perceive a more elastic demand curve for labor, they are likely to choose a lower wage, leading to higher employment. This is the effect present in our model: higher product market competition leads

[14] For a more formal discussion, see [Blanchard and Giavazzi, 2002].

unions to choose *a lower wage*, leading in turn to higher profit, higher capital accumulation, and so higher employment.[15]

2.2.2 Higher capital mobility

Consider now an increase in increase in θ, coming for example from capital market deregulation/integration. Then, from the equations above:

- If unions understand the change, so $\widehat{\theta} = \theta$ (and $\widehat{\sigma} = \sigma$), then they decrease the wage and increase profit. But the elasticity of capital, and thus of employment, with respect to profit increases. Thus the effect on employment is ambiguous:

  For values of θ close to zero (so a wage close to 1, and a profit rate close to zero), employment decreases. This is because the trade–off between lower wages and higher employment is sufficiently unattractive that workers prefer a decrease in employment to the decrease in the wage which would be needed to maintain employment. As θ increases however, the trade–off becomes more attractive, and employment eventually increases. The relation between w, N and θ is drawn in Figure 5.

  Thus, subject to the caveat above, if unions understand the change, capital market deregulation will lead to lower unemployment.

- If however unions do not understand the change, then increased capital mobility will be associated with an increase in unemployment. The wage does not change, and so profit does not change. The low profit rate leads to a larger response of capital, and thus a larger decrease in employment.[16]

  Put simply, higher capital mobility increases the elasticity of the derived demand for labor with respect to the wage. If unions do not take this into account, and do not moderate their wage demands, then capital, and by implication, employment will decrease, unemployment will increase.

[15] This discussion looks at symmetric, across the board, product market deregulation. If deregulation applies only to some sectors, then, if unions do not take this change into account, employment may well decrease in those sectors. Barring however unlikely asymmetric adjustment effects, implications for aggregate unemployment are likely to be the same as in the text.

[16] This assumes that the economy starts from a profit rate below the relevant world interest rate, as will be the case if θ or σ are low enough to start with.

To summarize: It is important to distinguish between the decline in rents, and the decline in quasi–rents. A decline in rents, coming from increased product market competition, is unlikely to generate an increase in unemployment, whether or not unions understand what is happening. A decline in quasi–rents, coming from increased capital mobility, if understood by unions, is likely also to lead to a decrease in unemployment. However, if it is not understood, it will lead to an increase in unemployment.

This suggests that, if unions learn about the change over time, higher capital mobility may lead first to an increase, then to a decrease in unemployment. This is what we explore next.

2.2.3 Learning and unemployment

To look at the implications of learning for unemployment dynamics, we focus on changes in θ (the reason is clear from above: increases in σ cannot generate an increase in unemployment, whether unions learn or not). For notational simplicity, we assume $\sigma = \infty$.

- To make learning non trivial, we introduce shocks to the labor demand schedule:

$$N_t = \left(\frac{1 - w_t}{r}\right)^{\theta_t} \times \epsilon_t$$

where ϵ_t is a log-normal disturbance. Taking logs:

$$n_t = \theta_t \ \log(\frac{1 - w_t}{r}) + \varepsilon_t$$

where ε_t is *iid* normally distributed with mean 0 and standard deviation s.

- Uncertainty about θ is formalized as follows: θ is either low, equal to $\underline{\theta}$ or high, equal to $\overline{\theta}$. At $t = 0$, the workers have the prior: $p_0 = \Pr(\theta = \overline{\theta})$, where p_0 is initially small.

- Given their beliefs, unions set the wage period by period so as to maximize:

$$\max E_t[\log(w_t N_t)]$$

The assumption that they maximize the expected value of the log of the wage bill rather than the wage bill itself is for simplicity. The more important assumption is that of period–by–

period maximization. This assumption eliminates strategic learning by wage setters. Under the assumptions we have made, it may sometimes be optimal for a long-lived union with a low discount rate to move widely the wage in order to learn θ with more precision. We do not believe this is empirically relevant for many reasons. One is the standard free riding problem: workers who lose their jobs in the experiment are not sure to find them afterwards while others benefit from the fast learning. The other is that adjustment costs are likely to make this strategy less appealing.

Under our assumptions, the wage chosen by the union in period t is given by:

$$\frac{1}{w_t} = \frac{\widehat{\theta}_t}{1 - w_t}$$

where

$$\widehat{\theta}_t = E_t[\theta] = p_t\overline{\theta} + (1 - p_t)\underline{\theta}$$

Define $x_t \equiv -\log(1 - w_t) + \log(r)$. The updating rule for p_t is in turn given by:

$$p_{t+1} = \left[1 + \frac{1 - p_t}{p_t} \times \exp(-\frac{1}{2s^2}\left[(n_t + x_t\underline{\theta})^2 - (n_t + x_t\overline{\theta})^2\right])\right]^{-1}$$

This is an almost standard Bayesian inference problem, except for the fact that the gain depends on the wage which itself depends on the initial beliefs (which is why there could be room for strategic learning).

Of course, given that the shocks are random, there are many possible learning paths. The simplest paths to look at are those where the shocks to ε_t are zero all along. Define $\Delta_\theta = \overline{\theta} - \underline{\theta}$. The dynamics of employment are then given by:

$$\begin{aligned}
p_{t+1} &= \left[1 + \frac{1 - p_t}{p_t} \times \exp(-\frac{\Delta_\theta^2}{2s^2}\, x_t^2)\right]^{-1} \\
x_t &= -\log\left(1 - \frac{1}{1 + p_t\overline{\theta} + (1 - p_t)\underline{\theta}}\right) + \log(r) \\
n_t &= -\theta_t\, x_t
\end{aligned}$$

Figure 6 shows the adjustment of employment and wages to an increase in θ from $\underline{\theta}$ to $\overline{\theta}$. (The values of the parameters used for the simulation are $\underline{\theta} = 0.2$, $\overline{\theta} = 0.25$, $p_0 = 0.1$, $r = 0.3$, $s = 0.1$). As θ increases, capital and employment decrease. Workers see that employment has fallen but initially, if p_0 is small, they believe that it is likely to be due to adverse transitory shocks. As employment stays low, they begin to update their beliefs about the true elasticity of the long run labor demand and they turn to wage moderation. This brings back capital and employment up over time. (In the long run, under these parameter values, employment ends up slightly higher—increasing from 0.89 in the initial steady state to 0.90 in the new steady state.)[17]

One important characteristic of the figure is the combination of higher unemployment and wage moderation; wage moderation is present, but insufficient to prevent the increase in unemployment. As we shall see in the next section, this fits the European experience quite well.

The sudden initial drop in employment is however not realistic. It is the consequence of two simplifying assumptions: That the drop in θ happens from one period to the next, and that there is no adjustment cost to investment. Removing any of these would smooth out the drop and produce a simple U-shaped path for employment (but substantially complicate the Bayesian learning computations.)

Figure 7 shows the trade-off between the size of the employment drop and its persistence. It is motivated by the fact that the drop of unemployment happened faster in small, more open, economies—the Netherlands and Ireland as primary examples. The figure shows the effect of an increase in θ for two different values of Δ_θ. (The values of the parameters used for the simulation are $\underline{\theta} = 0.2$, $\overline{\theta} = 0.25$ for the first case, $\overline{\theta} = 0.3$ for the second case, $p_0 = 0.1$, $r = 0.3$, $s = 0.1$.) For the larger value of Δ_θ, i.e. for the case where θ increases by a large amount, the initial drop in employment is large but learning is fast, leading to stronger wage moderation and a stronger return to high employment. For the smaller value of Δ_θ, i.e. for the case where θ increases by a small amount, the initial drop in employment is smaller but learning is slower, leading to milder wage moderation and a slower return to high employment. Again, as we shall see later, this appears to capture differences in wage moderation and unemployment between larger and smaller continental European countries.

[17]The priors are very important in determining the dynamics, just like in any Bayesian model. With tight priors, learning is slow and non-linear.

Integrating the results from the model and the evidence from the previous section suggests the following story. Both capital mobility and product market competition have substantially increased in the last 30–40 years. But it is important to distinguish between the two. Increased capital mobility, together with slow learning by unions, may well explain both the rise, and the more recent fall in European unemployment. Increased product market competition is more likely to work the other way, to decrease unemployment. In that light, the product market deregulation, which has taken place in Europe mostly in the 1990s, is more likely to have been one of the causes of the recent decrease in unemployment rather than a cause of the earlier increase.

Having refined the initial hypothesis, we can now return to the empirical evidence on unemployment and wages, first for Europe as a whole, and then with a focus on cross country differences.

2.3 Back to unemployment and wages

Our hypothesis has a number of straightforward implications for the joint behavior of unemployment and wages. First it predicts a hump–shaped evolution of unemployment; we already know this is true, and this was one of the motivations for this paper. Second, it predicts that unemployment will increase for some time in spite of wage moderation: If unions take time to learn, they will moderate wage demands, but not by enough to avoid an increase in unemployment for some time. Third, it predicts that, everything else equal, countries in which learning takes place faster will have both stronger wage moderation and a faster and stronger decline in unemployment. We now look at how these implications fit the data.

The main empirical issue here is how to look at wages, so as to see whether there was or not wage moderation. Clearly real wages went up during the period, but this obviously reflects for the most part productivity growth. To adjust wages for technological progress, we use the following benchmark. We assume that technological progress is Harrod neutral. Under that assumption, the economy has a balanced growth path, along which the wage per efficiency unit, that is the wage divided by the index of technology is constant. Thus, under that assumption, we can think of decreases in the wage per efficiency unit as reflecting wage moderation.

To construct the series for wage in efficiency units, we first construct the Solow residual for the business sector for each year for each country, divide it by the current share of labor to obtain the rate of change of the index of technology, integrate it over time, and take the exponential to get the index of technology. We then divide the wage by this index to get the real wage in efficiency units. We use the OECD business sector data base (which, unfortunately, has been discontinued, so our data ends in the late 1990s, at different years for different countries). The wage represents the cost of labor to firms, and so includes not only the wage , but also benefits and other labor taxes paid by firms.

The limits of the exercise are clear. The construction of the Solow residual using factor shares as weights is only correct if prices of factors reflect marginal cost. This is not the case under monopolistic competition, the assumption we made in writing down our model; rough corrections for the presence of positive markups do not however make a substantial difference to the picture. The assumption of Harrod neutral technological progress may not be correct, in which case even a constant constructed real wage may not be consistent with a constant profit rate, and thus with maintained capital accumulation and maintained employment (more on this later). Nevertheless, the exercise is a useful first pass.[18]

Figure 8 shows the evolution of unemployment and the real wage per efficiency unit for the group of continental European countries in our sample, the large E4 countries and the smaller S9 countries. The unemployment rate is a weighted average of the unemployment rates of the different countries, using relative labor forces as weights. The real wage per efficiency unit is a weighted average of the real wage per efficiency units in each country, using relative business sector employment as weights. (For reasons indicated above, 1997 is the last year for which the real wage series exists for all countries, and thus for which the average real wage can be constructed.)

The figure shows the hump shape of unemployment—a steady increase from the early 1970s on, a peak in 1997, and a limited decline since then. It also shows an initial increase in the real wage per efficiency unit from 1970 to 1975, followed by a steady decline since then.[19] By the mid 1980s, the real wage is back to its 1970 level, while the unemployment rate remains very high. Our model does not predict the initial increase in the real wage, but that increase is no great mystery: The presence of other shocks have been well documented, from the first oil price shock, to the decrease in productivity growth from the early 1970s on. What fits our story well is the steady decrease in

[18]The easier and often used alternative of looking at the wage divided by labor productivity—equivalently looking at unit labor costs, or the labor share, or the "real wage gap"—makes little sense if the goal is to detect wage moderation. Labor productivity depends on the labor–capital ratio, which, over time, is very much endogenous: Higher wages lead to a decrease in the labor–capital ratio, and an increase in labor productivity.

[19]Available evidence from a number of individual countries' sources indicates that the decline has continued since 1997.

wages from 1975 on, in parallel with the continuing increase in unemployment.[20]

Figures 9 and 10 turn to the two "miracle" countries, Ireland and the Netherlands. In both countries, the evolutions are striking: In Ireland, a sharp increase in unemployment to a peak of 17% in 1985 has been followed by an even sharper decline since then. In the Netherlands, an increase to a peak of 10% in 1983 has also been followed by a steady decline.[21] And, in both cases, there has been strong wage moderation from the early 1980s on.[22] These two unemployment miracles have clearly come with substantial wage moderation.

The patterns in Figures 8 to 10 are consistent with our hypothesis. They are obviously consistent with other hypotheses as well:

Take for example the coexistence of wage moderation and high unemployment. An increase in the cost of capital could generate the same pattern: If the cost of capital increases, the wage will have to decline just to maintain employment. If the wage declines, but by less than needed, unemployment will increase. The empirical evidence is that, indeed, the cost of capital moved substantially over the period in Europe, although not in a way which would, by itself, explain the joint evolution of wages and unemployment over the period.

Or take wage moderation itself. We have emphasized the role of learning by unions. But it could reflect in part weaker rather than smarter unions. Surely the effect of the Thatcher reforms on the U.K. labor market was to make the unions weaker, not necessarily smarter. Or wage moderation could reflect the effect of high unemployment itself on wage demands, rather than any change in attitudes. High unemployment surely has played a role, although this does not explain why, for example, the Netherlands still exhibits strong wage moderation despite a very low unemployment rate today. Indeed, in the case of the Netherlands, much informal evidence points to a change

[20] Even leaving aside the "miracle countries", those countries where unemployment has declined to very low levels, this aggregate picture hides a lot of heterogeneity across countries. Nearly all countries show however a pattern of wage moderation, and a hump-shaped, delayed, response of unemployment.

[21] It is sometimes argued that this decline is a statistical illusion, reflecting a shift to part-time work, and hiding a high proportion of people on disability insurance. It is not. The increase in part-time work has come with an even larger increase in labor participation. And, while the proportion of people on disability insurance is indeed high, it has come down with unemployment. For more discussion, see [Blanchard, 2000], Lecture 1, and references therein. For a general description of the evolution of unemployment in the Netherlands, see [Nickell and van Ours, 2000] or [Visser and Hemerijck, 1997, v].

[22] The constructed wage series for Ireland overstates the degree of wage moderation in Ireland. The reason: Multinational companies have a strong tax incentive to shift profits to Ireland. The share of these (paper) profits in GDP has steadily increased through time, leading to an overestimate of output and productivity growth. However, even after eliminating these profits from output, the data still show strong wage moderation[Blanchard, 2002]. For more on this and on the Irish case in general, see [Honohan and Walsh, 2002].

in the attitudes of unions as the main factor behind wage moderation: By the early 1980s, the large increase in unemployment led to a national agreement, known as the Wassenaar agreement, in which the unions recognized the need for wage moderation, and accepted wage moderation in exchange for a number of concessions from both firms and the state (in particular more generous early retirements and a shorter workweek.) Most observers agree that this agreement played a major role in the reduction of unemployment.[23] Some researchers have argued for the importance of collective bargaining in achieving wage moderation in Ireland as well. The evidence is actually less convincing in that case: Labor mobility between Ireland and the United Kingdom, together with high productivity growth in Ireland and lower productivity and wage growth in the UK, seems to have been a more important factor in generating the fall in the real wage per efficiency unit over the period.[24]

2.4 Trust, learning, and the evolution of unemployment

Why did some countries have stronger wage moderation than others? Or, within the logic of our hypothesis, why did unions in some countries learn and adjust faster than in others?

One potential explanation is different paces of structural change. The logic behind this explanation was shown in the second simulation presented in the learning model in Section 2: A stronger adverse shock led to a larger initial increase in unemployment, but also to faster learning, and thus to a faster decline later. For lack of an obvious metric, the evidence in Section 1 on the pace of capital market integration does not speak clearly on this issue. Small countries experienced a smaller increase, but from a much higher level to start with. But it is not implausible that even a similar across-the-board increase in capital market integration might have a larger effect on small open economies. If so, this might explain in part the different evolutions of unemployment in small and large continental European countries.

Another potential explanation is differences in "trust" between labor and capital. It is again plausible that the higher the level of trust, the faster unions might learn and adapt to changes affecting firms. In the logic of our learning model, to the extent that firms can send additional

[23] [Lipset, 2000] gives other examples of similar conversions either by unions or by social democratic and socialist parties: Australia in 1983, New Zealand in 1984, the United Kingdom in 1995, Spain in 1996, Portugal in 1996.

[24] See [Blanchard, 2000]. In other words, this may be a case of weak unions, not necessarily smart unions.

signals, the more these signals are believed by workers, the faster learning will take place.[25]

To explore this idea further, we construct a measure of trust, and look at its effect on unemployment, across time and countries. We proceed as follows.

First, we take as an (inverse) measure of initial trust the average level of strikes in the 1960s in each country. In general, the level of strikes is likely to depend on many factors beyond trust, from the level of unemployment, to the size of rents, to union power. For strikes to be a valid proxy for trust, we must assume that other factors were largely similar across European countries in the 1960s. This does seem plausible for the size of rents. And we shall show that our results are largely unaffected when controlling for initial union power (proxied by union coverage) and for initial unemployment rates.

Two measures of strike activity are available by country for each year for the 1960s. The first is the number of workers involved in strikes (WI), the second is the number of days lost to strikes (DL). They are highly but not perfectly correlated. Both give roughly similar results in the regressions below. In the results presented below, we use the following variable:

$$strike_i = max\left(\frac{DL_i}{std(DL)}, \frac{WI_i}{std(WI)}\right)$$

This specification is motivated by the notion that recorded strikes happened for sure, but not all strikes are recorded, so that both measures are lower bounds on strike activity. Two more issues come up in the construction of the strike variable. The first is that two of the countries in the sample were dictatorships in the 1960s, Portugal and Spain. The wage explosion that took place in the two countries upon the end of the dictatorship suggests that the true measure of trust was in fact quite low in the 1960s. But we have no way to take this into account and drop both countries from the sample. The other is how to treat the years 1968 and 1969, where, in a number of countries, most notably France, Germany and Italy, there was high labor unrest, and unusually high levels of strikes. On the argument that these episodes reflected other factors than the one we

[25] This assumes non strategic behavior on the part of firms. Strategic behavior has interesting implications as well: Think of a standard signalling model where firms want to convince workers that an adverse change has taken place, requiring wage moderation. To do so convincingly, they may need to cut employment (for example shift operations to another country) more than they would otherwise. The reason this convinces workers is the standard one in signalling models: Such an action only makes sense for firms if the adverse change has indeed taken place. Otherwise it would be too costly for firms to take such an action.

want to capture, we construct our measure of strikes by using the mean only for the period 1960 to 1967 (Given that France, Germany and Italy are high unemployment countries, our results below would actually be stronger, were we to use the whole decade to construct the mean.)

We construct a measure of openness which is the average ratio of imports plus exports to GDP for the period 1960 to 1967 (these dates being chosen for symmetry with the dates used in the construction of the conflict variable) The values of $strike_i$ and $open_i$ are plotted in the scatter diagram in Figure 11.

We have also obtained a measure of trust based on a survey estimate of the quality of management/workers relations. The survey asks whether these relations are generally cooperative or not. Figure 12 shows that there is a strong correlation between the rank of countries according to this measure (rank of trust) and our measure of labor conflicts in the 1960s. Given that these variables are constructed from entirely different data sets, this gives us some confidence in the ability of our measure to capture the dimension of labor relations we are interested in. Note, however, that the survey uses data from the 1990s, which makes it less appealing than *strike* to construct an independent explanatory variable for unemployment in the 1980s and 1990s.

We then run the following panel data regression for the period 1965 to 1999:

$$u_{it} = \alpha_t + \beta_t \times strike_i + \gamma_t \times open_i + u_{i,60} + \varepsilon_{it}$$

In words: we regress the unemployment rate in country i in year t on its average value in the 1960s ($u_{i,60}$), a set of time fixed effects, a set of time fixed effects interacted with our conflicts variable, and a set of time fixed effects interacted with the openness variable. Equivalently, one can think of this regression as a set of regressions, regressing in each year the unemployment rate across countries on a constant, unemployment in the 1960s, trust and openness.

As a way of summarizing the results, we plot in Figure 13 the typical impact of our "trust" variable, $\beta_t \times std(strike_i)$ and our openness variable $\gamma_t \times std(open_i)$ on the unemployment rate. We also plot the coefficient and standard errors ($\beta_t \pm 2\sigma_{\beta t}$, $\gamma_t \pm 2\sigma_{\gamma t}$) on Figure 14.

- Openness is uncorrelated with unemployment until the mid-1970s. From then on however, more open countries tend to experience higher levels of unemployment and the impact becomes significant in the 80s and the early 90s. At the end of our sample period (1999), the effect turns negative but insignificant. This is consistent with the outcome of the simulation reported in Figure 7. Other things equal, it appears that more open economies had more of an increase in unemployment early on, and more of a decrease in unemployment later on.

- Turning to trust, countries with higher levels of strikes (a lower level of trust under our interpretation) have slightly higher unemployment rates in the 1960s, but the effect is not statistically significant. From the mid-1970s on however, the impact becomes large (Figure 13) and significant (Figure 14). At its peak in 1987, our proxy for trust can explain a difference of up to 9 points in the unemployment rates: $\beta_{1987} \times [\max_i(strike_i) - \min_i(strike_i)] = 9$.

We made a number of robustness checks for our results. We used DL and WI separately and together; this makes little difference to the results. We replaced openness by country size, interacted with time effects. Size is correlated with openness, but the data indicate that openness is what matters. We allowed for union coverage interacted with time effects (as the strike variable may reflect union power in addition to trust): when introduced in addition to the trust variable, it turned out not to be significant. Indeed, openness and trust are the only variables that we have found to be consistently significant.

The trust variable has especially strong power in explaining differences across countries in the late 1980s. Table 1 shows the regressions of average unemployment rates between 1985 and 1989 on different labor market variables. The first regression uses DL and WI together with openness, the second regression uses *strike*, and the third uses the index of the quality of management/worker relations. All three deliver roughly the same message, with *strike* being more significant than the others[26].

Finally, the last two regressions presented in Table 1 show that *strike* retains significant explana-

[26] We have also explored another measure of trust, the proportion of votes going to the communist party in the 1960s. The motivation comes again from the current rhetoric of labor unions. Even today, the rhetoric of communist unions often resembles the "class struggle" view of relations between labor and capital presented in the introduction. In contrast, socialist and social democratic unions increasingly speak of the need for "partnership between labor and capital." The contrast is striking for example in France, where the CFDT—the main socialist union—has established a working relation with the MEDEF—the business organization—while the CGT, the communist union, has largely kept its traditional positions. In effect, only three countries have a relatively high percentage of communist votes in the 1960s, France, Italy, and Greece. All the others have low percentages (in many countries, the percentage was relatively high in the aftermath of World War II, but had declined substantially by the early 1960s). As France, Italy, and Greece have suffered from high and persistent unemployment, a regression using this measure of trust (interacted with time effects) gives roughly similar results to those described earlier. But the partition of countries is too rough to provide a satisfactory explanation of the cross country differences in the evolution of unemployment.

tory power once one controls for the other labor market variables used in [Blanchard and Wolfers, 2000][27].

Our results that initial trust between labor and capital appears to explain a good part of the subsequent evolution of unemployment come with many caveats. Nevertheless, we believe they capture something important, about the attitude of unions, and the way in which they determine the effects of shocks on the economy.[28]

2.5 Relation to the literature, and conclusions

In [Blanchard and Wolfers, 2000], one of the authors suggested that the only way to understand both the time series and cross-country evolutions of unemployment in Europe was by focusing on the interaction of shocks and institutions. The hypothesis we have developed in this paper fits well under this (admittedly rather generous) umbrella:

- Past research has focused on a number of shocks, from the slowdown in productivity growth from the early 1970s on, to movements in the price of oil in the mid and late 1970s, to movements in the cost of capital ([Phelps, 1994]) (low in the 1970s, higher in the 1980s, high in the 1990s), to increases in the pace in reallocation ([Ljundgqvist and Sargent, 1998]).

  We add to this list what we see as another important shock: structural changes in product and financial markets, in particular increases in capital mobility, both within and across countries. And the type of learning dynamics we focus on here clearly applies to other shocks as well: For example, it surely took some time for European economies to realize that the 30–year post–war period of high productivity growth had come to an end.

  Indeed, our argument extends straightforwardly to another type of shock, namely biased technological progress. A number of authors have argued that, either for exogenous reasons (having to do with the nature of technological progress itself), or endogenous reasons (decisions by firms to develop new technologies in order to use or save on a specific factor; see

[27] Note that these variables are defined in such a way that they are expected to increase unemployment. See [Blanchard and Wolfers, 2000] for details.

[28] Pierre Fortin has suggested to us another fascinating example, the difference between the evolution of unemployment in Ontario and Quebec. The comparison is interesting as both provinces share many of the same institutions. Unemployment in Quebec increased much more than in Ontario, and turned around later. Fortin suggests that the fact that labor in Quebec is typically French speaking and Catholic, whereas capital is often Anglo and Protestant led to worse labor relations and is an important part of the explanation (In Ontario, both capital and labor are Anglo and Protestant). For more on the evolution of unemployment in Quebec, see [Fortin, 2001].

[Acemoglu, 2002]), technological progress may have become increasingly labor saving during that period (see for example [Piketty, 1998]). One can think of such endogenous technological progress as leading, in effect, to an increase in the long run elasticity of labor demand. So, to the extent that such technological change was at work, the argument we developed in our paper applies directly: if unions were slow to understand the change, this can plausibly explain first the increase, and then the more recent decline in unemployment.

- Past research has focused on a number of institutions, and their interactions with shocks: [Ljundgqvist and Sargent, 1998] have looked, for example, at the interaction between the structure of unemployment benefits and higher turbulence; [Blanchard, 2000] (Lecture 3) has looked at how institutions such as employment protection which generate long individual unemployment duration, affect the dynamic effects of adverse shocks to labor demand.

  The crucial institution in our paper is collective bargaining. But so are the attitudes of the unions, and the role of learning and trust: we have no doubt that most of the decrease in unemployment in the Netherlands for example must be traced to a change in attitudes, rather than to specific labor market reforms. This suggests a broader definition of "institutions" than is standard.

  Indeed, even our definition may still not be broad enough. While we focused on unions, it is clear that the same process of learning has taken place in the larger political sphere—again with clear differences across countries. Some communist parties have retained much of the old rhetoric, some have evolved. Some socialist parties have become social–democratic parties, and now talk of partnership. Some are more schizophrenic. Thus, at some level, what is relevant is societal attitudes, not just union attitudes. And this points to a more complex political game than the simpler model of bargaining we focused on in our paper, a game in which not only unions, but also the median voter, determine the outcome: In 1979, voters in the UK elected Margaret Thatcher, over the strong opposition of unions. She then proceeded to drastically reduce the power of unions. At roughly the same time, in 1981, voters in France elected a socialist President, Francois Mitterand, who initially pursued traditional socialist policies, until being forced two years later to change and adopt more capital–friendly policies.

- The line of research most closely related to ours is that of Caballero and Hammour (in particular [Caballero and Hammour, 1998], [Caballero and Hammour, 1998b]). Under our hypothesis, unemployment dynamics come from the attempts by unions to preserve rents in the face of structural change. Under their hypothesis, unemployment dynamics come from the attempts by unions to appropriate more of the rents, starting in the late 1960s. Those attempts, Caballero and Hammour argue, are what led to the decrease in capital accumulation and employment over time.

The complete story surely has an element of both: the labor unrest in the late 1960s, and the increase in the real wage per efficiency unit in the early 1970s we documented earlier, suggests that part of the initial increase in unemployment was indeed due to a "wage push" rather than to insufficient wage moderation in the face of structural change. And there is also no question that some of the institutional changes which took place in the 1970s and 1980s, from higher unemployment benefits, to stronger employment protection, had the effect of decreasing profit, capital accumulation, and employment. Indeed, this suggests an important extension to our hypothesis. As unions learned of the structural change, this did not necessarily lead them to accept more wage moderation. Instead, in many cases, their reaction was to try to limit the decrease in employment, at least in the short run, for example through the passage of stronger employment protection legislation. The current legacy of these actions may therefore be a combination of wage moderation and worse labor market institutions.

This takes us to the implications of our hypothesis for the future. Our analysis leads us to be relatively optimistic. As learning takes place, increased capital mobility, and higher product market competition, are likely to lead to a continuing decline in unemployment. Achieving low unemployment however will also require reforms of some labor market institutions; these are also—slowly—taking place.

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	Dependent Variable is average unemployement rate between 1985 and 1989									
Variables	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Days Lost in Strikes in 1960s (DL)	0.13	0.01								
Workers Involved in Strikes in 1960s (WI)	45.89	1.77								
Conflicts in 60s = max(DL,WI)			2.19	3.09			1.59	2.33	1.68	4.54
Openess in 60s	8.25	2.38	7.58	2.64	5.97	1.95	2.82	1.21	3.69	2.67
Unemployment in 1960s	1.25	1.67	0.58	1.22			0.37	1.02	0.54	2.20
Replacement Rate							0.09	2.70	0.08	3.44
Unemployment Benefits							0.99	2.57	1.13	5.27
Union Coverage							0.05	0.03		
Employment Protection							0.25	2.03	0.21	3.25
Active Labor Policies							0.03	0.78		
Union Density							0.03	0.90		
Tax Wedge							0.02	0.50		
Coordination of Bargaining							2.06	3.31	1.65	5.00
Trust (90s measure)					-0.01	-3.75				
N	18		18		18		18		18	
Adj. R2	0.4278		0.5325		0.4279		0.883		0.9179	

Table 1: Regression of Average Unemployment Rate between 1985 and 1989 on Labor Market Variables

Figure 1: Barriers to Entrepreneurship, 1970-1998

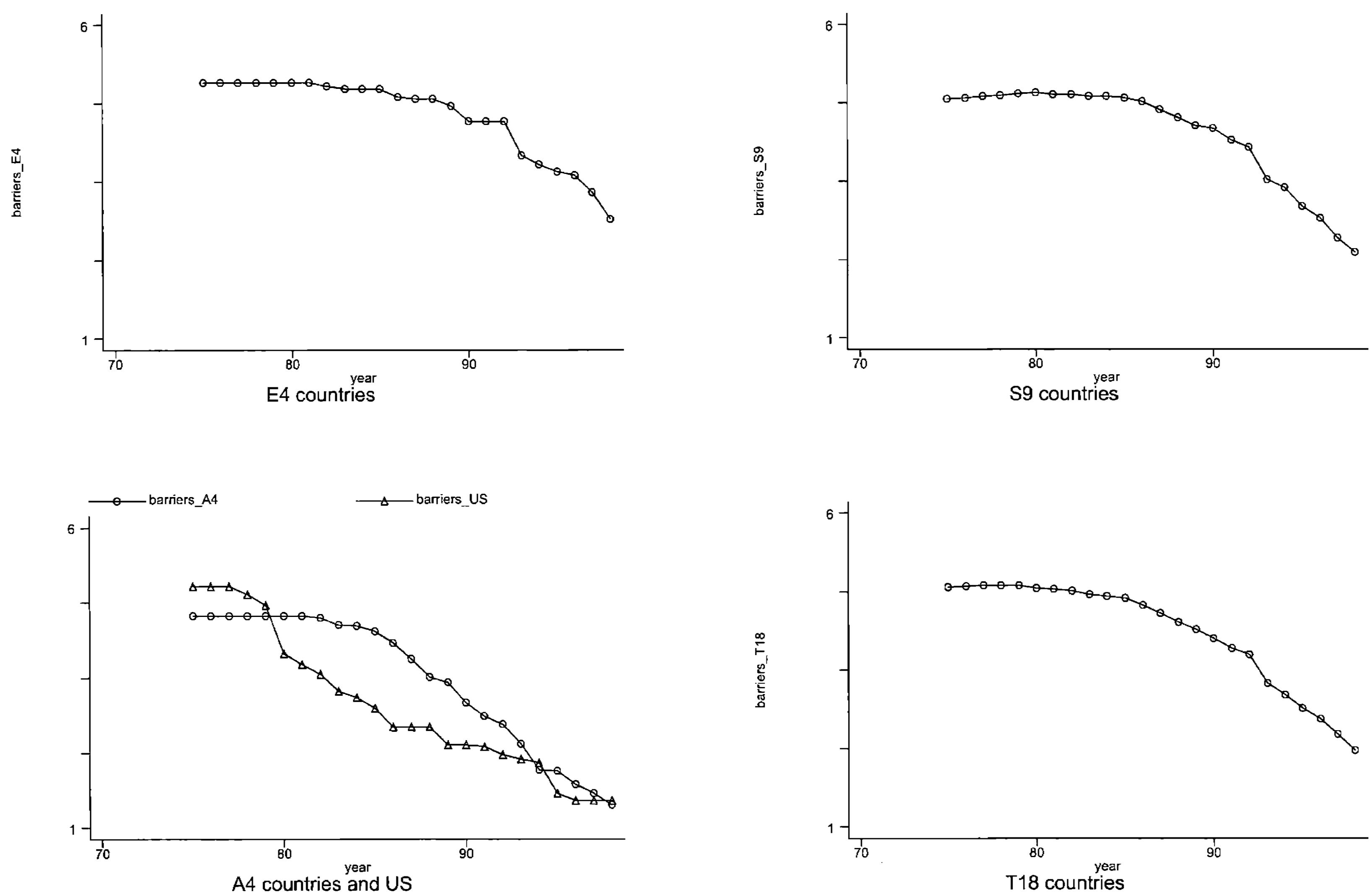

Figure 2: Openness (X+Q)/Y, 1960-1998

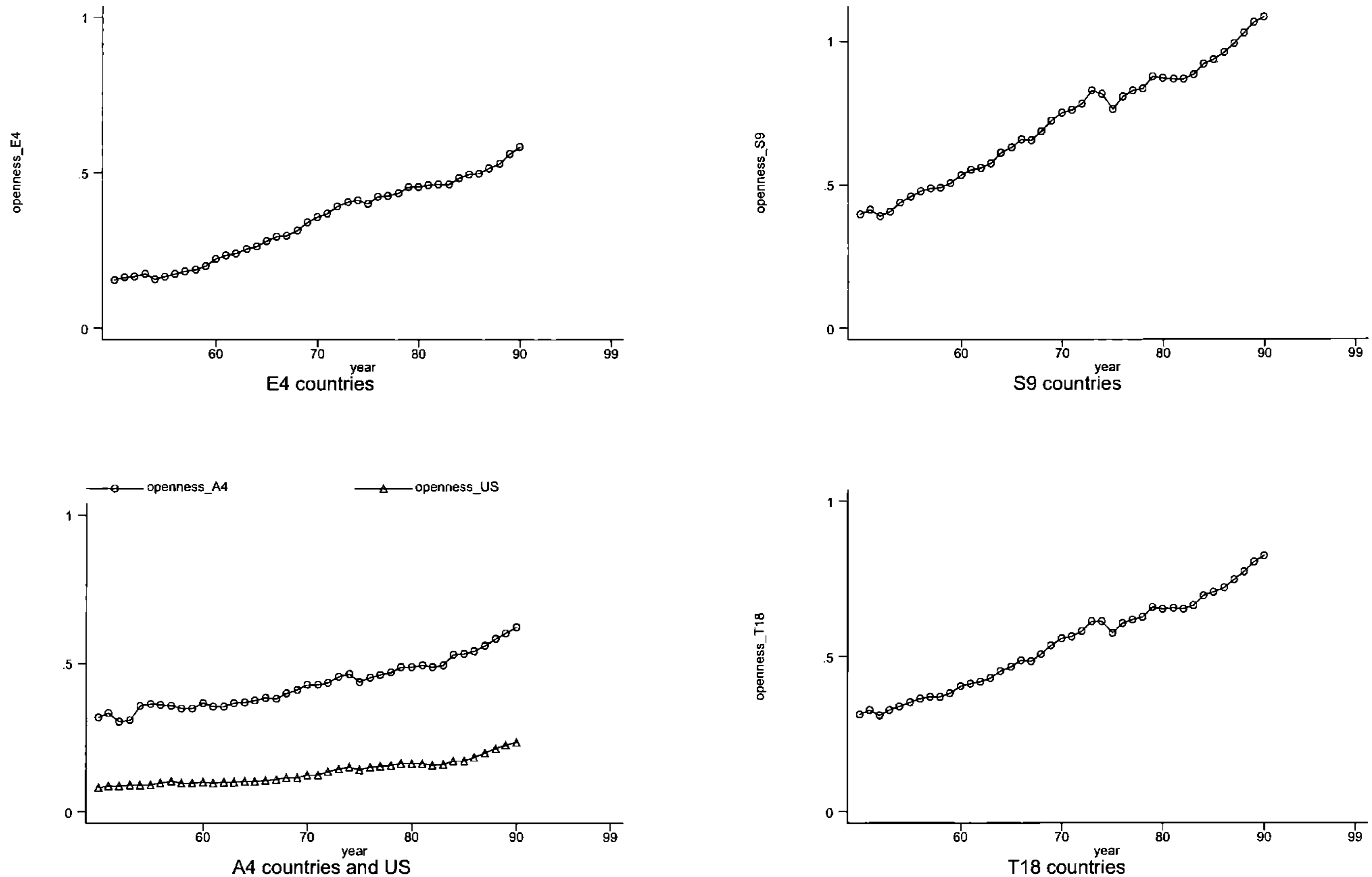

Figure 3: State Ownership Index, 1970-1998

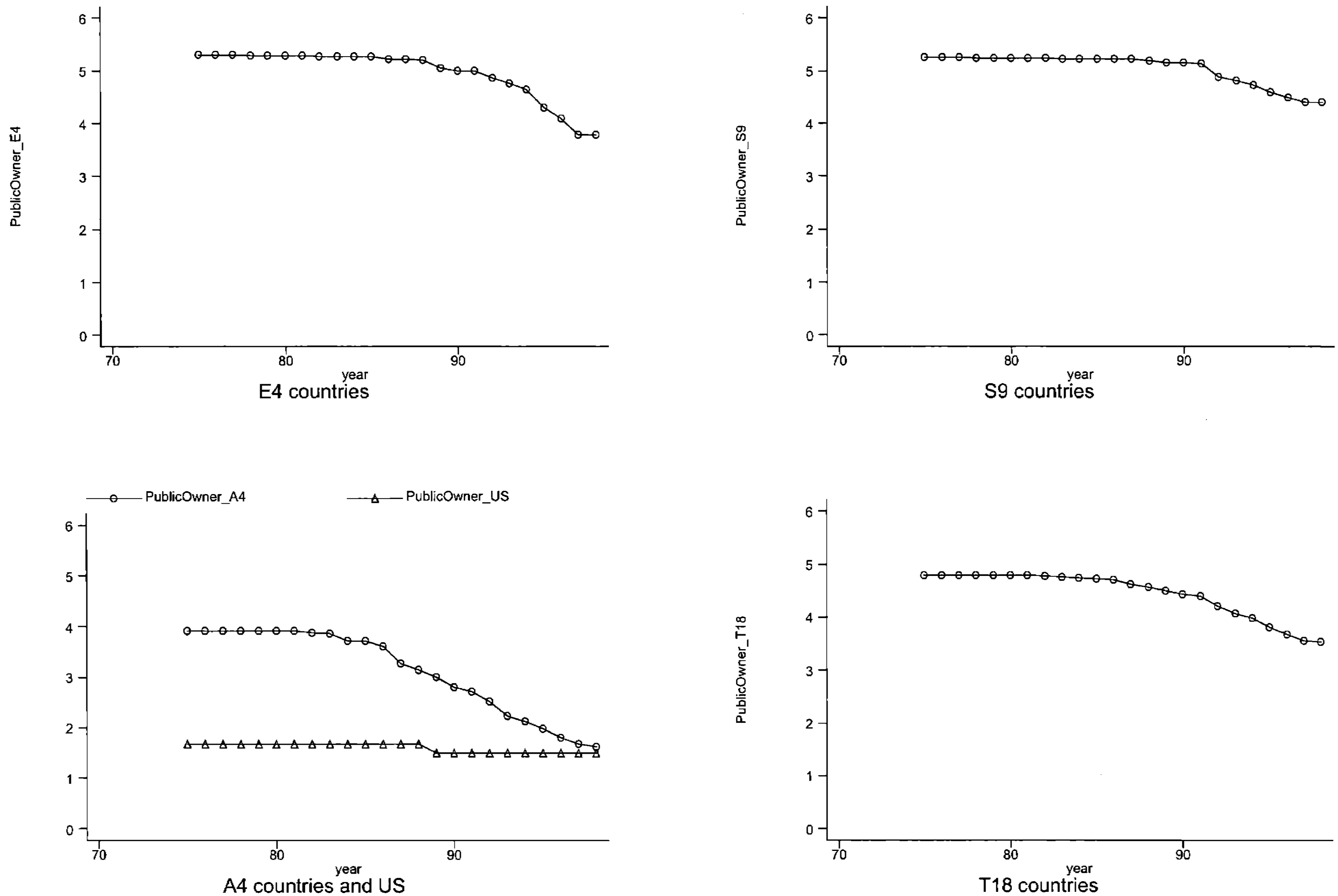

Figure 4: Capital Mobility, 1970-1998
FDI and Equity+Liabilities over GDP

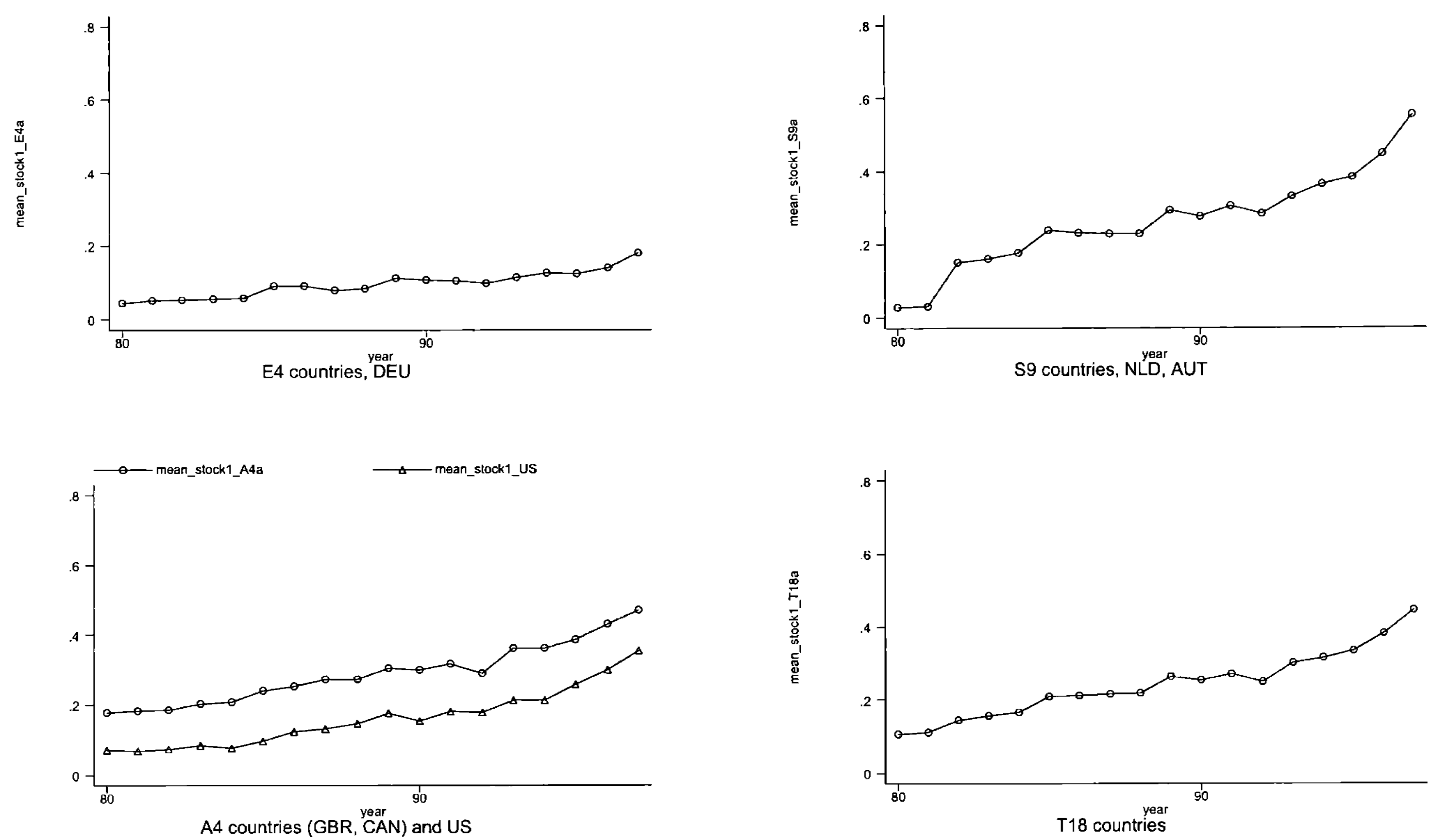

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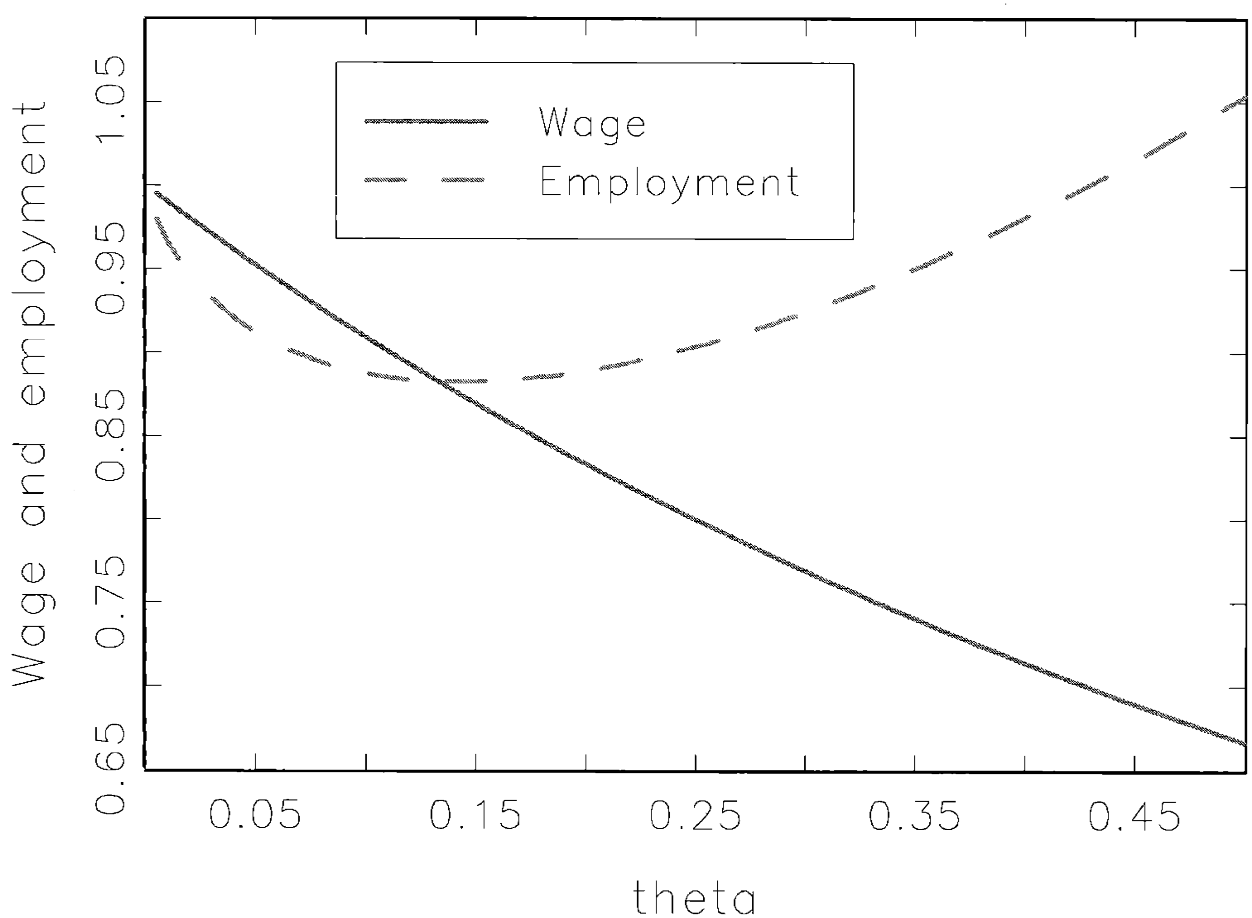
Figure 5. Increase in theta from 0.01 to 0.5



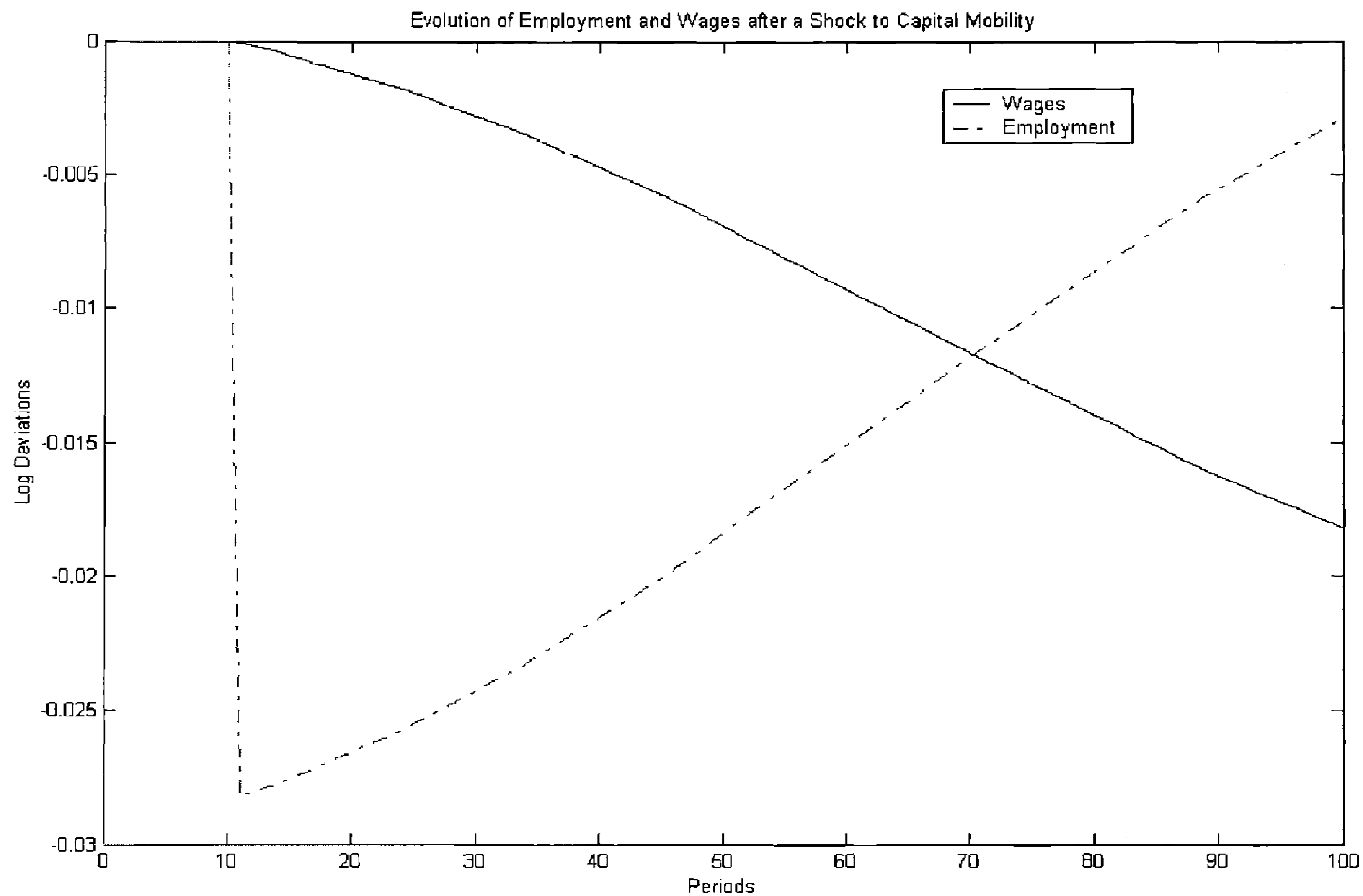


Figure 6: The shock to θ happens at t=10: θ jumps from .2 to .25. The parameters are r=.3 , s=.1 and the prior that θ=.25 is p_0= 0.1.

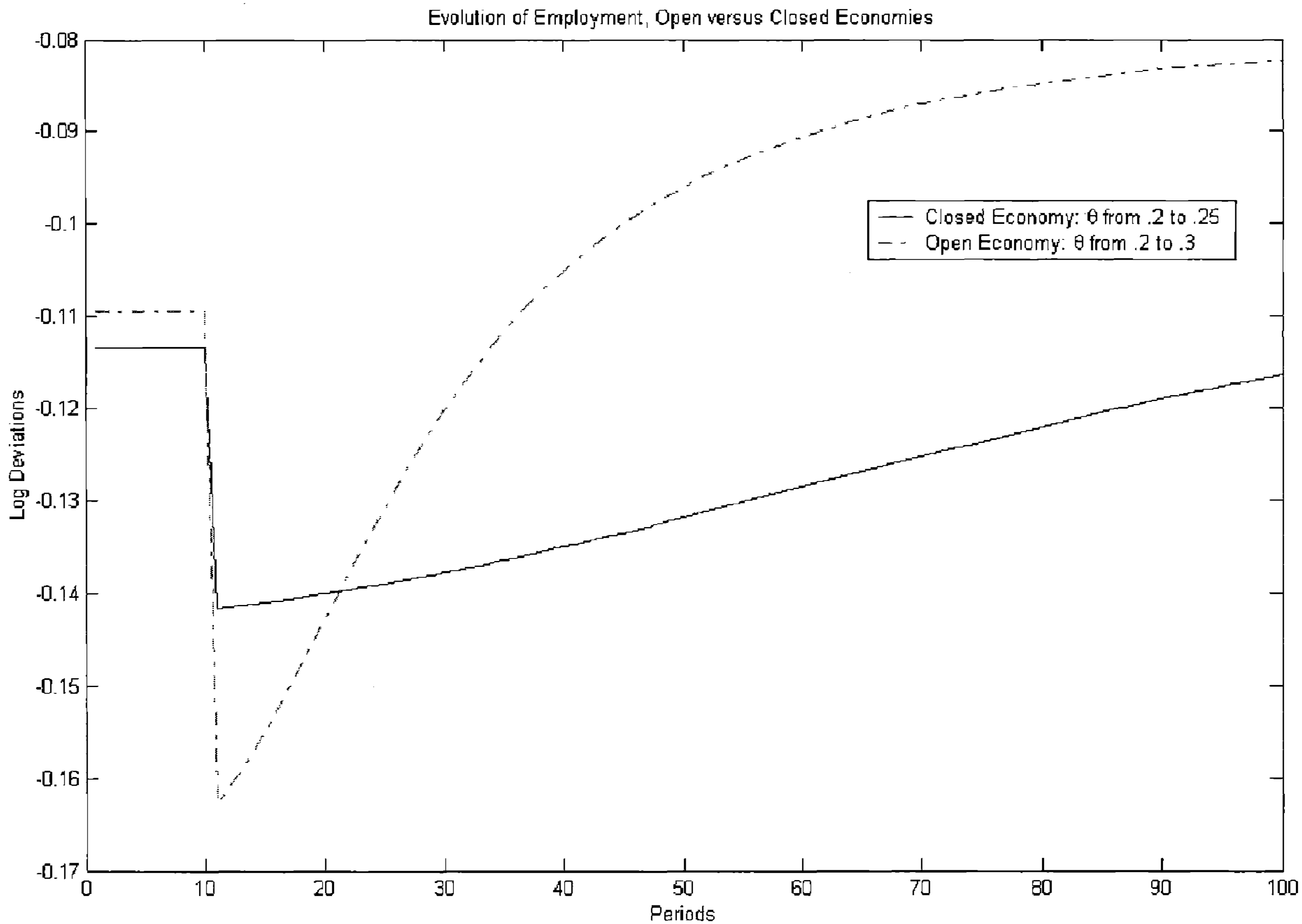


Figure 7: The dotted line ("Open Economy") is the path of the log of Employment for a jump in θ from .2 to .3. The plain line is the path for a smaller jump from .2 to .25.

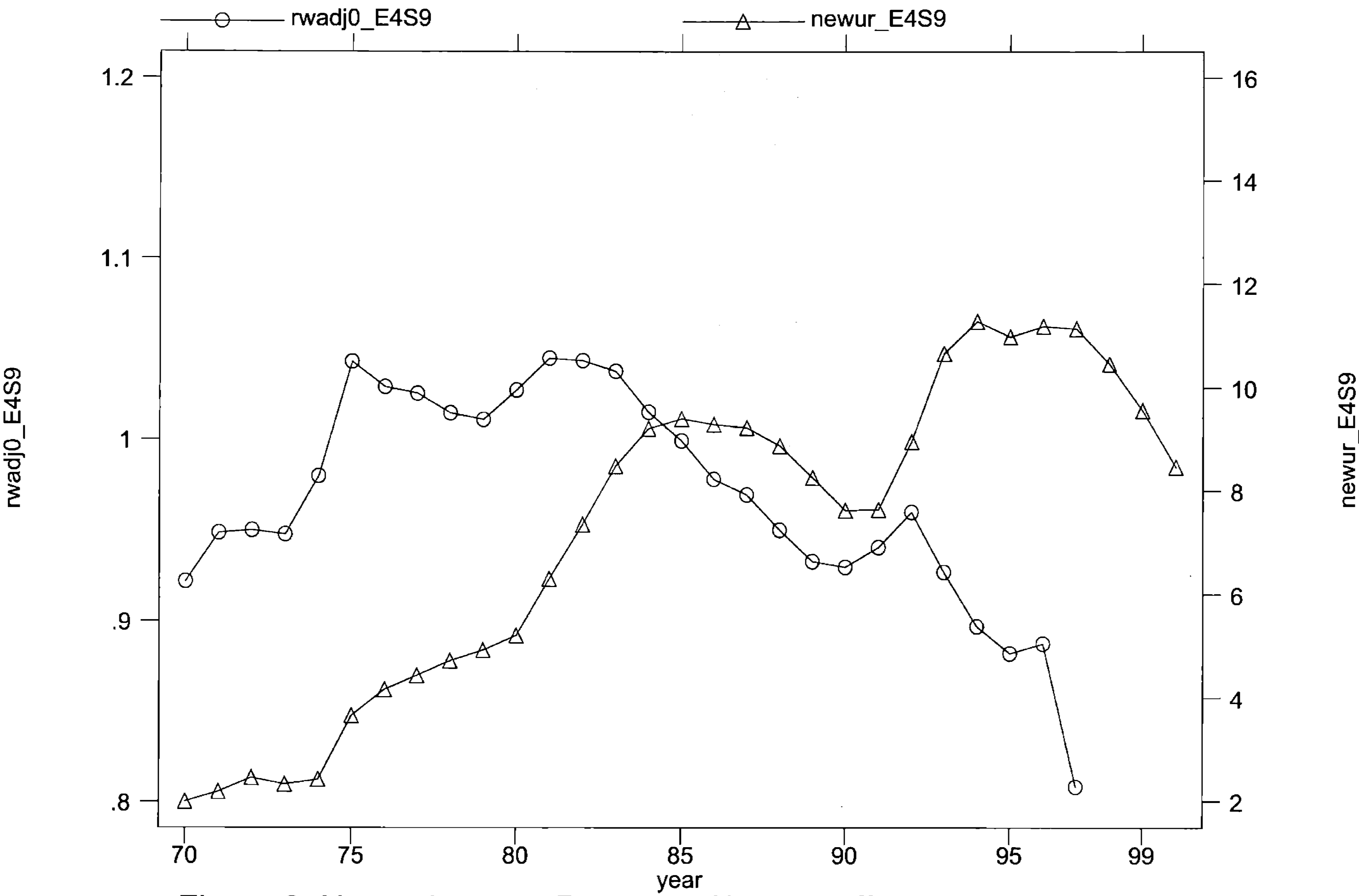


Figure 8: Unemployment Rate and Wage in Efficiency Units, E4+S9

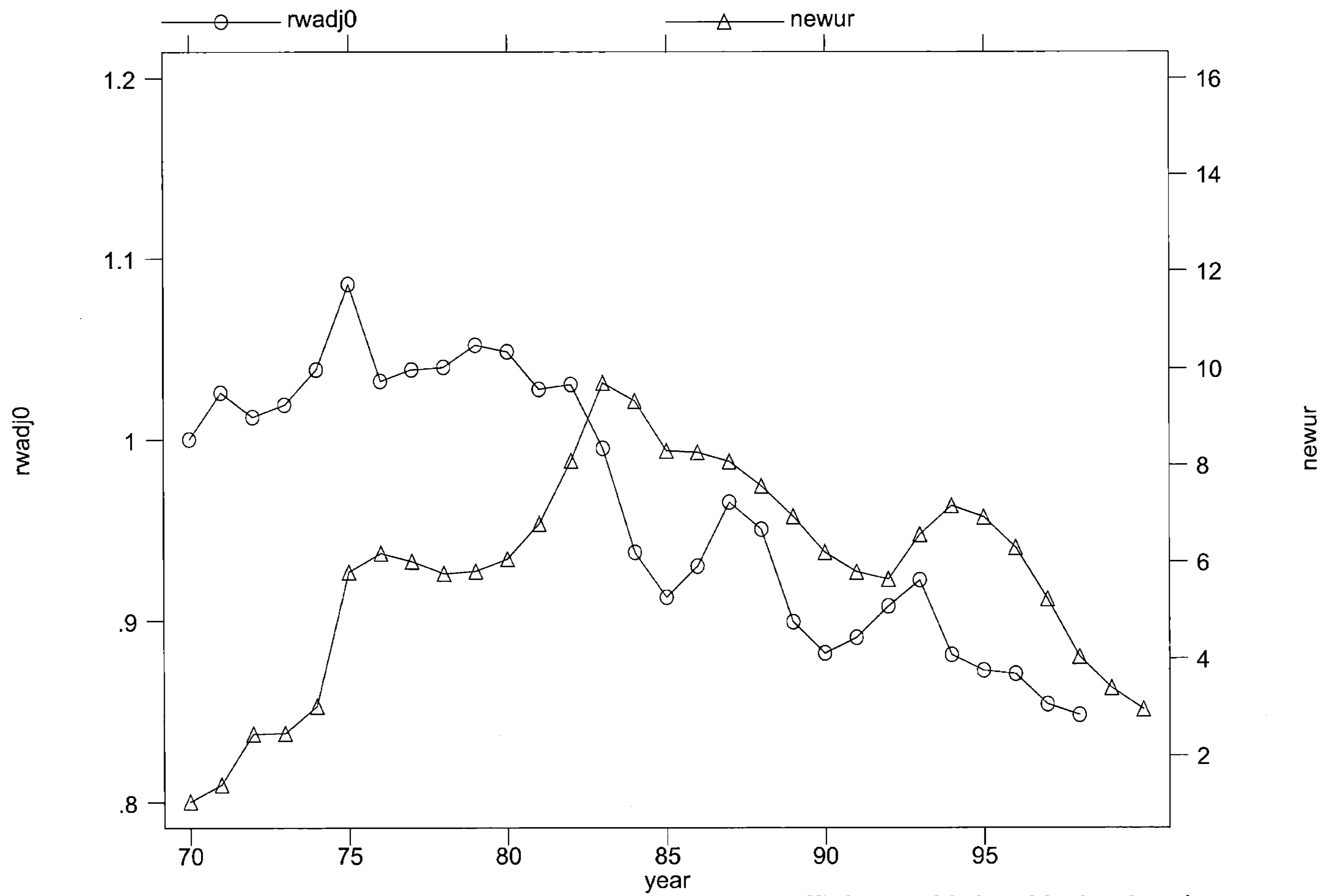


Figure 9: Unemployment Rate and Wage in Efficiency Units, Netherlands

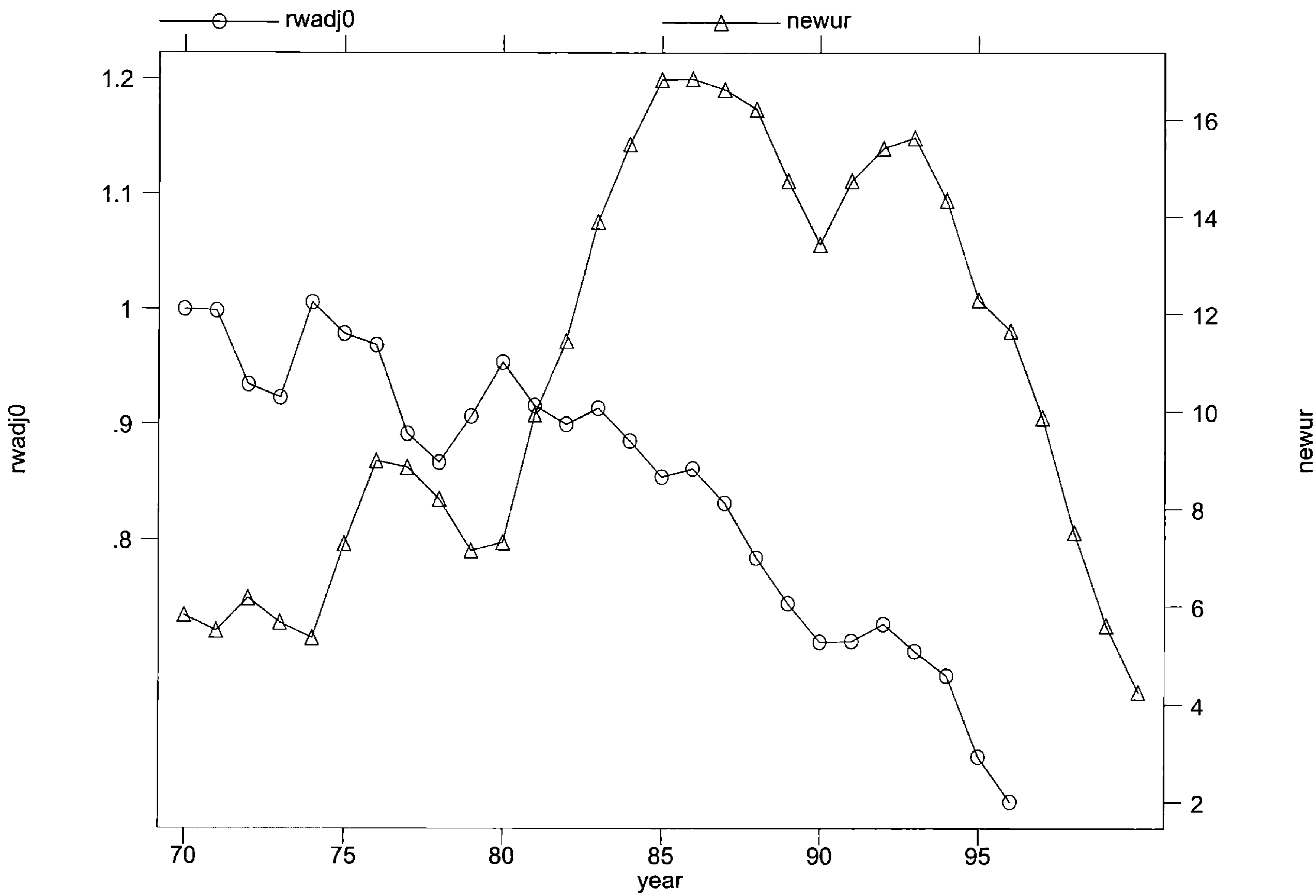


Figure 10: Unemployment Rate and Wage in Efficiency Units, Ireland

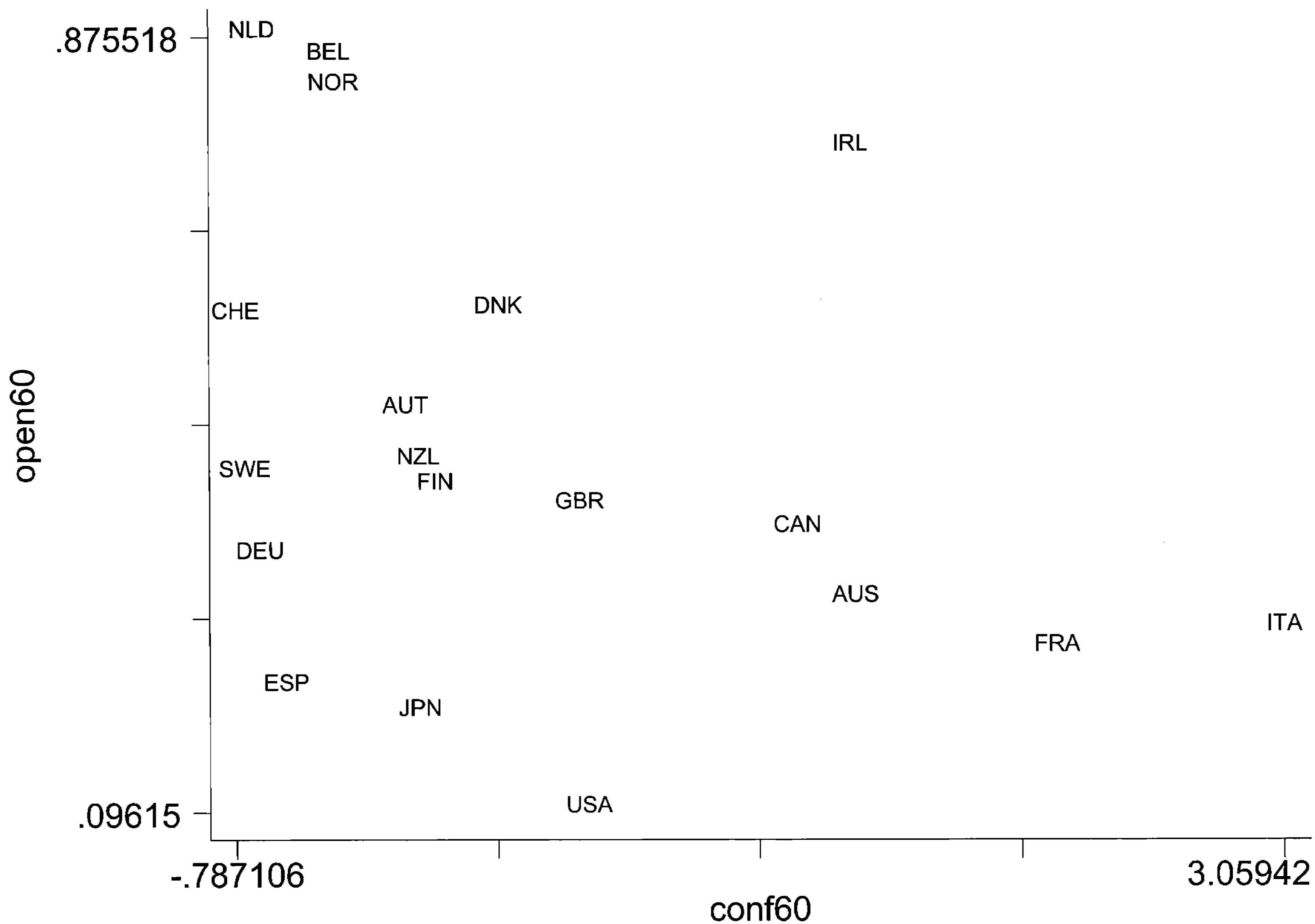


Figure 11: Average Openness and Labor Conflicts, 1960-67

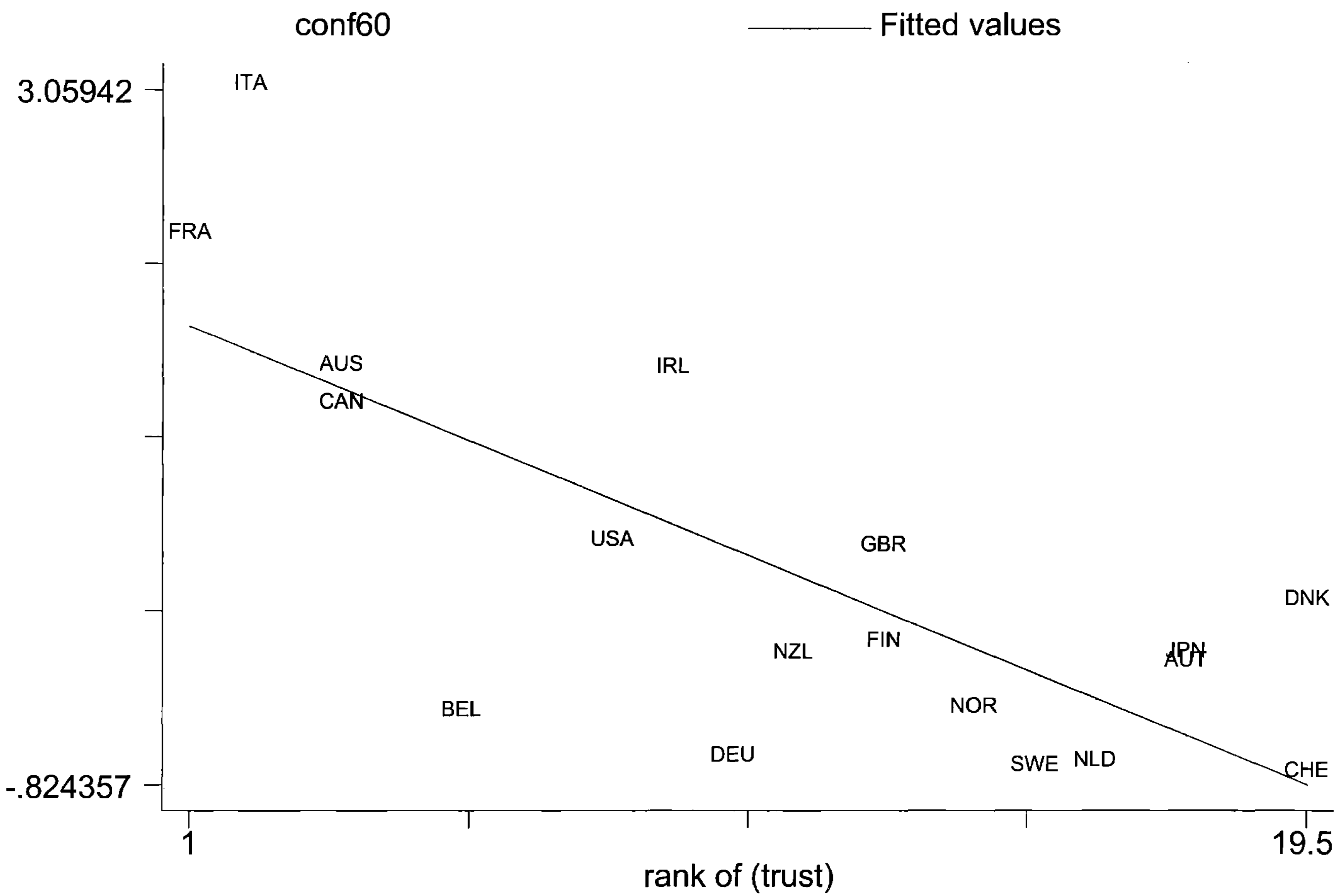


Figure 12: Labor conflicts in the 1960s and Trust in the 1990s

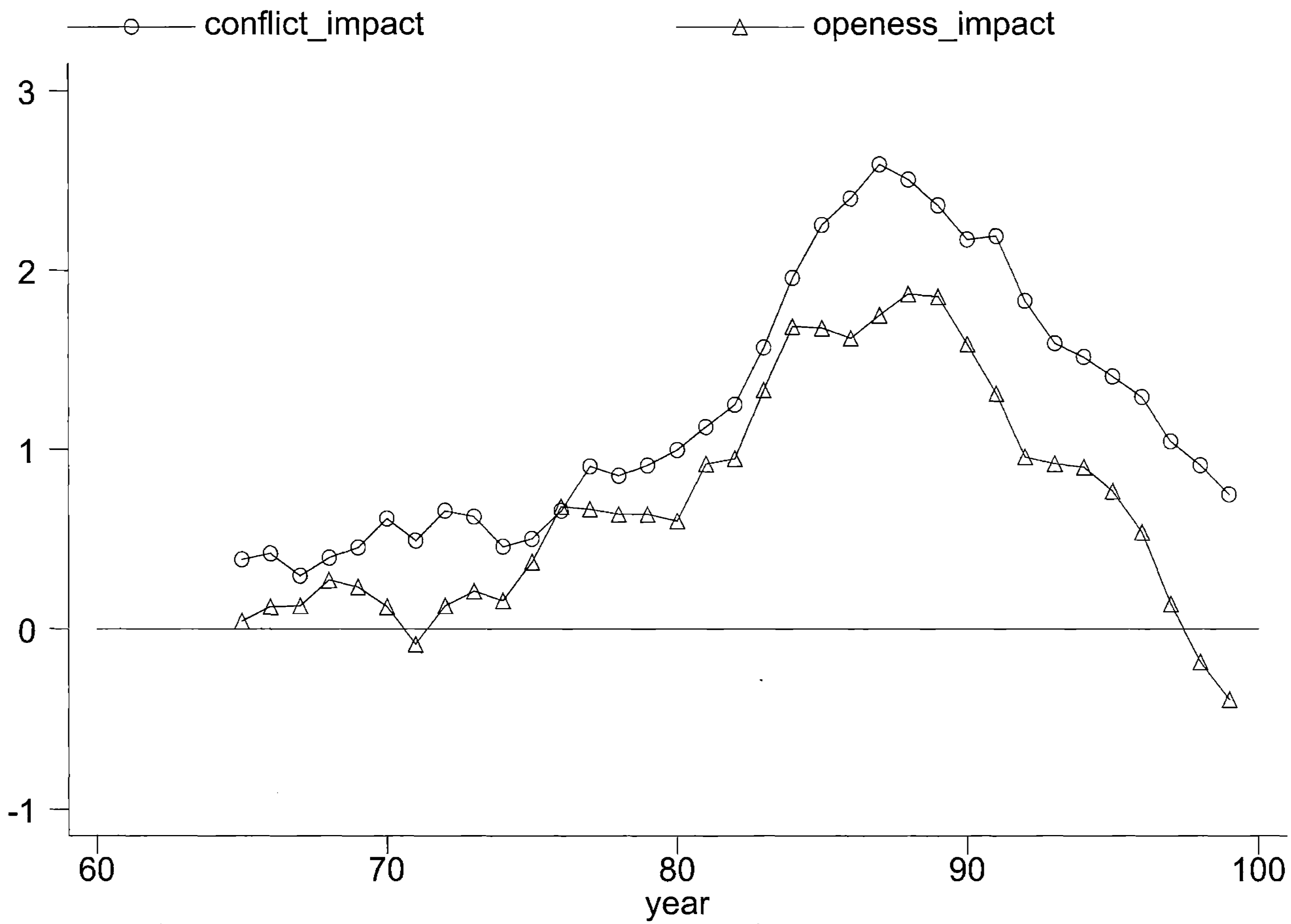


Figure 13: Effect of Openness and Labor Conflicts on Unemployment

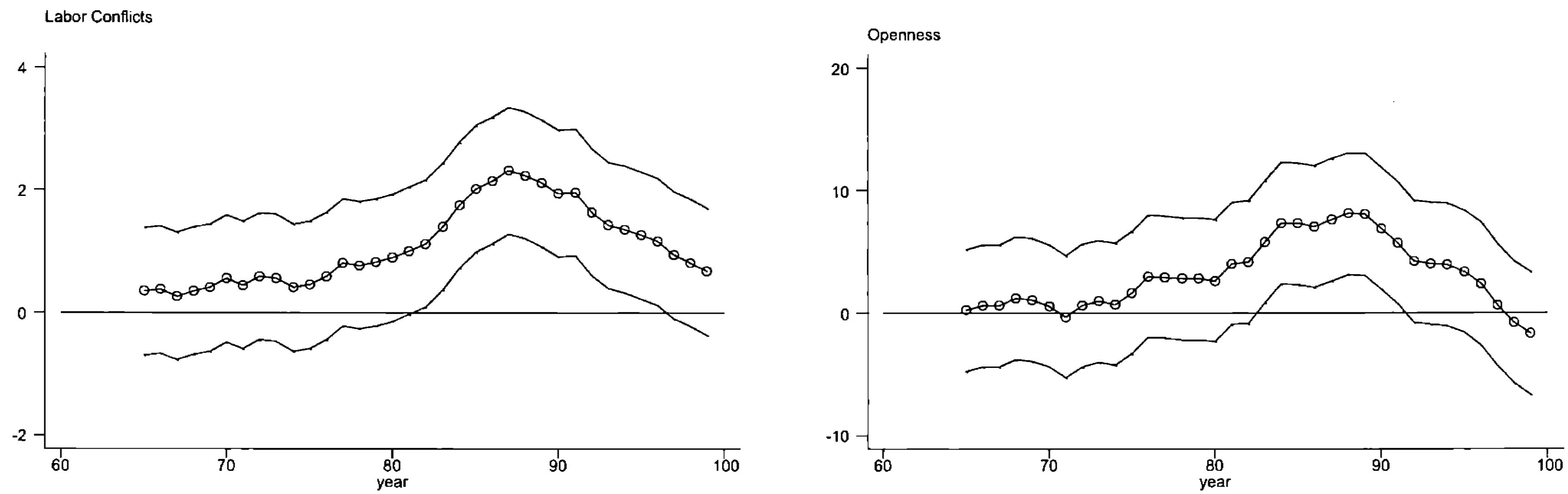


Figure 14: Coefficient and Standard Errors for CONF60 and OPEN60

Chapter 3

Monetary Independence in Emerging Markets: Does the Exchange Rate Regime Make a Difference?

with Eduardo Borensztein and Jeromin Zettelmeyer
International Monetary Fund

Introduction

We investigate the conventional proposition that floating exchange rates insulate domestic economies from international financial shocks. We focus on two types of shocks: changes in the monetary stance of the United States and changes in the risk premia attached to emerging market international bonds. We find clear empirical support for the conventional view in the comparison of Hong Kong and Singapore. The comparison of Argentina and Mexico is much less clear-cut, since U.S. interest rate shocks seem to have the conventional effects but emerging market risk premia shocks do not.

The highly volatile financial environment of the 1990s challenged the exchange rate regimes that most emerging market economies had chosen. Many countries had opted for regimes that provided significant exchange rate stability (as an anchor for domestic prices or simply to avoid fluctuations that were considered harmful to international trade) but left some room for current or future changes in the parity. Most, if not all, of the regimes that succumbed to crises (in the sense of suffering large and sudden depreciations in the value of their currencies) were of this type: pegs without restraining rules on central banks, bands, or alleged managed floats with very little exchange rate flexibility in practice. "Intermediate" pegs became "unsustainable" pegs[1]. The two allegedly viable regimes, at the two extremes of the continuum of exchange rate systems, differ sharply in some respects. The main advantage of floating exchange rate regimes over hard pegs—at least in principle—is that they allow the monetary authority to retain the domestic interest rate as a policy instrument. There is, however, a recent line of thought that considers that emerging market economies cannot benefit from the use of discretionary monetary policy and would in fact be worse off by leaving that possibility open.[2] This "fear of floating" school argues that, because of credibility problems, worries about inflation pass-through, and dollarization in the domestic financial system, central banks sharply curtail movements in the exchange rate even if they officially float. The result is "flexible regimes that are managed as if they were fixed, but without the benefits of pre-commitment" (Hausmann et al., 1999, p. 11). Thus, the claim is that the benefits of moving to a currency board system or even to full dollarization—namely, lower risk premia on both government and private sector liabilities thank to a reduced risk of depreciation—are not offset by the costs of reduced flexibility. The tests in this paper speak to the second part of this claim, by addressing the question of how much "insulation" flexible regimes provide in practice.

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[1] See, among others, Rubin (1999), Lipton (1999), Eichengreen (1999) and Goldstein (1999).

[2] Hausmann et al. (1999), Calvo (2000), Calvo and Reinhart (1999, 2000).

Some recent empirical studies—including Hausmann et al. (1999), Frankel (1999) and Frankel, Schmukler and Servén (2000)—have raised doubts on how floating exchange rate regimes work in emerging markets. Hausmann et al. find that the reaction of domestic rates to U.S. rates is insignificantly different across regimes using monthly data from 1960 to 1998 for 11 countries. Moreover, using daily data for 1998-99 for Mexico, Venezuela and Argentina, they find that the reaction of domestic interest rates to the international risk premium is highest for Mexico, the country with the most flexible exchange rate regime. Frankel (1999) regresses quarterly and monthly domestic interest rates in several emerging market countries on the U.S. Federal Funds rate, and concludes that interest rates in countries with floating or intermediate regimes (Mexico after 1994 and Brazil before mid-1998) show much higher interest rate responses than Argentina, Hong Kong, or Panama. Frankel, Schmukler and Servén (2000) extend these regressions by considering more countries, controlling for currency crisis episodes and inflation differentials, and running panel regressions in addition to regressions for individual countries. Their results are more ambivalent than those of the other authors: using a long sample from 1970-1999, flexible regimes do seem to display a smaller reaction of domestic to international interest rates; however, this result goes away when the sample is restricted to the 1990s and developing countries are considered separately. Although these results are suggestive, they raise questions about robustness and identification.

In this paper, we pay attention to identifying international interest rate shocks in a way that allows a structural interpretation. We provide two types of tests: event studies and vector auto regressions. We first conduct an event study that focuses on specific US monetary policy shocks, measured by reactions in federal funds futures rates to changes in the federal funds rate target, and examine their impact on the domestic interest rates and exchange rates of the countries in our sample. We then conduct an analogous study that looks at the reactions to large shocks to emerging market bond spreads associated with identifiable events. Finally, we run VARs at the daily frequency, using four variables: the domestic interest rate, the exchange rate, a measure for U.S. interest rate policy, and a measure of emerging market risk premia. We compare the impulse response functions of the VARs to the results of the event studies for both U.S. monetary policy shocks and emerging market risk shocks.

We compare systematically Argentina with Mexico, and Hong Kong with Singapore. In our sample period (starting in the early to mid-1990s), these economies represent polar choices of exchange rate regimes, which should allow us to detect differences more easily.[3] In addition, we run the test for some more advanced, small open economies: Australia, Canada and New Zealand, and for Chile[4].

We find that interest rates in Hong Kong react one-for-one to U.S. monetary policy shocks, while interest rates in Singapore increase by about 0.3 basis points (bp) after a 1 bp increase in U.S. interest rates; there is also a significant (but moderate) depreciation of the exchange rate in Singapore when US interest rates increase. For the period after 1997, we see large responses of interest rates in Hong Kong to shocks to emerging market risk premia, while the reactions of interest rates in Singapore are not significant. In line with conventional priors, VAR-based impulse response functions show a significant response of domestic rates to US interest rates in Argentina, but not in Mexico; however, this is largely a consequence of imprecise estimates for Mexico, with both the interest rate and the exchange rate effects being not statistically significant. The event study, albeit of limited value because of the small sample of monetary policy shocks, does find a significant effect on Mexican

[3] Neither Mexico nor Singapore follow a pure float. Mexico's monetary policy targets domestic inflation but appropriately regards the exchange rate as a source of inflationary pressure so that, for example, it would tighten monetary policy in response to a weakening of the exchange rate (see Carstens and Werner, 1999). Singapore's monetary framework is less explicit, and could be described as monitoring a basket of currencies with the ultimate objective of targeting domestic inflation (Nadal-De Simone, 2000). Despite not being clean floats, the exchange rate regimes of these two countries are typical examples of viable floating exchange rate systems in the emerging market environment.

[4] Although Chile was formally following a preannounced bands for the exchange rate over the sample period, studies of ex-post exchange market behavior indicate a high degree of exchange rate flexibility (Levy-Yeyati and Sturzenegger, 1999)

interest rates, but generally of smaller magnitude than in Argentina, where interest rates appear to overreact to US rates. Finally, we find very large reactions of domestic interest rates to emerging market spread shocks, of about the same size, for *both* Mexico and Argentina. Floating exchange rates thus do not seem to have appreciable benefits in insulating a Latin American economy such as Mexico from shocks to international risk premia. Interestingly, this finding can*not* be easily attributed to a lack of de-facto exchange rate flexibility, as the reactions of the Mexican exchange rates to shocks to risk premia are also very large.[5]

3.1 Methodology

We focus on the reactions of two domestic variables (interest rate and exchange rate) to two kinds of shocks (US interest rates and emerging market risk premia). We use two approaches, event studies and VARs.

3.1.1 Dynamic Specification

Our starting point is the risk-adjusted interest parity condition:

$$r = r^* + \rho + E[\tfrac{\dot{e}}{e}] \qquad (1)$$

[5] Note, however, that previous studies that did not control for the exchange rate found a much higher response of interest rates in Mexico than in Argentina (Hausmann et al, 1999).

As usual, r denotes the instantaneous domestic interest rate, r^* is the instantaneous foreign interest rate, ρ is the risk premium and $E[\frac{\dot{e}}{e}]$ is the expected instantaneous rate of depreciation of the domestic currency.

In our regressions below, we examine the effect on domestic interest rates and exchange rates of shocks to the international interest rate, r^*, and to the risk premia, ρ. There are a-priori reasons to believe that the insulating property of floating exchange rate regimes, if it exists at all, could differ depending on the origin of the shock. In particular, arguments that monetary authorities in emerging market countries are reluctant to let the exchange rate adjust in response to an external shock would generally seem to apply with greater force to shocks to ρ than to shocks to r^*[6]. Consequently, it is important to examine the effects of r^* and ρ separately. This will enable us to see if domestic interest rates react differently to the two types of shocks, and if the exchange rate regime modifies these reactions.

3.1.2 Identifying Shocks to International Interest Rates

The existing empirical literature—in particular, Hausmann et al. (1999) and Frankel, Schmukler and Servén (2000)—tends to focus on U.S. market interest rates (90-day T-bill or LIBOR US dollar rates), usually at the monthly frequency, to examine how the link between international and domestic

[6] One reason, stressed by Calvo and Reinhart (2000), may be that the monetary authorities in emerging market countries are unlikely to let the exchange rate go at times when they are cut-off from international capital markets, because depreciations may have contractionary effects in such times. Another argument focuses on non-linearities in the effect of currency depreciation on output. This may arise from credibility and reputation issues, as also argued by Calvo and Reinhart (2000), among others: a large depreciation may be a bad signal about the domestic authorities' willingness to keep inflation under control, and thus make future inflation control more difficult and perhaps invite further outflows. Allowing the exchange rate to depreciate following a ρ-shock may create a bigger credibility problem than after an r^*-shock, for instance because shocks in ρ are larger on average and require a larger depreciation.

interest rates depends on the exchange rate regime. Since domestic financial markets are small relative to the U.S. money market, it seems fair to assume that U.S. T-bill rates are exogenous, or at the very least contemporaneously uncorrelated with the error term in the context of a regression of domestic rates on international rates. However, while the small size of financial markets in emerging countries makes it unlikely that reverse causality is an issue, there may be common shocks that affect both U.S. and domestic interest rates, leading to a potential endogeneity problem. Two examples come to mind. First, shocks to market risk premia that have a "safe haven" effect - i.e. prompt a flight into U.S. instruments- would tend to bias the estimated effect of U.S. interest rates on domestic interest rates downwards. Second, there are shocks related to U.S. activity (for example, unexpectedly high quarterly growth figures) that affect both U.S. interest rates and domestic interest rates directly, through an expectation of higher domestic growth; these shocks would introduce an upward bias in the estimated effect of U.S. interest rates. The latter would seem to be mainly an issue for countries with strong U.S. trade links, such as Mexico. In the context of regressions at the monthly or quarterly frequency, however, it may be a broader problem: to the extent that business cycles are synchronized across countries, unexpected movements in U.S. output might be correlated with shocks to domestic output. This can generate a correlation between interest rate movements that does not reflect the reaction of domestic interest rates to U.S. policy shocks, but rather the endogenous reaction of both U.S. interest rates and domestic interest rates to common shocks.

We propose two strategies to get around the identification issues.

First, following Skinner and Zettelmeyer (1995), we use the jumps in the U.S. three-month T-bill rate on the days of fed-policy announcements. This constitutes a set of U.S. interest rate shocks *attributable to U.S. monetary policy* (assuming that there were no other major news that might have influenced the three-month T-Bill on the same day). We also use federal funds futures data to identify the surprise content of a *particular change in the federal funds target*[7].

Second, we run VARs using *daily time series* data. One can infer "monetary policy surprises"—or more accurately, shocks to *expectations* about U.S. monetary policy— directly from observed changes in federal funds futures rates. Of course, these will reflect shocks to the *arguments* in the monetary policy reaction function (for example, news about output or employment) as well as monetary policy shocks in a strict sense, i.e. the random component of policy-driven changes in interest rates. However, at the daily frequency, it may be acceptable to assume that a jump in the federal funds futures rate, driven by a shock to employment growth in the U.S., does not affect interest rates in Argentina *other* than through its implications for future U.S. monetary policy.

The first approach is more likely to produce a measure that truly reflects exogenous policy shocks. The second, however, has the advantage that it compares dynamic paths, rather than just instantaneous responses, and allows us to use a much richer dataset.[8]

3.1.3 Identifying Shocks to Emerging Market Risk Premia

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[7] The federal funds futures rate is based on a futures contract that calls for delivery of interest paid on a principal amount of $5 million in overnight funds. Payments are made whenever the futures contract settlement price changes during the contract month. This, in turn, is calculated based on the arithmetic average of the daily effective federal funds rate reported by the Fed for each day of the contract (calendar) month. This implies that the one-month ahead Federal Funds futures rate will represent the market expectation of the average federal funds rate during the next full calendar month; the two-month federal funds rate the market expectation of the average federal funds rate during the calendar month after that, etc. For details, see Carlson, McIntire and Thomson (1994).

[8] This is true both because there were only 45 changes in the Federal Funds rate target from 1989 until mid-2000 (see Appendix I for details), and because the information content of these events is relatively small, since many were highly anticipated (particularly after 1994, when the Fed almost always changed the target on FOMC meetings that were scheduled in advance). Moreover, not all events can be used for all countries because of either data problems in the domestic interest rate variable (Argentina), or because of changes in the exchange rate regime (Mexico).

Our concern is to identify *exogenous shocks to* ρ. Conceptually, the risk premium attached to the bonds of a particular country can change either because of domestic shocks, or because of external shocks. These external shocks include crises in *other* markets that adversely affect the prime lenders, without having a significant direct impact on the country.

As a proxy, we use J.P. Morgan's Emerging Market Bond Index (EMBI), and a more recent version that has a broader regional coverage (the Emerging Market Bond Index Global, or EMBIG). However, to the extent that the bonds of the country we are considering are part of the index, an endogeneity problem continues to exist, albeit in weaker form than if we had used country-specific sovereign bond spreads as a measure of risk.[9] For this reason, we pursue a two-track approach, just as in the context of identifying U.S. monetary policy shocks using both event studies and daily VARs. For the event studies, we look at the response of domestic interest rates to shocks that are sufficiently important to be discussed in the financial press, which allows us to pinpoint their regional origin. We therefore construct, for each country, a set of ρ-shocks that excludes domestic shocks as well as shocks in countries with strong direct economic links. For example, the run on Hong Kong in October of 1997 is part of the sample of events used to examine interest responses in Argentina and Mexico but not in Hong Kong itself. Similarly, the event-set for Argentina excludes both events originating in Argentina and in neighboring Brazil. This enables us to compare the reactions of domestic interest rates to shocks in risk premia that are not related to domestic developments.

3.2 Event studies Results

[9] In principle, one could address this by removing the spreads of the country bonds in question from the emerging market average. Unfortunately, however, the weights used to compute the index change daily depending on market volume, and are not publicly available.

3.2.1 Impact Effects of U.S. Monetary Policy Shocks

We start out by comparing immediate reactions of domestic interest rates to U.S. monetary policy for the five emerging economies (Hong Kong, Singapore, Chile, Mexico, Argentina) and three advanced economies (Australia, Canada, New-Zealand). We identify U.S. monetary policy shocks in three ways: (1) the change in 3 month U.S. T-Bill rate in reaction to a (publicly announced or at least publicly understood) change in the federal funds target; (2) Kuttner's (2000) measure of monetary policy surprises based on the reaction of the same-month federal fund futures rate to the policy action; (3) an analogous measure based on the reaction of a weighted average of the two-month ahead and three-month ahead federal funds futures rate, which we dub "FF2CONT", and which is described in detail in the appendix. The latter measure captures not only the policy surprise associated with the meeting itself, but also the impact of the meeting on expectations about monetary policy actions in meetings over the next 2-3-months, which corresponds to the maturity of the interest rate data we typical use on the left hand side.[10] All three measures of policy are highly correlated (see Appendix Table A1), so in practice, it does not matter much which one is used. Figures 1 through 3 use the change in FF2CONT as our preferred measure, but the regressions that follow are use on all three measures.

Figures 1 and 2 compare the reactions of interest rates and exchange rates to U.S. monetary policy shocks for the three advanced economies, Hong Kong, Singapore and Chile. The horizontal axis of each plot shows U.S. monetary policy shocks. In the plots on the left column, the vertical axis shows

[10] For example, suppose that an interest rate hike is expected with some probability for either today's meeting or the next meeting (but not for both). If the hike materializes today, then Kuttner's measure will only pick up the shock associated with today's action, while FF2CONT will pick up the sum of today's shock and the revision of expectations for the next meeting, in the opposite direction.

the change of a domestic interest rate on the same dates (adjusted for the time difference in the case of the Pacific markets);[11] in the plots on the right column, the vertical axis shows the percentage change in the exchange rate (where a depreciation is defined as an increase). As an interest rate measure, we picked the most liquid money market rate of approximately three-month maturity that was available at the daily frequency during the 1990s (see Appendix for details about the data). For Chile, there is no liquid instrument that trades daily, and we use a time-deposit rate provided by the central bank.[12]

Three insights emerge from this exercise. First, *all* countries show positive correlations between domestic interest movements and U.S. monetary policy shocks, and, with the exceptions of Chile and obviously Hong Kong, exchange rate changes and U.S. shocks. Perhaps surprisingly, the correlation between domestic interest rates and U.S. shocks mostly appears tighter than that between exchange rates and U.S. shocks. Second, the reaction of interest rates in Hong Kong, the only fixed exchange rate regime in this group, is substantially larger than for the other countries. Third, with respect to the correlation between domestic interest rate changes and U.S. monetary policy shocks, the two emerging markets floaters in the sample—Chile and Singapore—seem to respond no differently than the three industrialized economies.

These results are consistent with conventional priors. In small open economies with floating regimes, one would expect monetary authorities, particularly if they target inflation, to "lean against" nominal exchange rate appreciations or depreciations. This would generate a positive correlation between

[11] In other words, for Hong Kong, Singapore, Australia and New Zealand, the dates were moved forward by one day to take account of the fact that a date t announcement in Washington would impact these markets at date $t+1$.

[12] The contracts underlying this rate are expressed in an inflation-indexed currency unit, the "unidad de fomento" (UF) rather than in Chilean pesos. However, for the purpose of measuring daily reactions, this is almost as good as a nominal instrument since the day-to-day changes in the value of the UF relative to the Chilean peso are very small.

domestic and international interest rate movements, but obviously less so than in the case of a currency board regime.

Figure 1. Australia, Canada and New Zealand: Reaction of Interest and Exchange Rates to U.S. Monetary Policy Shocks

(FF2CONT as measure of shock in percentage points, on X-axis)

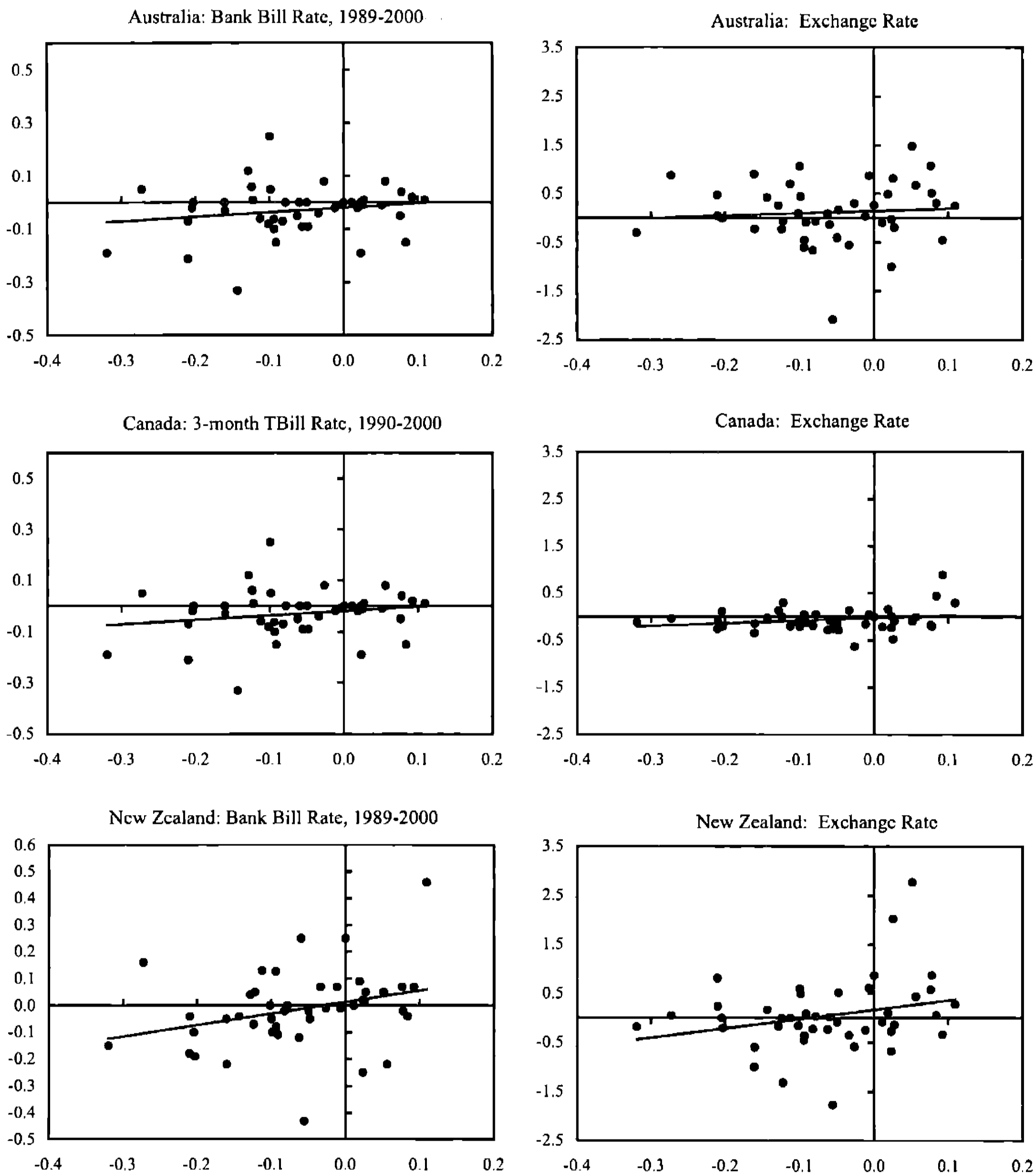


Figure 2. Hong Kong, Singapore, and Chile: Reaction of Interest and Exchange Rates to U.S. Monetary Policy Shocks (FF2CONT as measure of shock in percentage points, on X-axis)

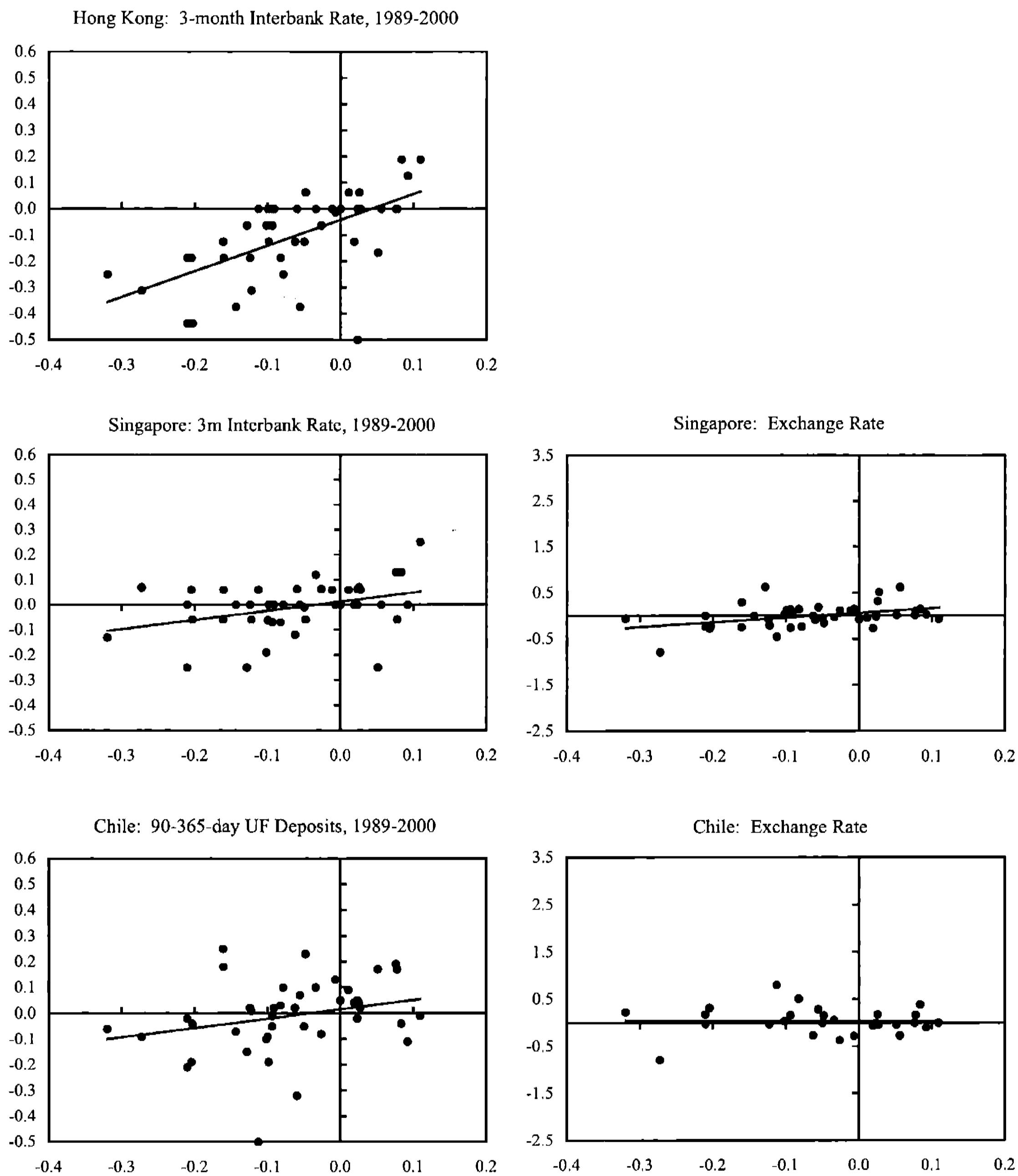


Figure 3. Mexico and Argentina: Reaction of Interest and Exchange Rates to U.S. Monetary Policy Shocks (FF2CONT as measure of shock in percentage points, on X-axis)

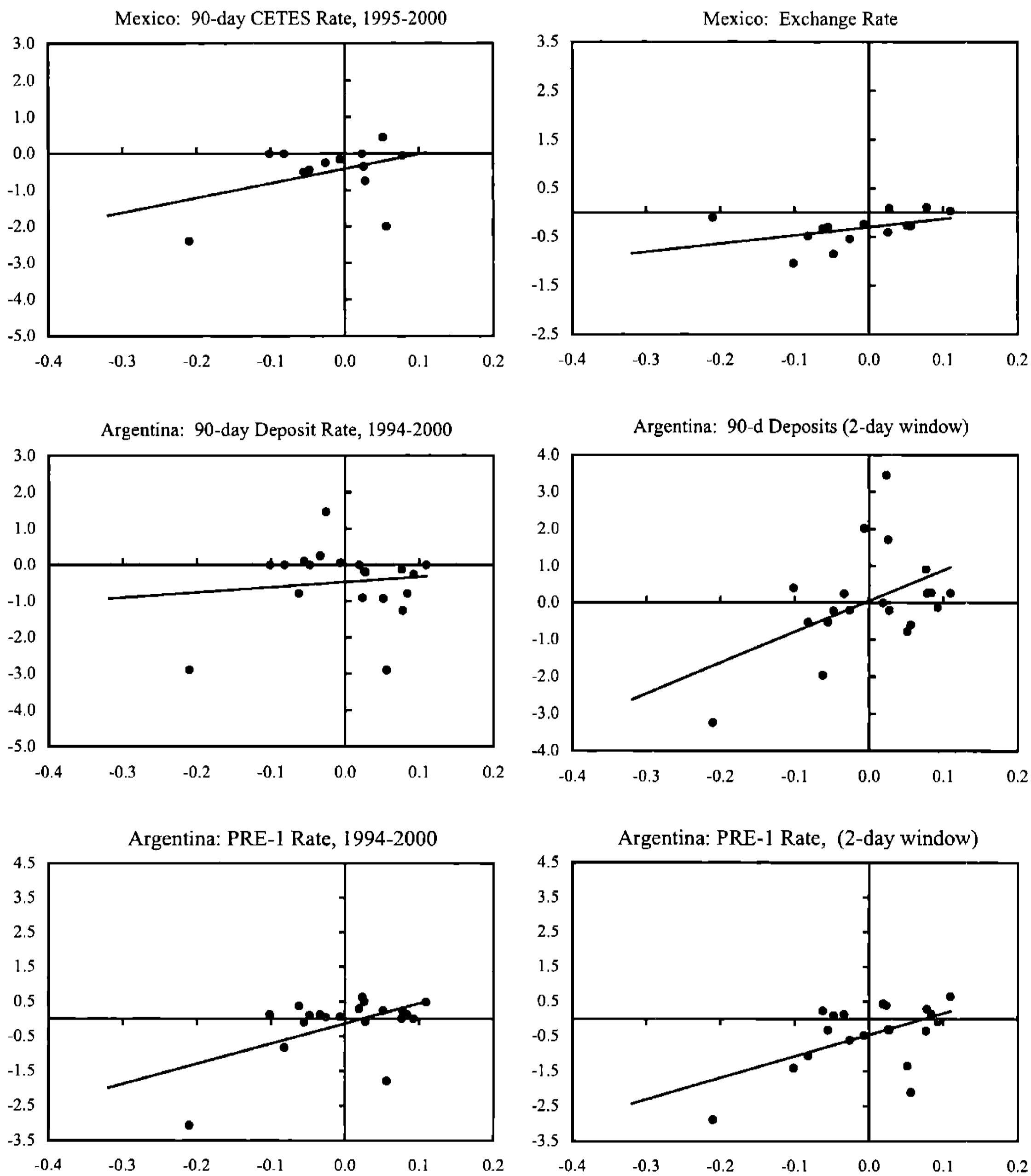


Figure 3 shows analogous plots for Argentina and Mexico. For Argentina, a liquid money market rate is only available beginning in 1997, which would have rendered the sample too short. Consequently, we used two alternative interest rates: a 90-day deposit rate which is available consistently since 1993, and yields on longer term domestic government bonds (PRE1) that have a liquid market.[13] To deal with the time zone difference—which implies that U.S. announcements may sometimes arrive after markets have closed in Argentina—as well as possible stickiness in the Argentinean deposit rate, we show the change of domestic interest rates both over the same dates as for the US t-bill rate (i.e. *t* minus t-1, where *t* indicates the day of the US announcement), and an extended the time window to give the domestic rate one extra day to react (i.e., *t*+1 minus *t*-1). For Mexico, we use a treasury-bill type rate, the 91-day secondary market CETES rate, although it occasionally has missing data points, and does not appear to be very liquid over some sub periods.

For Mexico, although the magnitude of the reaction of the exchange rate to U.S. monetary policy shocks seems to be broadly in line with that of the industrial countries, the reaction of domestic interest rates appears much larger (note the difference in the scale of the vertical axis in Figure 3). The reaction of interest rates in Argentina is also of very large, even larger than in Mexico. Note, however, that this impression is based on very few data points, since we have no reliable interest rate data for Argentina before 1993, and that the floating regime for Mexico only started in 1995. Also, note that just one or two outliers may drive the interest rate reactions for both Mexico and Argentina. The regression results give a better sense of the magnitude and statistical significance of the correlations suggested by the plots, and permit to check the robustness of the results to excluding outliers. Table1 shows simple static regressions of domestic interest rate changes on U.S. monetary policy shocks occurring on the same day, using three alternative measures for the U.S. shocks, while

[13] The PRE1 ("Previsional 1") bond was issued to settle debts with pensioners with an original maturity of 8 years, and is actively traded by domestic and foreign investors. A similar, PRE2, bond was issued in dollars. The remaining maturity of these bonds, of course, declines steadily over our sample.

Table 2 shows corresponding regressions with changes in the exchange rate on the left hand side. In the appendix, we also show a set of analogous regressions in which we additionally control for changes in J.P. Morgan's EMBI on the day of U.S. policy announcements (Tables A3a and A3b). In the discussion that follows, we focus on Tables 1 and 2 because the inclusion of the change in the EMBI reduces the sample in half (many U.S. policy actions occurred in the early 1990s, before the EMBI became available). However, a comparison of the results with those of Table A3 shows that this is of no consequence for the main conclusions of this section.

The results mostly confirm the preceding discussion, and can be summarized in four points:

(i) The sensitivity of domestic interest rates to U.S. policy shocks is remarkably similar for the three industrial countries, Singapore and Chile. In most cases, a one basis point U.S. policy shock leads to a change of about 0.2 to 0.4 basis points in the domestic interest rate. This relationship is statistically significant for all countries except Australia and Chile.

Table 1. Impact Effect of U.S. Monetary Policy Shocks on Domestic Interest Rates
(Dependent variable: changes in domestic interest rate; t values in italics)

	Policy measure					
	Change in FF2CONT 1/		Kuttner (2000) 2/		Change in US 3m T-Bill	
	policy measure	regression constant	policy measure	regression constant	policy measure	regression constant
Hong Kong	0.98	-0.04	0.64	-0.06	0.90	-0.05
(N=44)	*4.90*	*-1.76*	*3.83*	*-2.35*	*4.81*	*-2.05*
Singapore	0.37	0.01	0.23	0.01	0.36	0.01
(N=44)	*2.54*	*0.75*	*2.05*	*0.38*	*2.72*	*0.73*
Australia	0.17	-0.02	0.14	-0.02	0.15	-0.02
(N=44)	*1.19*	*-1.14*	*1.28*	*-1.23*	*1.11*	*-1.26*
Canada	0.40	0.01	0.27	0.01	0.37	0.01
(N=38)	*3.99*	*0.94*	*3.33*	*0.57*	*3.89*	*0.77*
New Zealand	0.43	0.01	0.31	0.01	0.44	0.01
(N=44)	*1.99*	*0.53*	*1.87*	*0.35*	*2.26*	*0.57*
Chile	0.358	0.016	-0.021	-0.009	0.45	0.02
(N=44)	*1.27*	*0.47*	*-0.10*	*-0.26*	*1.75*	*0.66*
Argentina (90-d deposit)	8.36	0.05	6.88	-0.02	8.36	0.13
(N=20) 3/	*2.33*	*0.18*	*2.40*	*-0.07*	*3.57*	*0.55*
Argentina (PRE-1)	6.20	-0.45	5.87	-0.51	5.63	-0.39
(N=20) 3/	*2.73*	*-2.55*	*3.51*	*-3.13*	*3.70*	*-2.47*
Mexico	4.04	-0.41	5.61	-0.36	4.82	-0.28
(N=13)	*1.42*	*-1.84*	*2.54*	*-1.86*	*2.39*	*-1.33*
Memorandum Item: Results for Argentina and Mexico after excluding outliers 4/						
Argentina (90-d deposit)	3.70	-0.11	3.49	-0.16	4.59	-0.07
(N=17) 3/	*1.31*	*-0.59*	*1.50*	*-0.83*	*2.41*	*-0.43*
Argentina (PRE-1)	4.01	-0.25	3.19	-0.30	2.96	-0.24
(N=18) 3/	*1.93*	*-1.92*	*1.87*	*-2.16*	*1.91*	*-1.83*
Mexico	0.77	-0.18	1.37	-0.18	0.28	-0.18
(N=11)	*0.41*	*-1.72*	*0.75*	*-1.80*	*0.18*	*-1.68*

1/ Change in weighted average between 2-month ahead and 3-month ahead federal funds futures rate (see Appendix).
2/ Unexpected change in the federal funds target, based on change in the current-month federal funds futures rate.
3/ Two-day window.
4/ Defined as changes of domestic interest rates of 200 basis points or more on one day.

Table 2. Impact effect of US Monetary Policy Shocks on Bilateral Exchange Rates
(dependent variable: percentage change in bilateral exchange rate; t values in italics)

	Policy measure					
	Change in FF2CONT 1/		Kuttner 2/		Change in US 3m T-Bill	
	policy measure	regression constant	policy measure	regression constant	policy measure	regression constant
Australia	0.48	0.15	0.29	0.14	1.11	0.18
(N=44)	*0.50*	*1.30*	*0.40*	*1.26*	*1.28*	*1.71*
Canada	0.56	-0.03	0.50	-0.03	0.49	-0.03
(N=44)	*1.53*	*-0.69*	*1.82*	*-0.69*	*1.45*	*-0.81*
New Zealand	1.92	0.17	1.43	0.15	0.74	0.04
(N=44)	*1.75*	*1.33*	*1.70*	*1.23*	*2.17*	*1.04*
Singapore	1.03	0.06	0.48	0.03	1.03	0.05
(N=44)	*2.89*	*1.50*	*1.64*	*0.75*	*2.70*	*1.43*
Chile	-0.04	0.04	0.15	0.05	0.11	0.05
(N=28)	*-0.08*	*0.64*	*0.34*	*0.80*	*0.25*	*0.77*
Mexico	1.69	-0.30	1.24	-0.30	0.82	-0.29
(N=14) 2/	*1.65*	*-3.52*	*1.24*	*-3.34*	*0.88*	*-2.98*

1/ Change in weighted average between 2-month ahead and 3-month ahead federal funds futures rate (see
2/ Unexpected change in the federal funds target, based on change in the current-month federal funds futures
3/ Sample begins in July 1995.

(ii) For Hong Kong, interest rates rise about one-for-one with U.S. policy, in line with a textbook model of a currency board regime.

(iii) For both Argentina and Mexico, interest rate responses are much higher than one-for-one, although somewhat larger for Argentina. The estimated coefficients are, however, highly sensitive to outliers. After dropping outliers, all coefficients substantially decline in magnitude, although they are generally still larger than one. For Argentina, most coefficients remain significantly larger than zero, while, in the case of Mexico, coefficients become insignificantly different from zero after dropping outliers. However, given the large standard errors and small sample, the comparison between Argentina and Mexico is clearly not conclusive based on these findings.

(iv) Finally, the results also confirm the expected positive response of exchange rates to U.S. interest rate shocks for the floating regime countries, although the coefficients are not always statistically significant. This time, the coefficient for Mexico appears more or less in line with that for the other floaters in the sample.

3.2.2 Impact of Large Shocks to Emerging Market Risk Premia

We performed an analogous study of the reactions of domestic interest rates and exchange rates to large movements in emerging market risk premia. To define a suitable set of "events", we proceeded as follows. First, we identified all days on which J.P. Morgan's EMBI Global, or EMBIG, composite bond index moved by at least 3 percent. The EMBIG is a broad-based index of emerging market bond prices, which is available since January 1994. The 3-percent threshold was chosen because it is sufficiently high that the financial press would usually notice and attempt to interpret the "jump" in emerging market bonds, and sufficiently low as to yield enough events (40 events in the period between January 1994 and mid-2000, of which about half occur after the Asia crisis; see Appendix Table A2 for a full listing). Second, we checked the background for each event using the *Financial Times*, in order to identify the market or markets in which the shock originated. This turned out to be relatively easy in all but two cases. Finally, for each country, we examined the reaction of domestic interest rates to the shocks, both on the entire sample and—to disentangle the effect of domestic and international shocks, as discussed previously—excluding the shocks that appear to have "originated" in the country or in a neighboring country with strong real linkages (e.g., Brazil for the case of Argentina).

We measure the shocks as the changes in the EMBI spread over the day, this being the only general measure of emerging market bond spreads that is available since the early 1990s.[14] For the sample period after 1997, we also used the broader-based EMBI Global spread index, which becomes available in 1998, as an alternative measure. For Argentina and Mexico, where dollar-denominated sovereign bond yields are available over the entire sample period, we also examined the reaction of domestic interest rates to the change in the dollar-denominated bond yield on that date (the idea being that the latter is likely to be a better measure of how the international shock affects the *country-specific* risk premium). For similar reasons, we also used the EMBIG regional sub index for Asia in some of the regressions involving Hong Kong and Singapore.

Figures 4-6 plot changes in domestic interest rate and (if applicable) the exchange rates against the full sample of 40 large changes in the EMBI spread. Tables 3 and 4 show regression results both for the full sample and for the sub-samples that are deemed exogenous for each country. The tables also distinguish between regression results based on the entire 1994-2000 period and those that apply only to the period after the Asian crisis. This turns out to make a big difference for the Asian economies, particularly Hong Kong.

The results show that, for the three industrial countries and Chile, the response of interest rates and exchange rates to the large EMBI shocks is mostly not significant. The main exception is a significant reaction of the Canadian *exchange* rate to EMBI/EMBIG shocks, both for the entire sample period and in the post-Asia sample period. The latter is somewhat surprising, particularly since we do not see the same kind of reactions for Australia and New Zealand. For the post-Asia sample period, we also

[14] J.P. Morgan publishes the "EMBI Global" bond *price* index beginning in 1994, but unfortunately not the corresponding index of bond *spreads*, which starts only in 1998.

see a significant reaction of Chilean exchange rates to EMBI and EMBIG shocks once country-specific events are excluded; however, this result is based on a very small event set.

For the Asian countries, there is a small but significant and robust reaction of interest rates to EMBI shocks over the entire sample period for Hong Kong (coefficient of about 0.25), but not for Singapore, where the corresponding coefficient is insignificant (and in fact negative). If one restricts attention to the period after the Asia crisis, both the coefficients for Hong Kong and Singapore become much larger, and the latter is now borderline significant. Note also that the coefficients are larger the higher the weight of Asia in the measure of emerging market risk that we use in the regression, as one would expect. However, the reaction of Hong Kong interest rates is much larger regardless of the sub-sample and measure of risk used. This accords with conventional priors about the potentially insulating effects of Singapore's exchange rate regime. However, this interpretation appears to conflict with the behavior of Singapore's exchange rate, which also shows no sign of depreciating in response to EMBI/EMBIG shocks, and often has the wrong sign. Thus, the evidence might simply suggest that Hong Kong is more vulnerable to speculative attacks than Singapore when there are crises elsewhere.

For Mexico and Argentina, we observe virtually the same reaction of the interest rates to shocks to international risk premia as long as (1) the PRE-1 rate is used for Argentina (domestic deposit rates, which are not shown in the figures and tables, show very little response); and (2) events originating in Argentina or Brazil are removed from the sample for Argentina (Table 3).[15] The coefficient is about 1

[15] On closer inspection, it turns out that the latter hinges mainly on one outlier for Argentina, namely the sharp drop in the EMBI spread on January 15, 1999, when emerging markets and particularly Brady bonds recovered from an initial over-reaction to the Brazil devaluation two days earlier. While Argentinean Brady bonds followed the general trend toward lower spreads, the PRE-1 did not, and the yield on the PRE-1 rose sharply. A possible interpretation is that at this point markets may have realized that the crisis was under control and the *real* would stabilize at the depreciated level. While reducing the chance of a further deepening of the Brazilian crisis, this my have increased doubts about the sustainability of the exchange rate regime in Argentina.

on the long (1994-2000) sample, regardless whether the EMBI or a Brady bond yield is used to measure the shocks, and slightly higher if the post-Asia sample is used. If we use deposit rates for Argentina or if we do not remove shocks originating in Argentina or Brazil, then interest rate reactions to EMBI shocks actually appear smaller for Argentina than for Mexico. Thus, there is no evidence that the floating exchange rate regime helped insulate Mexico from EMBI shocks, in line with earlier claims by Hausmann et al. (1999).

However, this finding does not provide strong support for the "fear of floating" hypothesis because the Mexican exchange rate did in fact exhibit large, highly significant responses to EMBI shocks (see Table 4). According to these estimates, the elasticity of exchange rates with respect to an exogenous 100 basis point EMBI or Brady Bond shocks is in the order 1-2 percent. This is roughly in line with exchange rate elasticities with respect to changes in *domestic* interest rates estimated by Zettelmeyer (2000) for several industrial countries with floating regimes. If anything, the results seem in line with a stylized fact in advanced open economies, namely that the increase in exchange rate volatility associated with floating exchange rate regimes is not necessarily offset by a reduction in volatility elsewhere in the domestic economy.[16] In our case, Mexican interest rates seem at least as volatile as interest rates in Argentina.

As with US monetary policy shocks, we checked that these results are robust if *both* changes in emerging market risk premia and U.S. interest rates are included in the regressions (Table A4a and A4b in the Appendix).

[16] See in particular, Flood and Rose (1995). Related results are presented in Baxter and Stockman (1989) and Jeanne and Rose (2000).

Figure 4. Australia, New Zealand, Canada, and Chile. Reaction of Interest and Exchange Rates to EMBI Shocks, 1994-2000 (measure of shock, in percentage points, on X-axis)

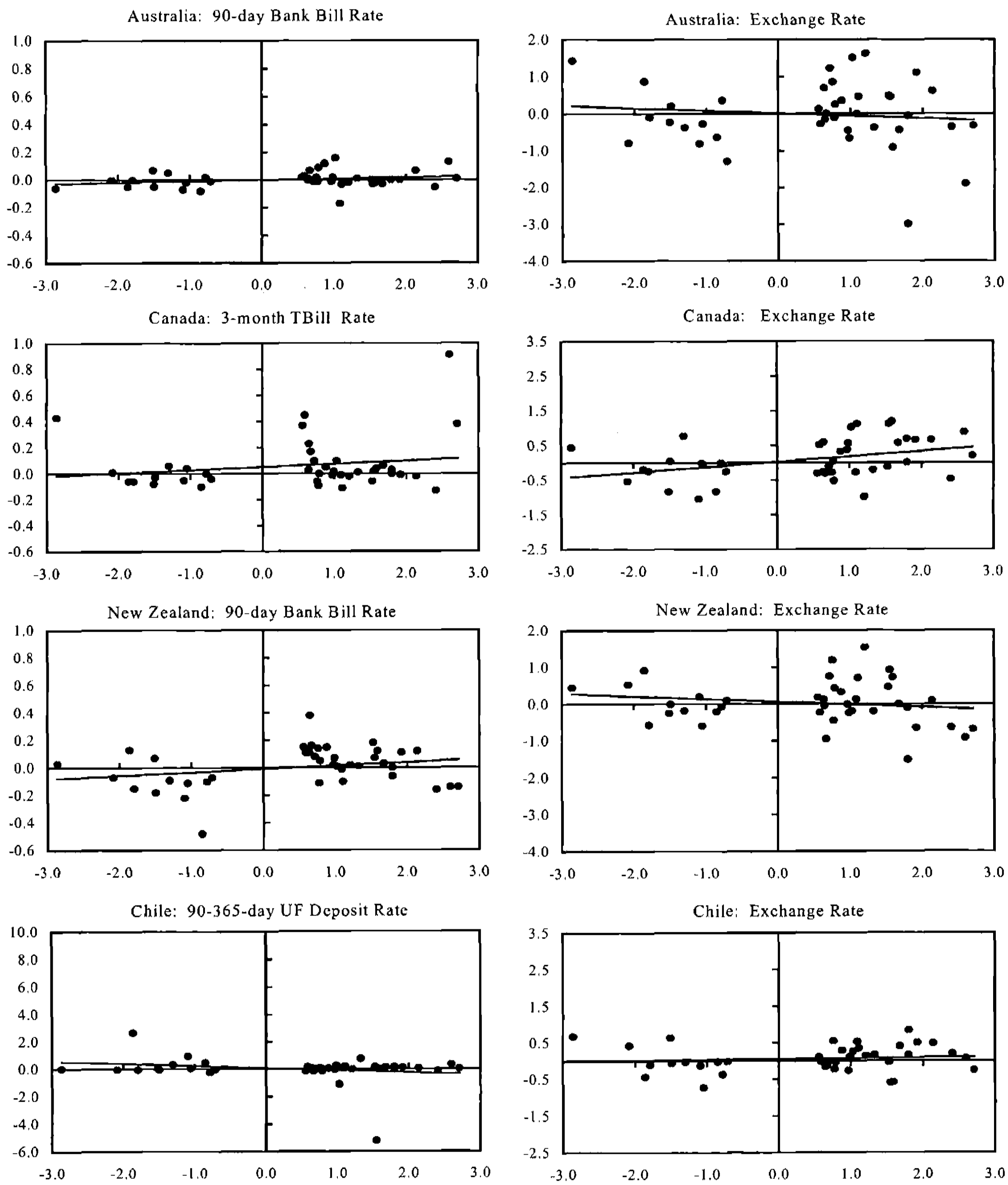
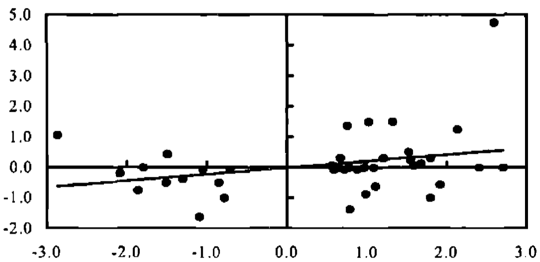


Figure 5. Hong Kong and Singapore:

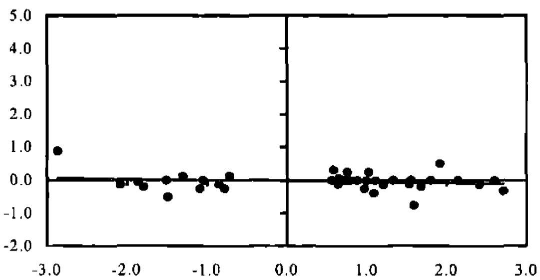
Reactión of Interest and Exchange Rates to EMBI Shocks, 1994-2000

(measure of shock, in percentage points, on X-axis)

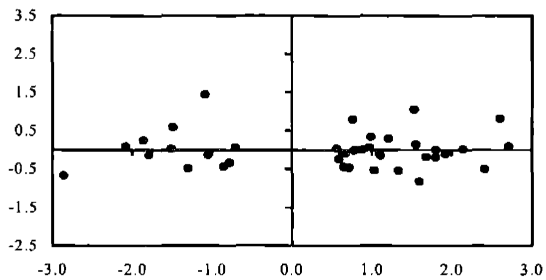
Hong Kong: Int. Rate, EMBI Shocks, 1994-2000



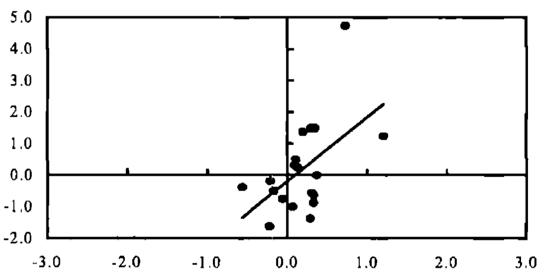
Singapore: Int. Rate, EMBI Shocks , 1994-2000



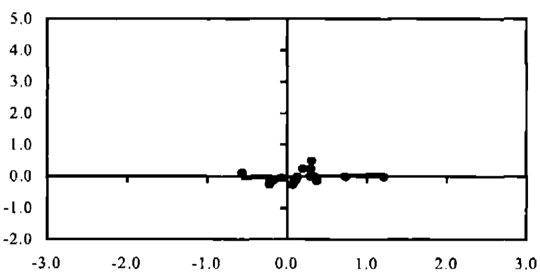
Singapore: Exch. Rate, EMBI Shocks, 1994-2000



Hong Kong: Int.Rt, EMBIG Asia Subindex, 98-00



Singapore: Int.Rt, EMBIG Asia Subindex, 98-00



Singapore: Exch.Rt, EMBI Asia Subindex, 98-00

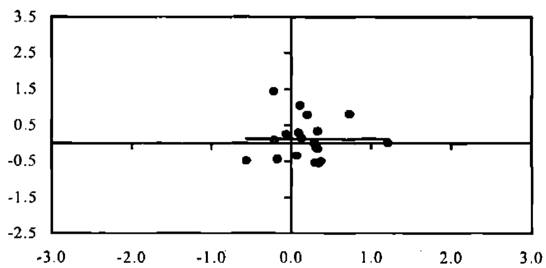


Figure 6. Mexico and Argentina:. Reaction of Interest and exchange Rates to EMBI Shocks, 1994-2000 (measure of shock, in percentage points, on X-axis)

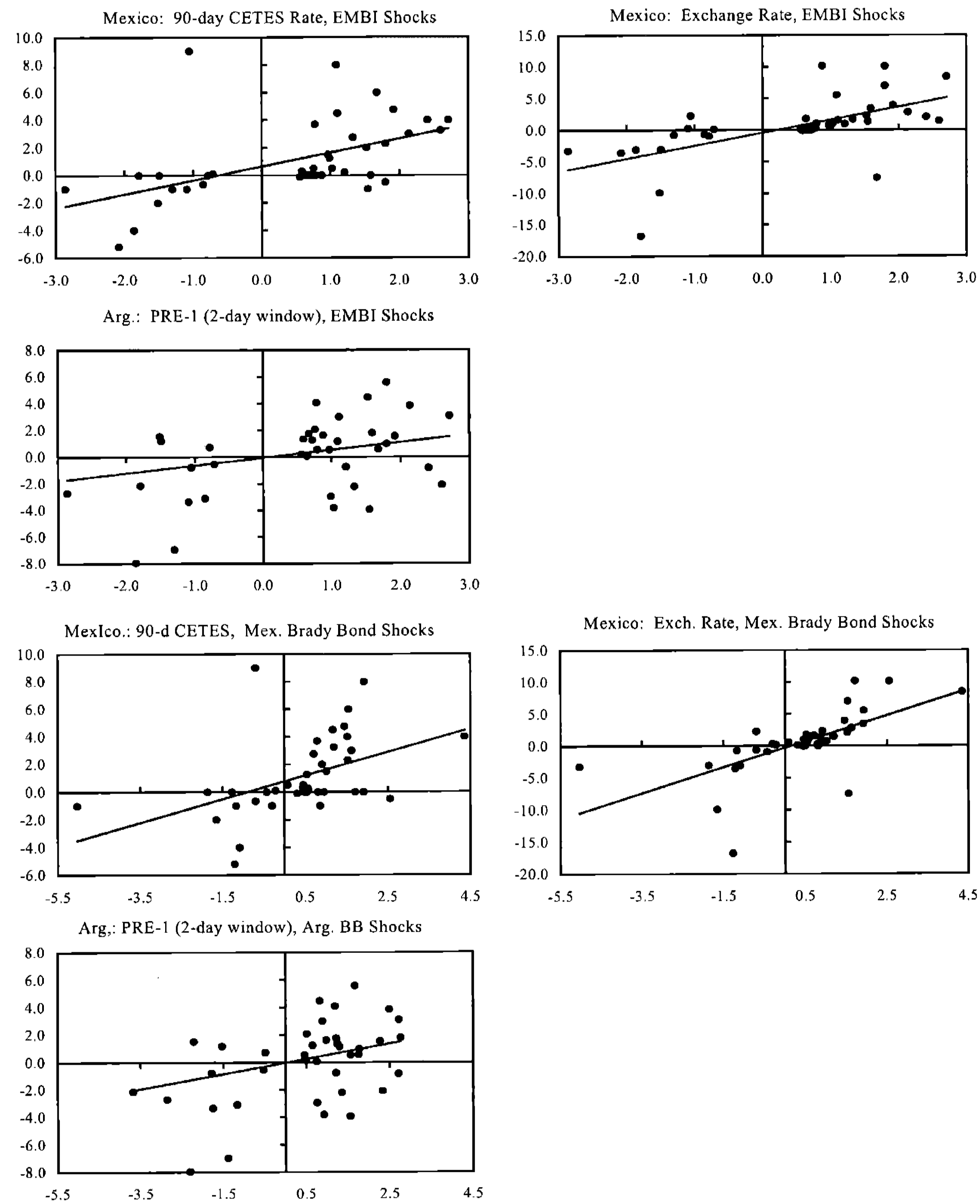


Table 3. Impact effect of Shocks to International Risk Premia on Domestic Interest Rates

(Dependent Variable: Changes in Domestic Interest Rate; t-values in italics, number of observations in parentheses)

	Using EMBI to measure shock								Using EMBIG to measure shock,				Using Country Bond or Subindex, 2/			
	Sample Period: 1994 - 2000				Sample Period: 1998 - 2000				Sample Period: 1998 - 2000				Sample Period: varies by country 3/			
	Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/	
	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant
Hong Kong	0.22	0.00	0.27	0.06	0.53	-0.13	0.60	-0.02	0.72	-0.15	0.82	-0.03	2.04	-0.20	2.17	-0.14
	1.93	*0.00*	*2.38*	*0.34*	*2.61*	*-0.42*	*2.87*	*-0.05*	*2.74*	*-0.49*	*3.04*	*-0.09*	*2.58*	*-0.61*	*2.68*	*-0.38*
	(40)		(35)		(19)		(15)		(19)		(15)		(19)		(15)	
Singapore	-0.03	-0.02	-0.04	-0.04	0.04	-0.03	0.02	-0.06	0.06	-0.03	0.04	-0.06	0.09	-0.02	0.06	-0.06
	-0.95	*-0.48*	*-1.44*	*-0.94*	*1.43*	*-0.63*		*-1.61*	*1.64*	*-0.73*	*1.29*	*-1.69*	*0.81*	*-0.44*	*0.75*	*-1.52*
	(40)		(35)		(19)		(15)		(19)		(15)		(19)		(15)	
Australia	0.01	0.00	...	...	0.01	0.00	...	...	0.02	0.00	...	...	...	...	...	...
	1.35	*0.02*			*1.44*	*0.25*			*1.69*	*0.15*						
	(40)				(19)				(19)							
Canada	0.02	0.05	...	...	0.04	0.00	...	...	0.06	0.00	...	...	...	...	...	...
	1.06	*1.61*			*1.28*	*0.00*			*1.37*	*-0.05*						
	(40)				(19)				(19)							
New Zealand	0.02	-0.01	...	...	0.03	-0.04	...	...	0.05	-0.05	...	...	...	...	...	...
	1.47	*-0.34*			*1.32*	*-1.12*			*1.54*	*-1.23*						
	(40)				(19)				(19)							
Chile	-0.17	0.09	-0.03	0.09	-0.34	0.19	-0.12	0.18	-0.41	0.18	-0.15	0.18	...	...	...	...
	-1.48	*0.55*	*-0.67*	*1.36*	*-1.50*	*0.55*	*-0.94*	*1.07*	*-1.39*	*0.51*	*-1.03*	*1.11*				
	(40)		(26)		(19)		(11)		(19)		(11)					
Argentina 4/	0.57	-0.04	0.95	-0.10	0.37	-0.82	1.26	-1.72	0.50	-0.84	1.48	-1.70	0.55	0.00	0.96	-0.08
	1.56	*-0.07*	*2.56*	*-0.19*	*0.52*	*-0.75*	*1.72*	*-1.73*	*0.55*	*-0.76*	*1.68*	*-1.71*	*1.80*	*-0.01*	*2.86*	*-0.16*
	(40)		(26)		(19)		(11)		(19)		(11)		(40)		(26)	
Mexico	1.01	0.65	0.90	0.48	1.54	-0.19	1.46	-0.08	1.96	-0.19	1.83	-0.04	0.85	0.77	1.16	0.51
	3.64	*1.58*	*2.24*	*0.86*	*6.41*	*-0.52*	*5.48*	*-0.20*	*5.96*	*-0.49*	*5.18*	*-0.10*	*3.14*	*1.83*	*1.98*	*0.88*
	(40)		(26)		(19)		(18)		(19)		(18)		(40)		(26)	

1/ Excludes events originating in Asia for Hong Kong and Singapore; Argentina and Brazil for Chile and Argentina
2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Change in Brady Bond Yield for Argentina and Mexico.
3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore
4/ PRE-1 rate, 2-day window.

Table 4. Impact Effect of Shocks to International Risk Premia on Exchange Rates

(Dependent variable: percentage change in domestic currency per US$; t values in italics, number of observations in parentheses)

	Using EMBI to measure shock								Using EMBIG to measure shock, Sample Period: 1998 - 2000				Using Country Bond or Subindex, 2/ Sample Period: varies by country 3/			
	Sample Period: 1994 - 2000				Sample Period: 1998 - 2000											
	Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/	
	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant
Singapore	0.00	0.00	0.01	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	-0.02	0.00	-0.02	0.00
	1.30	*-0.79*	*1.36*	*-0.67*	*-1.01*	*-0.10*	*-1.09*	*-0.44*	*-1.02*	*-0.09*	*-1.09*	*-0.43*	*-1.31*	*0.11*	*-1.20*	*-0.23*
	(40)		(35)		(19)		(15)		(19)		(15)		(19)		(15)	
Australia	-0.07	0.01	...	...	0.07	0.10	...	...	0.11	0.10	...	...	...	...	...	...
	-0.67	*0.09*			*0.50*	*0.44*			*0.56*	*0.42*						
	(40)				(19)				(19)							
Canada	0.16	0.03	...	...	0.20	-0.03	...	...	0.28	-0.04	...	...	...	...	...	...
	2.45	*0.34*			*1.74*	*-0.15*			*1.93*	*-0.23*						
	(40)				(19)				(19)							
New Zealand	-0.07	0.06	...	...	-0.12	0.27	...	...	-0.15	0.27	...	...	...	...	...	...
	-1.05	*0.61*			*-1.10*	*1.63*			*-1.08*	*1.62*						
	(40)				(19)				(19)							
Chile	0.02	0.06	0.01	0.14	0.07	0.04	0.13	0.05	0.10	0.04	0.16	0.05	...	...	...	...
	0.51	*0.91*	*0.20*	*2.13*	*1.39*	*0.54*	*2.36*	*0.67*	*1.55*	*0.48*	*2.46*	*0.66*				
	(40)		(26)		(19)		(18)		(19)		(11)					
Mexico	2.04	-0.39	1.09	0.41	1.13	0.00	1.06	0.11	1.44	0.00	1.32	0.14	2.02	-0.29	1.67	0.31
	4.70	*-0.61*	*4.62*	*1.25*	*8.19*	*0.00*	*7.09*	*0.48*	*7.21*	*0.01*	*6.43*	*0.59*	*5.13*	*-0.47*	*5.35*	*1.00*
	(40)		(26)		(19)		(18)		(19)		(18)		(40)		(26)	

1/ Excludes events originating in Asia for Singapore, Argentina and Brazil for Chile.
2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Brady Bond Yields for Argentina and Mexico.
3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore

3.3 Vector Autoregressions

We ran country-specific vector autoregressions, using daily data, on the variables FF2CONT as measure of U.S. monetary policy, a measure of emerging market risk (either the EMBI or the EMBI Global spread), the natural logarithm of the exchange rate (when applicable) and the corresponding domestic interest rate. We ran two sets of regressions. The first is based on a long sample, which uses the EMBI and generally begins in 1992—except for Argentina, where we begin in 1994 due to lack of reliable domestic interest data for the earlier years, and Mexico, where it begins in 1995. The second set of VARs is based on a post-Asia crisis sample and uses the EMBIG. This second sample is motivated mainly by the fact that the responses of Hong Kong and Singapore to emerging market shocks seem to have changed after the Asia crisis, as suggested in the results of the previous section. However, the longer sample is appropriate and more informative for most other countries, thus, in what follows we only discuss the shorter sample when it yields significantly different results.

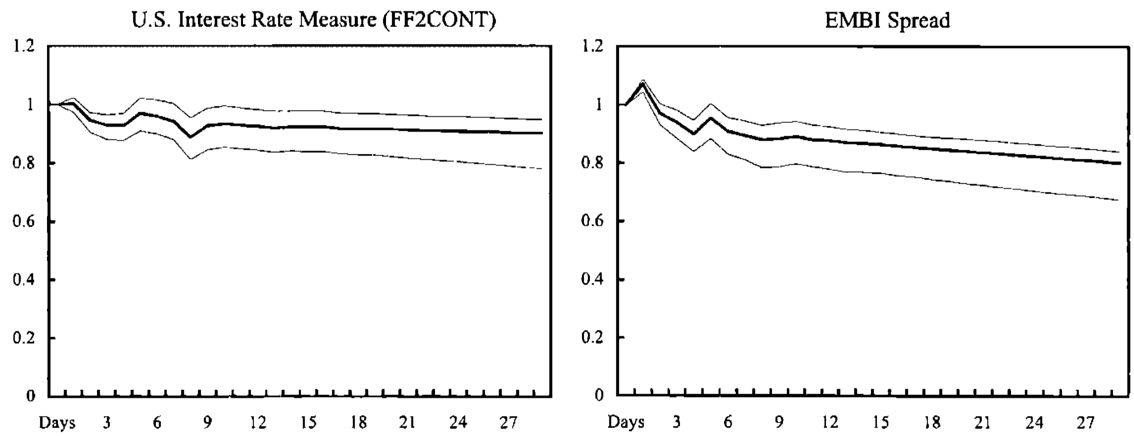
We identified the system by imposing an ordering on the contemporaneous relationship that assumes that FF2CONT contemporaneously affects all other variables but is not itself affected by any of them, that the emerging market risk measure is contemporaneously only affected by FF2CONT but affects the other two, and so forth. In addition, we test, accept, and impose full exogeneity of FF2CONT. Note that the results that follow are not sensitive to changes in the relative ordering of exchange rates and domestic interest rates or to using the alternative U.S. policy measures shown in Tables 1 and 2.

The main downside, as argued before, is that the identification of the underlying shocks is less clean than in the previous section. In the case of EMBI shocks, endogeneity may be an important issue with regard to Mexico and Argentina, which are included in the EMBI with large weights. To deal with this problem in at least a rudimentary fashion, we excluded sub-periods from the sample in which there is a presumption that the EMBI might be driven by domestic shocks affecting the country whose interest rate we are examining; thus, the sample used in the regressions for Mexico begins in June of 1995. The samples for Hong Kong and Singapore do not include the period after July 1997 in our baseline regression, and they only start in January 1998 in the shorter regression that uses the EMBIG. As it turns out, the impulse response functions to EMBI and EMBIG shocks are almost entirely consistent with the results from the impact regressions, lending some credibility to our identification assumptions.

Because the VAR systems do not include variables such as output, money and prices which one would expect to adjust after the very short run, we limit ourselves to showing the impulse responses for about 3-weeks after each shock. To help interpret the results, it is useful to understand what the shocks do to the underlying variables themselves, in other words, how much persistence there is in the series we are shocking. This is answered in Figure 7, which shows the two impulse responses with respect to a shock to themselves based on our long regression sample. As one would expect, both shocks are highly persistent over the short run that we are considering, especially U.S. interest rate shocks. After 30 days, about 90 percent of the initial U.S. interest rate shock is still present. This must be borne in mind when interpreting the short-run persistence of some of the reactions in domestic interest rates and exchange rates. For the EMBI shock, about 80 percent is still present after 30 days. Note also the slight overshooting of the EMBI at the outset. This overshooting is even more pronounced (and persistent) in the short (post-Asia) regression sample, and may explain some of the overshooting we see in the corresponding impulse response functions below.

Figure 7. Impulse Response Functions of US Interest Rates and EMBI Spread

with Respect to a One-Percentage Point Shock to Themselves, 1992-2000



3.3.1 Shocks to U.S. interest rates

Figures 8 through 10 display the impulse response functions for both domestic interest rates and exchange rates with respect to a one percentage point shock to U.S. interest rates. We begin again with the industrial countries to define a "baseline" with which to compare the results for the emerging markets.

For Australia, Canada and New Zealand, the results are in line with conventional expectations, and broadly consistent with those of the previous section. A one basis point shock leads to 0.5 basis point interest pass-through and 0.2 percent depreciation on impact. As in the previous section, the responses of interest rates are estimated much more tightly than the exchange rate responses, which are statistically significant in only one case (Canada).

For Singapore, the interest rate reaction is more or less in line with that of the industrialized countries (0.2-0.4 basis points on impact for a 1 bp shock, later rising to about 0.6). For Hong Kong, the response is approximately three times as large: about 1 basis point on impact, later rising to about 1.5. In Singapore, the exchange rate seems to absorb roughly half of the shock.

In the cases of Argentina, Mexico, and Chile, the estimation results are much noisier and thus harder to compare. For Argentina, the results again show a consistent, significant over-reaction of the interest rate on impact, roughly 1-3 basis points per basis point of U.S. shock. The estimated impact effect on Mexican interest rates appears smaller, but the standard errors are too large to reach a definite conclusion.

Figure 8. Australia, New Zealand, and Canada:

Impulse Response Functions of Interest Rates (percentage points) and Exchange Rates (logs) with Respect to 1 Percentage Point Shock to U.S. Interest Rate

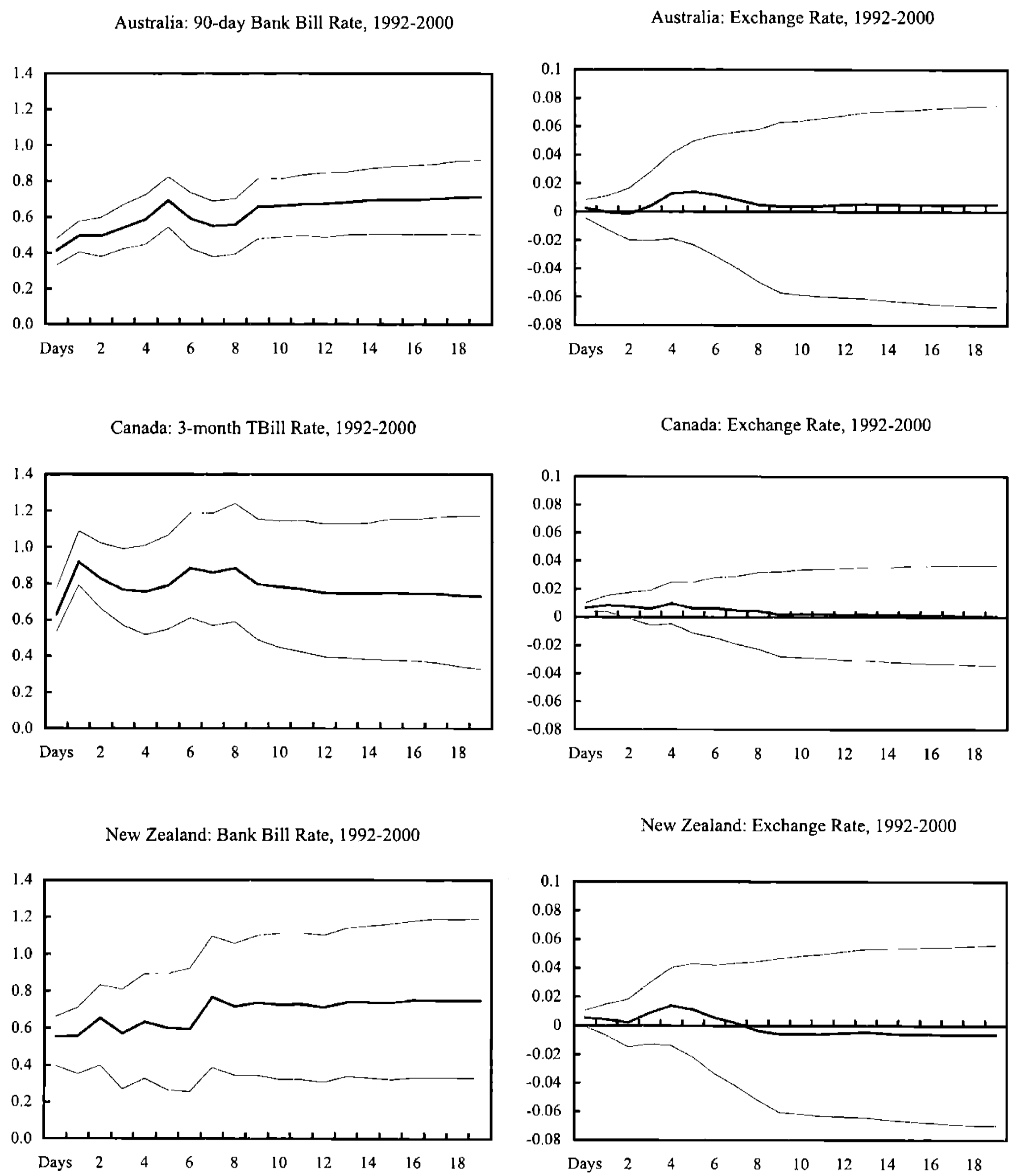
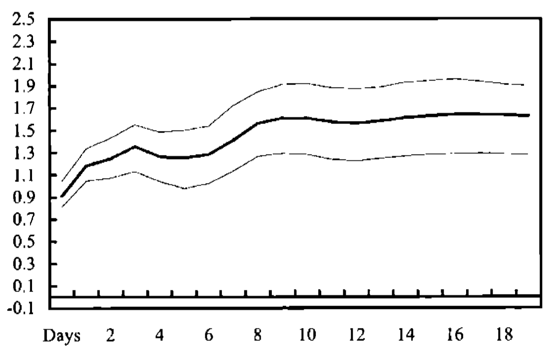


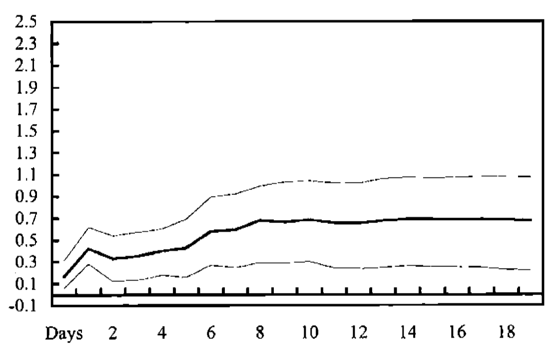
Figure 9. Hong Kong and Singapore:

Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (logs) with Respect to 1 Percentage Point Shock to U.S. Interest Rate

Hong Kong: 3-month Interbank Rate, 1992-1997



Singapore: 3-month Interbank Rate, 1992-1997



Singapore: Exchange Rate, 1992-1997

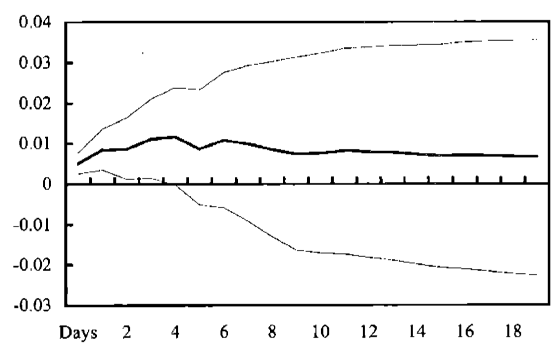
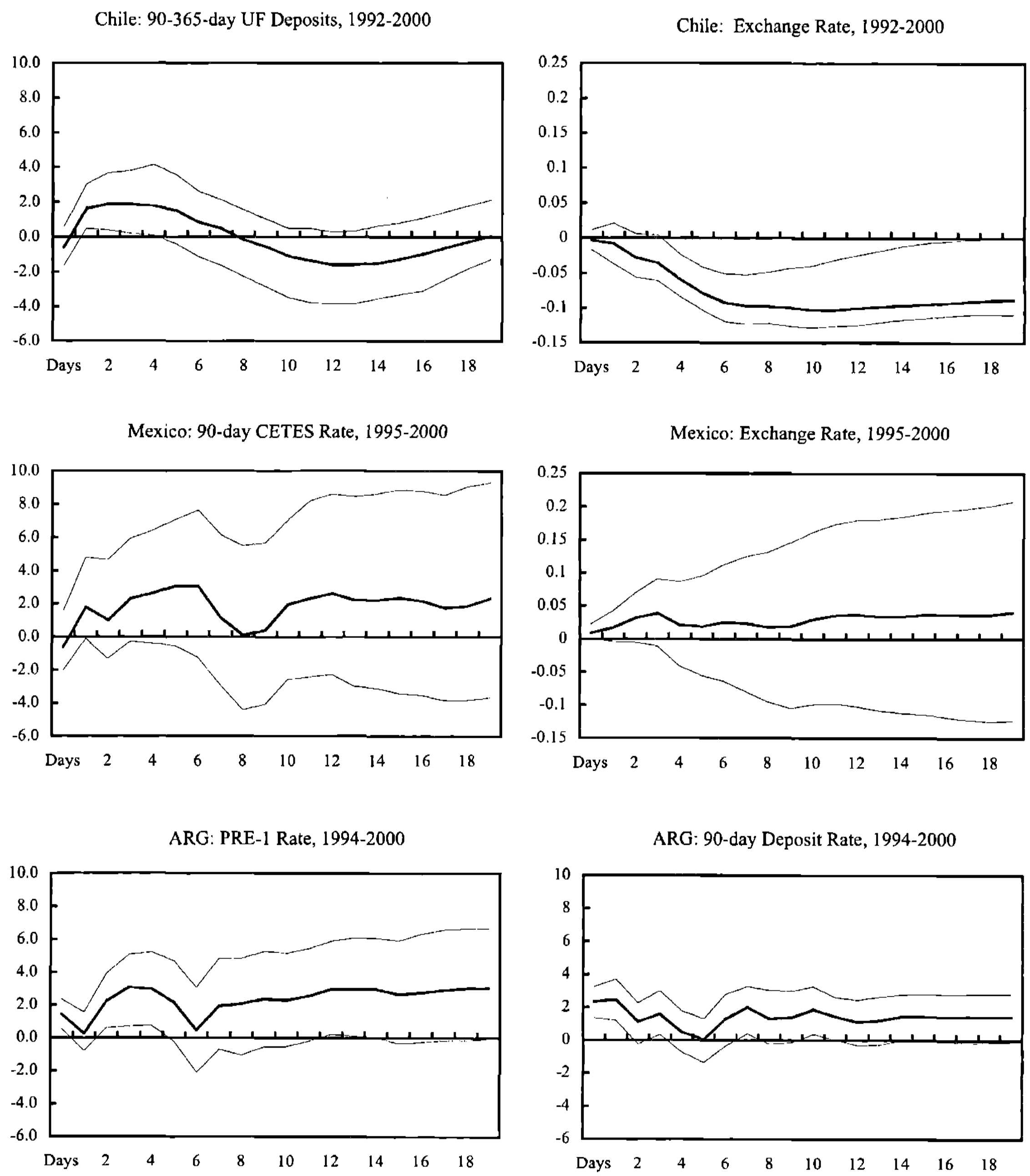


Figure 10. Chile, Mexico, and Argentina:

Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (logs) with respect to 1 Percentage Point Shock to US Interest Rate



Short run effects of shocks to emerging market risk premia

3.3.2 EMBI shocks

Next, consider impulse responses with respect to a one-percentage point shock to the EMBI or EMBIG spread (Figures 5a through 5c). In interpreting these results, it is important to keep in mind that the typical EMBI shock is about ten times larger than the typical U.S. interest rate shock (the standard deviation of the orthogonalized error is about 2.6 basis points for the latter, and 28 basis points for the former). Thus, relative to the standard volatility of both measures, a one percentage point EMBI shock represents a much smaller shock than a one percentage point U.S. interest rate shock.

All three industrialized countries show some response to EMBI shocks (in terms of both interest rates and exchange rates, see Figure 5a). However, these are very small for Australia and New Zealand. For Canada, the estimated effect on interest rates is somewhat larger: approximately a 4 basis point increase for a 100 basis point jump in the EMBI spread. The relatively large effect for Canada may be driven by "contagion" during the Tequila crisis (see Zettelmeyer (2000)).

Based on the 1992-1997 sample (i.e. before the Asia crisis, see upper panel of Figure 5b), Hong Kong shows no significant reaction to EMBI shocks. For Singapore, the reaction, if anything, appears to be *negative*, suggesting a "safe haven" effect. Based on the post-Asia crisis sample, however, Hong Kong shows a very large, significant response to EMBIG shocks, while Singapore shows a much smaller, but still positive and significant response (see lower panel of Figure 5b). The estimated short-run responses (about 0.4 – 0.7 for Hong Kong and about 0.05 – 0.1 for Singapore) are in line with the impact coefficients estimated in the previous section (Table 3). Note also that, unlike in

Figure 5, there seems to be a significant response of the Singapore exchange rate, although it is small (about 0.2 percent for a 100 point EMBIG shock).

Both Mexico and Argentina exhibit very large reactions to EMBI shock. The point estimates indicate an "overreaction" between about 1.5:1 and 2:1. This is larger than the impact reactions estimated in the previous sections, which were in the order of 1:1. Note again that the large reaction of the Mexican interest rate occurs in spite of a large, significant response of the exchange rate (about 1.5 percent depreciation in response to a 100 basis point EMBI shock, consistent with our earlier findings. Chile seems much less sensitive to EMBI shocks than Argentina and Mexico, both in terms of interest rate pass through and in terms of exchange rate fluctuations.

Figure 11. Australia, New Zealand, and Canada:

Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (logs) with respect to 1 Percentage Point Shock to EMBI

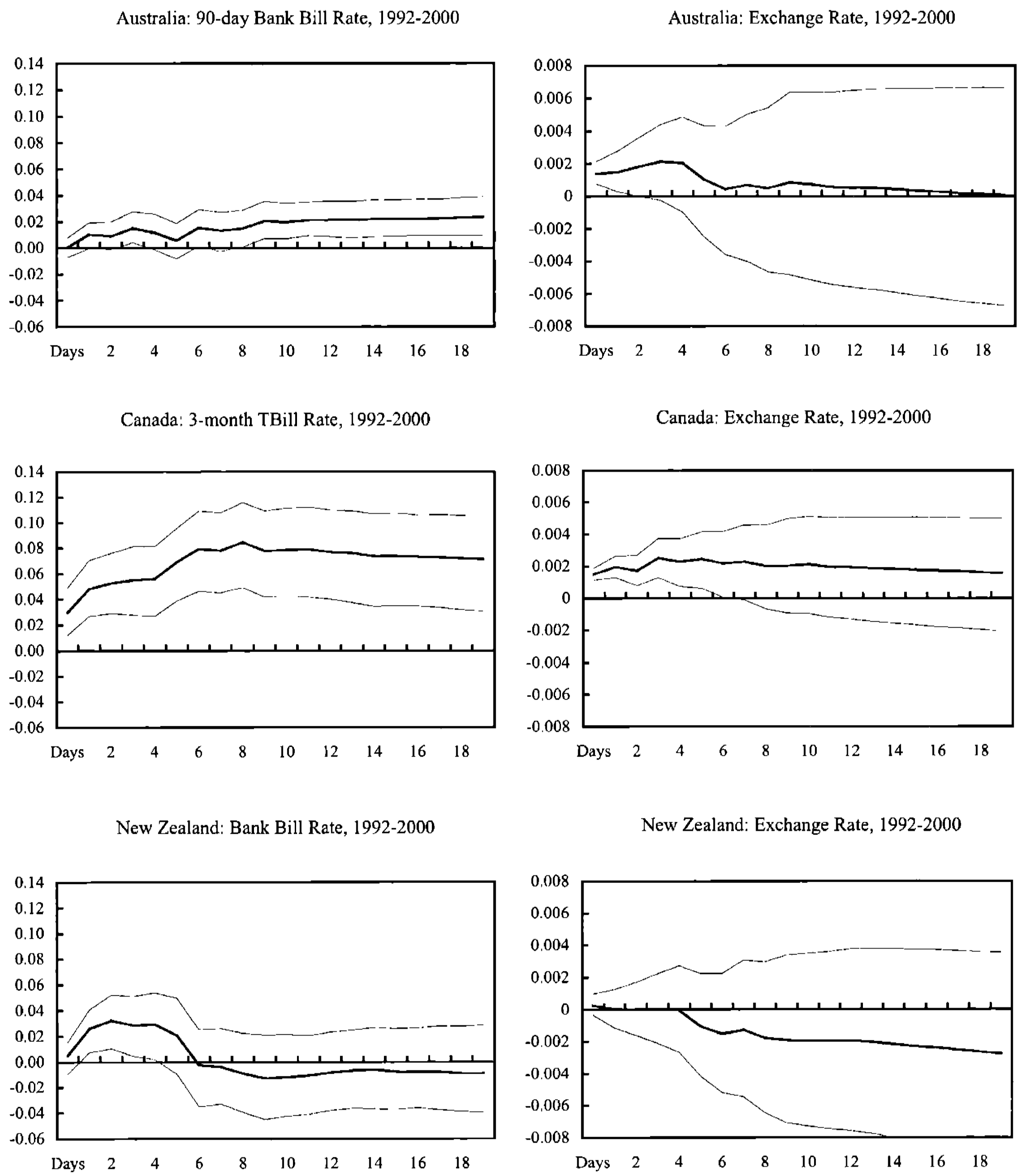


Figure 12. Hong Kong and Singapore:

Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (logs) with respect to 1 Percentage Point Shock to Emerging Market Risk Premia Shocks

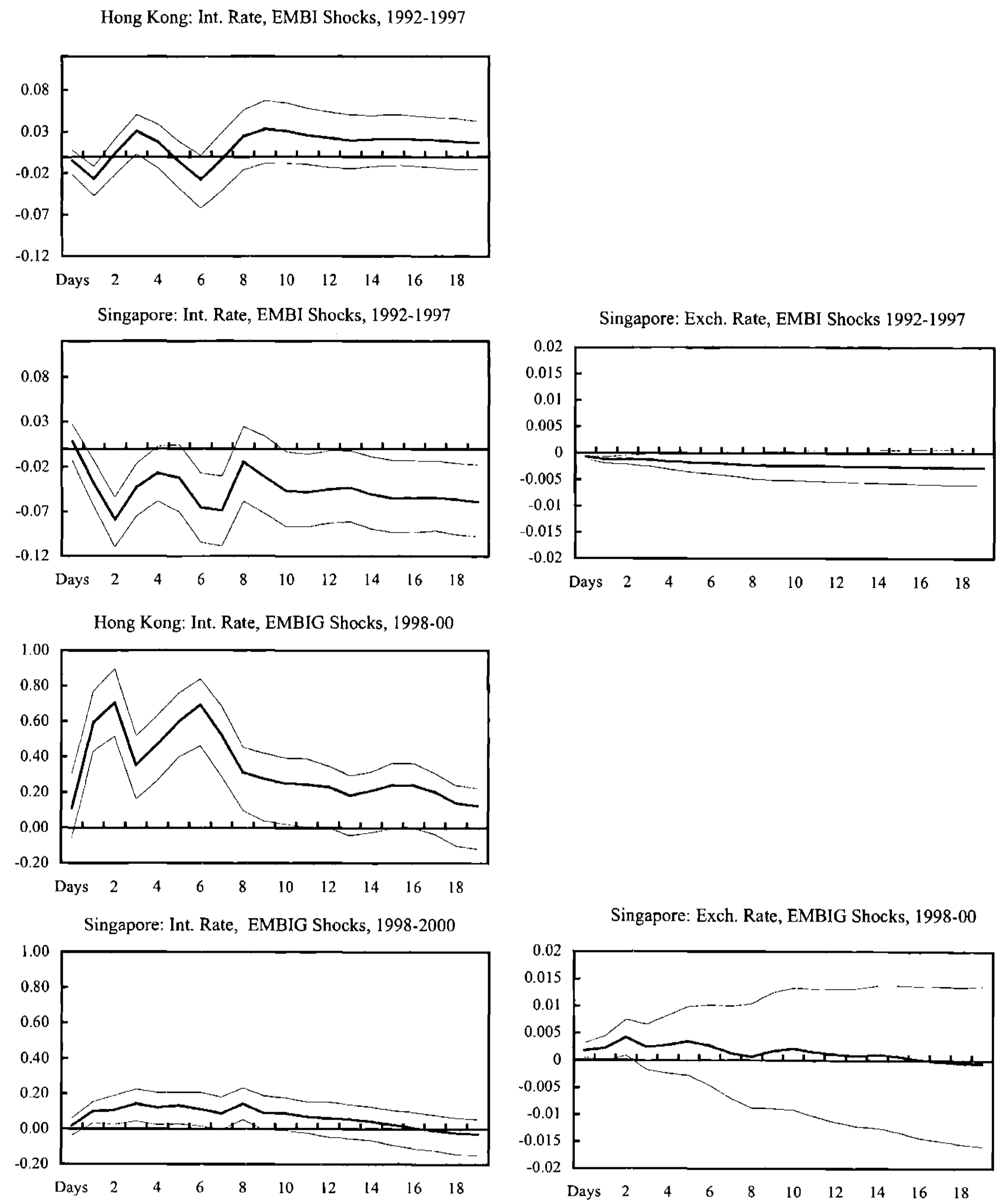
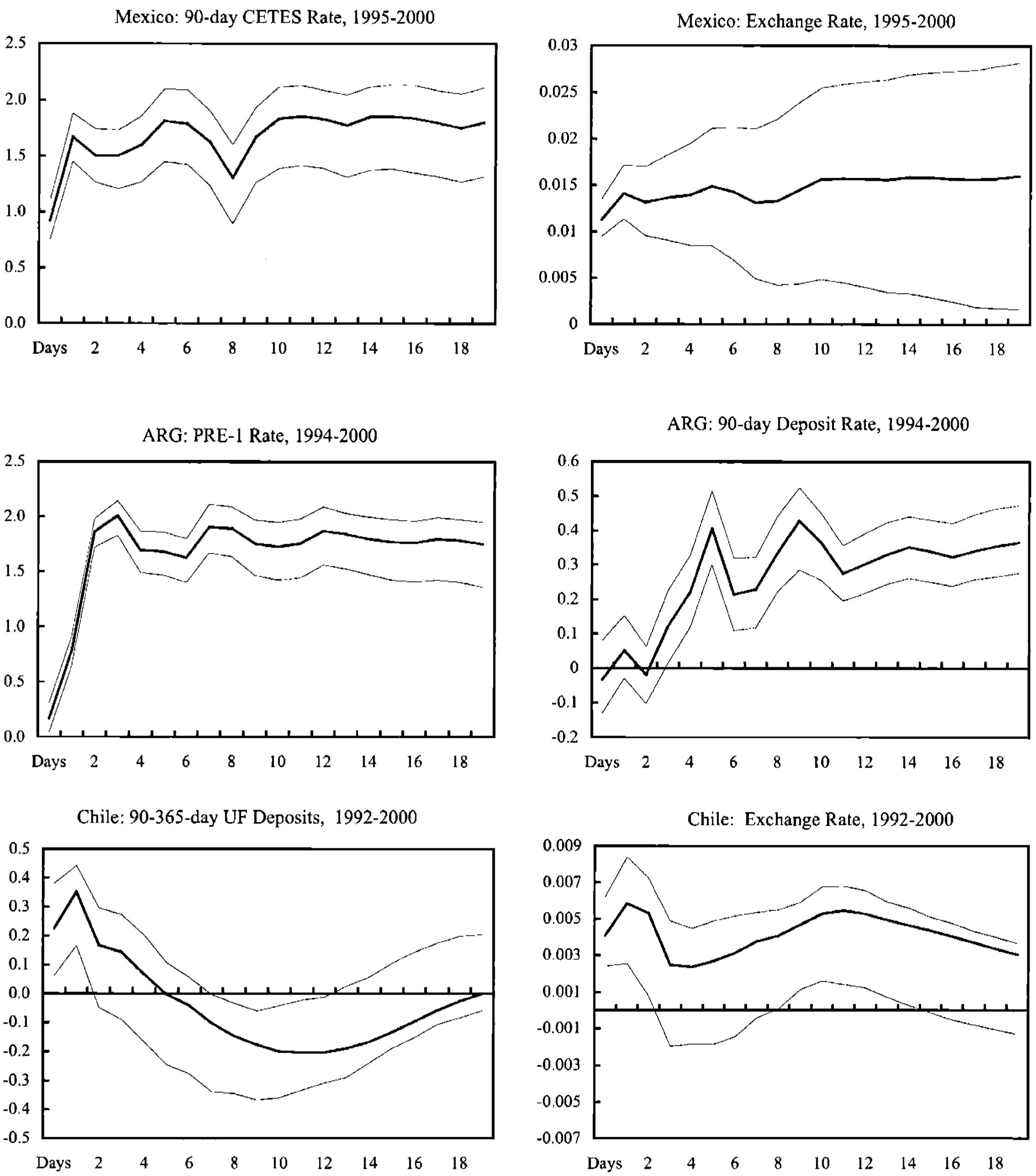


Figure 13. Chile, Mexico, and Argentina:

Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (logs) with respect to 1 Percentage Point Shock to Emerging Market Risk Premia Shocks



3.4 Conclusions

This paper has tested the proposition that floating exchange rate systems insulate domestic interest rates from shocks in the international financial markets. While true in conventional analytical models, this weak form of "monetary independence" may not be valid in a context in which the credibility of the central bank is tenuous and the reactions of international investors are unpredictable.

We have investigated this "monetary independence" proposition with respect to two types of shocks: changes in US dollar interest rates and changes in the risk premium attached to emerging markets debt. We have focused on economies that have broad similarities but are at the polar ends of exchange rate systems: Hong Kong and Singapore, and Mexico and Argentina

We have found different results in the comparison of the Asian and Latin American pairs. The conventional view about monetary autonomy describes well the case of Hong Kong and Singapore. Interest rates in Hong Kong are much more sensitive to shocks to emerging market risk premia and to U.S. monetary policy shocks than interest rates in Singapore. Results from the comparison between Argentina and Mexico with respect to US monetary shocks are also consistent with the conventional view, but they are not quite as persuasive because the estimation is less precise. We suspect that this is because the comparison between Mexico and Argentina is confined to a relatively short sample, the second half of the 1990s, during which U.S. monetary policy shocks were comparatively few and small. Revisiting the evidence in a few years may result in a clearer picture. Results from the reaction to shocks to the risk premium, by contrast, are in conflict with the conventional prediction. We find large effects on domestic interest rates, and of the same order of magnitude in Argentina and Mexico. Interestingly, however, this does *not* seem to come from a lack of exchange rate flexibility in Mexico, since *both* the interest rate *and* the exchange rate display very large, statistically significant reactions to shocks to emerging markets risk premia.

In sum, our findings provide some support for the hypothesis of monetary independence under floating exchange rate regimes, at least compared to the recent literature. At the same time, they raise new questions: in particular, it is unclear why the floating exchange rate regime in Mexico does not have an insulating effect with respect to shocks to international risk premia, in spite of the fact that the exchange rate shows very large reactions to such shocks. This is consistent neither with the conventional proposition nor with the "fcar of floating" view.

APPENDIX I

Data Sources

Domestic Interest Rate Data:

Argentina: (1) "PRE-1", the interest rate on an Argentinean domestic peso-denominated bond (Source: Central Bank of Argentina). (2) 90 day inter-bank deposit rate, paid on deposits of more than 1 million pesos for a fixed time period (Source: Bloomberg); (3) 90 day deposit rate (Source: Datastream).

Australia: 3 month bank bill rate, (Source: Datastream).

Canada: 3 month Treasury bill rate (Source: Datastream).

Chile: 90-365 day time deposit rate provided by the central bank, denominated in an inflation-indexed currency unit, the "unidad de fomento" (UF). This data was kindly provided by the Central Bank of Chile.

Hong Kong: Hong Kong's 3 month inter-bank rate. This data was kindly provided to us by the Hong Kong Monetary Authority (HKMA).

Mexico: (1) 91-day CETES rate, a weekly auction rate determined in the primary market (Source: Datastream). (2) 91-day CETES rate determined daily in the secondary market (Source: Bloomberg). (3) 28-day CETES rate, determined daily in the secondary market (Source: Bloomberg).

New Zealand: 3 month bank bill rate (Source: Datastream).

Singapore: 3 month interbank rate (Source: Datastream).

Exchange rate data was downloaded from Datastream.

Emerging Market Bond Spread data (EMBI and EMBI Global) was downloaded from J.P. Morgan.

US interest rate data was downloaded from Datastream. We use the Federal Funds Futures as an indicator of market's expectations of future US monetary policy. Given that the domestic interest rates we use have an horizon of 3 months, we use the Fed Futures rates with corresponding maturity. At the monthly frequency, we simply use the 2 months ahead futures. At the daily frequency however, we need to construct our own indicator. The traded contract is based on the average monthly federal funds rate for some given future month, so it changes discontinuously at the end of each calendar month. More precisely, let FF2(m,d) be the k-calendar months ahead futures rate at day d of month m. For instance, let m=1, and k=2 so that FF2(1,d) is what the market expects, on day d of January, the average fed funds rate will be in March. Thus, FF2(1,1) is effectively a 3 months ahead expected rate, whereas FF2(1,31) is effectively a 2 months ahead rate. Moreover, between January 31 and February 1, the so called two months ahead rate jumps since FF2(1,31) refers to the expected rate for March whereas FF2(2,1) refers to April. To deal with those calendar effects, we construct a rate that is an average of the two and three calendar months ahead rates: on the first day of any given month, it is simply the FF2 rate and on the last day it is FF3. Between those two extremes, the weights vary linearly, so that the exact formula is:

FF2CONT(m,d)=(1-d/31)*FF2(m,d)+d/31*FF3(m,d).

FF2CONT has the two properties we were looking for: it has a constant horizon and it is "continuous" in m (in the sense that there are no spurious jumps at the end of the month).

It is possible to construct other well behaved rates, for instance by mixing FF3 and FF4. However, those rates happen to be extremely correlated and our results are insensitive to the particular choice, as long as the horizon we are considering is in line with the horizon of the domestic interest rate.

Missing Values. It turns out that EMBI and domestic interest rates series contain missing values at the daily frequency. Given the rich lag structure of the daily VARs, each missing value forced us to drop 10 observations. We therefore decided to interpolate the missing values by drawing a straight line between the previous and next non missing values. This amounts to replace 8,9,NA,11 by 8,9,10,11 for few observations. The point estimates are not affected, but of course the estimated standard errors become smaller (significantly smaller in the case of Mexico).

Sample exclusions. For the reasons explained in the text, regressions involving Mexico start only in June 95. Those involving Hong Kong and Singapore either do not include the period after July 97 (in the VARs using the EMBI) or do not include the period before January 1998 (in the VARs using the EMBIG).

Notes on Methodology

Exogeneity of US monetary Policy : for both the monthly and daily VARs, we test, accept and impose the condition that US interest rates are not affected by other variables in the VAR. This is clearly a non-controversial assumption, except for the case of the Russia/LTCM crisis. The point estimates of the impulse functions are not affected, but the restriction helps narrowing the error bands.

Daily VARs and impulse response functions: All the impulse responses were constructed for 30 periods using 10 lags. The ordering of the vector autoregression (VAR) was as follows: i) FF2CONT (constructed 2-3 months ahead federal fund futures, see above for details), ii) EMBI (emerging market bonds spreads) iii) natural logarithm (ln) of the exchange rate iv) domestic interest rate. In the case of Argentina and Hong Kong, the VAR excludes the exchange rate. In the case of Canada, FF2CONT is the closing value of the day. For Hong Kong, Singapore, Australia and New Zealand, it is lagged once. For Argentina and Mexico, we experimented with both and chose the lagged rate.

Table A1. Shocks Associated with US Monetary Policy Actions During the 1990s

Date understood	DR change	FFT change	US 3mTB change	Kuttner (2000) change	FF2cont change
06/06/89	0.00	-0.25	-0.02	-0.01	0.00
07/07/89	0.00	-0.25	-0.10	-0.03	-0.06
07/27/89	0.00	-0.25	0.05	0.00	-0.10
10/18/89	0.00	-0.25	0.00	0.00	0.02
11/07/89	0.00	-0.25	-0.11	0.04	-0.12
12/20/89	0.00	-0.25	-0.12	-0.17	-0.08
07/13/90	0.00	-0.25	-0.08	-0.14	-0.09
10/29/90	0.00	-0.25	0.02	-0.31	-0.01
11/16/90	0.00	-0.25	-0.01	0.04	0.01
12/07/90	0.00	-0.25	-0.11	-0.27	-0.16
12/18/90	-0.50	-0.25	-0.18	-0.21	-0.16
01/08/91	0.00	-0.25	-0.07	-0.18	-0.10
02/01/91	-0.50	-0.50	-0.19	-0.25	-0.20
03/08/91	0.00	-0.25	-0.11	-0.16	-0.13
04/30/91	-0.50	-0.25	-0.07	-0.17	-0.14
08/06/91	0.00	-0.25	-0.08	-0.15	-0.09
09/13/91	-0.50	-0.25	-0.06	-0.05	-0.05
10/30/91	0.00	-0.25	-0.07	-0.05	-0.09
11/06/91	-0.50	-0.25	-0.14	-0.12	-0.12
12/06/91	0.00	-0.25	-0.07	-0.09	-0.11
12/20/91	-1.00	-0.50	-0.30	-0.28	-0.27
04/09/92	0.00	-0.25	-0.21	-0.24	-0.21
07/02/92	-0.50	-0.50	-0.31	-0.36	-0.32
09/04/92	0.00	-0.25	-0.22	-0.22	-0.20
02/04/94	0.00	0.25	0.10	0.12	0.09
03/22/94	0.00	0.25	-0.05	-0.03	-0.03
04/18/94	0.00	0.25	0.11	0.10	0.11
05/17/94	0.50	0.50	0.05	0.13	0.02
08/16/94	0.50	0.50	0.17	0.14	0.08
11/15/94	0.75	0.75	0.10	0.14	0.08
02/01/95	0.50	0.50	0.07	0.05	0.02
07/06/95	0.00	-0.25	-0.14	-0.01	-0.08
12/19/95	0.00	-0.25	-0.11	-0.10	-0.10
01/31/96	-0.25	-0.25	-0.08	-0.07	-0.06
03/25/97	0.00	0.25	0.00	0.03	0.03
09/29/98	0.00	-0.25	-0.05	0.00	0.06
10/15/98	-0.25	-0.25	-0.29	-0.26	-0.21
11/17/98	-0.25	-0.25	-0.08	-0.06	-0.06
06/30/99	0.00	0.25	-0.04	-0.04	-0.05
08/24/99	0.25	0.25	0.08	0.02	0.03
11/16/99	0.25	0.25	0.01	0.09	0.08
02/02/00	0.25	0.25	-0.07	-0.05	-0.03
03/21/00	0.25	0.25	0.01	-0.03	-0.01
05/16/00	0.00	0.50	0.03	0.05	0.00

Table A2. Shocks Associated with jumps in the EMBI Spread

Event Date	EMBI Spread Change (bp)	Interpretation	Regional Origin
02/24/1994	64	Investors worried about effects of reforms in Brazil. Argentina hit also.	Brazil
03/21/1994	56	Interest rates rise in Brazil. Asian markets down also, but mostly for individual reasons.	Brazil
03/24/1994	65	DK	DK
03/28/1994	72	Assassination of Mexican presidential candidate. Effects felt in Argentina and Venezuela	Mexico
04/04/1994	59	Interest rates rise in the US, Dow falls. Markets hit in Asia, possibly in Latin America as well.	U.S.
04/07/1994	-71	Mexican interest rates increase.	Mexico
12/21/1994	78	Mexico devalues. Argentina and Brazil both react strongly.	Mexico
12/27/1994	180	Concerns over rising interest rates and further currency problems in Mexico hit Mexico, Brazil, and Argentina. Possible banking problems in Argentina as well.	Mexico
01/04/1995	109	More peso problems and interest rate increases in Mexico, general nervousness about the future of the Mexican economy. Argentina and Brazil fall sharply.	Mexico
01/09/1995	168	DK	DK
01/10/1995	271	Downgrade in Mexico's credit rating sinks Brady bonds in Mexico, Brazil, Argentina, and Venezuela.	Mexico
01/11/1995	-149	Clinton announces plan to help Mexico. Stocks in Mexico increase, as well as in Brazil and Argentina. Argentina also pushed by government assurances of strength of peso and solid growth.	Mexico
01/12/1995	-286	Morgan Stanley says that things will look up for Mexico. Clinton makes more assurances. Reserve requirements are relaxed in Brazil and Argentina. Argentine government makes more assurances about strength of peso.	Mexico
01/30/1995	88	Concers over whether Clinton's Mexican aid package will go through. Equities in Mexico and Brazil fall.	Mexico
01/31/1995	-151	Clinton announces new international aid plan for Mexico. Shares in Mexico, Brazil, and Argentina rise sharply.	Mexico
03/07/1995	159	Credit squeeze pushes Argentina equities lower. Brazil also falls due to uncertainty about Brazil's exchange rate policy, and from spillover from Argentina.	Argentina
03/10/1995	-179	Brazil stocks rise sharply as reaction to government measures aimed at stopping outflows of foreign capital. Mexico rises on satisfaction with new economic plan.	Brazil, Mexico
03/14/1995	-105	Argentina reaches agreement with IMF. Causes stocks to rise in Brazil as well.	Argentina
06/09/1995	97	Concerns over exchange rates in Brazil and general economic uncertainty in Venezuela and Argentina pushes markets down in Brazil, Venezuela, and Argentina.	Brazil, Argentina, Mexico
03/08/1996	67	Markets in Mexico, Argentina, and Brazil fall because US will most likely not lower interest rates.	U.S.
10/27/1997	180	In the midst of the Asian crisis, markets in that region suffer modest losses. Asian crisis causes US markets to drop sharply. US and Asian losses cause nosedives in Mexico, Argentina, Peru, Venezuela, Chile, and South Africa.	Asia

Table A2 (continued)

Event Date	EMBI Spread Change (bp)	Interpretation	Regional Origin
08/07/1998	79	Asian markets sink due to general uncertainty about the economic stability in the region. Brazilian and Mexican markets fall on uncertainty regarding the Chinese currency. Russia falls on speculation that it will be unable to pay off debt.	Asia
08/10/1998	76	Asian currency fears hurt markets in Thailand, Malaysia, and Taiwan, as well as Turkey. Russia continues to sink as debt crisis looms.	Asia, Russia
08/13/1998	-78	George Soros suggests Russian devaluation. Russia drops, pulls down South Africa, Poland, Hungary. Asia slides, on ruble and other regional developments.	Russia
08/17/1998	99	Russia devalues, pulls down South Africa, Mexico, Venezuela, Singapore, Malaysia, China, and Thailand (although Asian markets also suffer from regional and specific country problems.).	Russia
08/20/1998	153	Fears of devaluation in Venezuela. Markets drop in Brazil, Argentina,	Russia,
08/21/1998	214	Continued fears of devaluation in Venezuela. Shares in Argentina, Mexico, and Brazil decline. Problems in Russia and Latin America push Malaysian markets lower.	Venezuela, Russia
08/26/1998	103	More Russian debt problems. Stocks drop in Mexico and Argentina, South Africa, Hungary and Turkey.	Russia
08/27/1998	260	Still more fallout from Russia. Brings down Turkey, Hungary, Poland, Argentina, Brazil, Mexico, and South Africa.	Russia
09/01/1998	-109	US markets rally. Argentina and Chile react with gains.	U.S.
09/03/1998	133	Moody's downgrades Brazil's credit rating. Economic uncertainty in Venezuela. Argentina falls on news from Venezuela and Brazil. Russian markets also fall on rouble weakness.	Russia, Brazil, Venezuela
09/10/1998	241	Devaluation fears hit Brazil. Shares drop in Mexico, Argentina, Venezuela, and Chile. Global turmoil also affects South Africa.	Brazil
09/15/1998	-186	IMF negotiations with Brazil cause markets in Brazil, Argentina, and Mexico to rise (Good bank news from Mexico as well.)	Brazil, Mexico
09/16/1998	-130	Greenspan decides not to cut interest rates. Uncertainty over Brazil. Brazil, Argentina, and Chile suffer.	U.S.
09/17/1998	155	More uncertainty over Brazil. Mexico comes back from holiday and drops. Brazilian and Argentine markets also decrease.	Brazil
09/23/1998	-85	Hopes revive for a US interest rate cut. Brazil, Mexico, Argentina, and Venezuela all rally.	U.S.
10/01/1998	111	Fears about Japanese economy and general global instability hit markets around the world. Latin America drops sharply.	Japan
01/13/1999	192	Brazilian devaluation. Latin American shares plummet, as well as shares in South Africa and Asia. (Asia also worries about economic problems in China).	Brazil, China
01/15/1999	-208	Brazil floats. Latin American markets recover some.	Brazil
01/21/1999	121	Sharp depreciation in Briazil's currency. Brazil, Argentina, Mexico, and South Africa drop. Asian markets fall on economic uncertainty over China.	Brazil, China

Table A3a. Impact effect of US Monetary Policy Shocks on Domestic Interest Rates, Controlling for Changes in EMBI
(dependent variable: changes in domestic interest rate; t values in italics)

	Policy measure								
	Change in FF2CONT 1/			Kuttner 2/			Change in US 3m T-Bill		
	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant
Hong Kong	0.89	0.09	-0.06	0.70	0.15	-0.06	0.77	0.13	-0.05
(N=44)	*3.03*	*0.56*	*-1.67*	*2.82*	*0.92*	*-1.84*	*2.99*	*0.83*	*-1.49*
Singapore	0.48	0.00	0.00	0.40	0.03	0.001	0.49	0.02	0.01
(N=44)	*2.23*	*0.01*	*0.17*	*2.21*	*0.28*	*0.049*	*2.73*	*0.19*	*0.41*
Australia	0.33	0.13	-0.03	0.24	0.15	-0.03	0.22	0.15	-0.03
(N=44)	*2.63*	*2.01*	*-2.17*	*2.25*	*2.27*	*-2.30*	*1.86*	*2.15*	*-2.03*
Canada	0.51	0.11	0.01	0.39	0.14	0.01	0.44	0.13	0.02
(N=38)	*3.46*	*1.35*	*0.83*	*3.06*	*1.72*	*0.59*	*3.43*	*1.67*	*1.00*
New Zealand	0.63	0.032	-0.0004	0.56	0.07	0.00	0.64	0.06	0.01
(N=44)	*2.29*	*0.22*	*-0.014*	*2.47*	*0.50*	*-0.11*	*2.80*	*0.42*	*0.23*
Chile	0.41	-0.340	-0.008	0.390	-0.315	-0.010	0.50	-0.33	0.00
(N=44)	*1.47*	*-2.29*	*-0.26*	*1.73*	*-2.19*	*-0.31*	*2.19*	*-2.35*	*-0.01*
Argentina (90-d deposit)	10.15	-1.45	-0.05	7.22	-0.64	-0.06	8.76	-0.83	0.08
(N=20) 3/	*2.56*	*-1.04*	*-0.16*	*2.39*	*-0.48*	*-0.21*	*3.60*	*-0.73*	*0.33*
Argentina (PRE-1)	7.63	-1.16	-0.52	6.20	-0.62	-0.55	5.92	-0.62	-0.43
(N=20) 3/	*3.10*	*-1.34*	*-2.90*	*3.57*	*-0.82*	*-3.20*	*3.77*	*-0.84*	*-2.59*
Mexico	9.47	-3.00	-0.43	8.35	-2.33	-0.40	6.69	-2.00	-0.29
(N=13)	*3.11*	*-2.69*	*-2.41*	*4.32*	*-2.95*	*-2.66*	*3.56*	*-2.33*	*-1.60*
Memorandum Item: Results for Argentina and Mexico after excluding outliers 4/									
Argentina (90-d deposit)	5.88	-1.59	-0.23	3.87	-1.10	-0.23	4.90	-1.14	-0.14
(N=17) 3/	*2.12*	*-2.04*	*-1.27*	*1.72*	*-1.46*	*-1.21*	*2.71*	*-1.69*	*-0.85*
Argentina (PRE-1)	3.70	0.29	-0.23	2.96	0.49	-0.25	2.73	0.43	-0.20
(N=18) 3/	*1.62*	*0.37*	*-1.47*	*1.67*	*0.67*	*-1.60*	*1.67*	*0.58*	*-1.36*
Mexico	0.84	-0.04	-0.18	1.62	-0.18	-0.19	0.12	0.13	-0.17
(N=11)	*0.33*	*-0.04*	*-1.49*	*0.70*	*-0.20*	*-1.60*	*0.06*	*0.14*	*-1.44*

1/ Change in weighted average between 2-month ahead and three-month ahead federal funds futures rate (see Appendix).
2/ Unexpected change in the federal funds rate target, based on change in the current-month federal funds futures rate (see Kuttner
3/ Two-day window.
4/ Defined as changes of domestic interest rates of 200 basis points or more on one day.

Table A3b. Impact Effect of US Monetary Policy Shocks on Bilateral Exchange Rates, Controlling for Changes in EMBI
(dependent variable: percentage change in bilateral exchange rate; t values in italics)

	Policy measure								
	Change in FF2CONT 1/			Kuttner 2/			Change in US 3m T-Bill		
	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant
Australia	1.50	1.09	0.25	1.19	1.19	0.24	1.61	1.15	0.27
(N=23)	*1.18*	*1.61*	*1.69*	*1.13*	*1.76*	*1.64*	*1.48*	*1.74*	*1.84*
Canada	0.88	-0.10	-0.03	0.80	-0.05	-0.03	0.80	-0.06	-0.02
(N=23)	*1.50*	*-0.33*	*-0.41*	*1.65*	*-0.16*	*-0.47*	*1.57*	*-0.20*	*-0.30*
New Zealand	1.40	0.88	0.31	0.95	0.97	0.30	1.39	0.94	0.33
(N=23)	*0.83*	*0.98*	*1.58*	*0.68*	*1.09*	*1.52*	*0.96*	*1.06*	*1.65*
Singapore	0.71	0.19	0.09	0.41	0.24	0.08	0.36	0.23	0.08
(N=23)	*1.81*	*0.89*	*1.89*	*1.23*	*1.09*	*1.65*	*0.99*	*1.05*	*1.66*
Chile	-0.43	-0.42	0.01	-0.22	-0.44	0.02	-0.36	-0.44	0.01
(N=23)	*-1.11*	*-2.02*	*0.23*	*-0.69*	*-2.15*	*0.36*	*-1.08*	*-2.14*	*0.18*
Mexico	1.78	-0.05	-0.30	1.01	0.18	-0.30	0.52	0.28	-0.30
(N=14)	*1.26*	*-0.10*	*-3.36*	*0.85*	*0.38*	*-3.23*	*0.48*	*0.57*	*-2.94*

1/ Change in weighted average between 2-month ahead and 3-month ahead federal funds futures rate (see Appendix).
2/ Unexpected change in the federal funds target, based on change in the current-month federal funds futures rate.
3/ Sample begins in July 1995.

Table A4a. Impact Effect of Shocks to International Risk Premia on Domestic Interest Rates, Controlling for US Interest Rate Shocks (measured by FF2CONT)
(Dependent Variable: Changes in Domestic Interest Rate; t-values in italics, number of observations in parentheses)

	Using EMBI to measure shock												Using Country Bond or Subindex, 2/					
	Sample Period: 1994 - 2000						Sample Period: 1998 - 2000						Sample Period: varies by country 3/					
	Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/		
	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant
Hong Kong	0.21	-0.81	-0.01	0.26	-1.49	0.05	0.56	3.87	-0.08	0.66	6.42	0.09	2.08	1.99	-0.17	2.24	3.19	-0.09
	1.88	*-0.18*	*-0.03*	*2.32*	*-0.34*	*0.28*	*2.57*	*0.44*	*-0.25*	*2.90*	*0.71*	*0.23*	*2.50*	*0.23*	*-0.49*	*2.60*	*0.35*	*-0.22*
		(40)			(35)			(19)			(15)			(19)			(15)	
Singapore	-0.03	0.66	-0.02	-0.04	0.67	-0.04	0.05	1.77	-0.01	0.03	1.27	-0.04	0.12	1.43	0.00	0.08	1.03	-0.04
	-0.89	*0.56*	*-0.38*	*-1.38*	*0.58*	*-0.84*	*1.85*	*1.52*	*-0.12*	*1.55*	*1.46*	*-0.99*	*1.05*	*1.17*	*-0.05*	*1.00*	*1.16*	*-1.02*
		(40)			(35)			(19)			(15)			(19)			(15)	
Australia	0.01	0.70	0.00	...	...	...	0.02	0.85	0.01	...	...	...	...	...	...	...	...	...
	1.71	*2.86*	*0.48*				*2.16*	*2.20*	*0.97*									
		(40)						(19)										
Canada	0.03	0.86	0.06	...	...	...	0.05	0.77	0.01	...	...	...	...	...	...	...	...	...
	1.14	*0.97*	*1.74*				*1.34*	*0.51*	*0.16*									
		(40)						(19)										
New Zealand	0.03	2.74	0.01	...	...	...	0.06	3.55	0.00	...	...	...	...	...	...	...	...	...
	2.48	*5.75*	*0.46*				*3.65*	*5.51*	*0.03*									
		(40)						(19)										
Chile	-0.17	-3.30	0.07	-0.03	-1.85	0.07	-0.41	-10.29	0.06	-0.13	-3.97	0.11	...	...	...	...	...	...
	-1.53	*-0.75*	*0.42*	*-0.64*	*-1.06*	*1.03*	*-1.75*	*-1.08*	*0.17*	*-1.00*	*-0.91*	*0.57*						
		(40)			(26)			(19)			(11)							
Argentina 4/	0.58	4.79	-0.01	0.95	-0.92	-0.11	0.40	3.94	-0.77	1.25	-7.53	-1.86	0.55	3.60	0.02	0.97	-3.55	-0.12
	1.57	*0.33*	*-0.02*	*2.51*	*-0.07*	*-0.19*	*0.52*	*0.13*	*-0.65*	*1.60*	*-0.28*	*-1.60*	*1.78*	*0.25*	*0.04*	*2.82*	*-0.26*	*-0.23*
		(40)			(26)			(19)			(11)			(40)			(26)	
Mexico	0.96	-25.15	0.50	0.79	-19.35	0.45	1.43	-14.91	-0.38	1.37	-14.57	-0.28	0.83	-27.59	0.58	1.09	-21.94	0.43
	3.64	*-2.42*	*1.27*	*2.00*	*-1.59*	*0.83*	*5.95*	*-1.53*	*-1.00*	*5.15*	*-1.46*	*-0.67*	*3.31*	*-2.60*	*1.46*	*1.94*	*-1.82*	*0.77*
		(40)			(26)			(19)			(11)			(40)			(26)	

1/ Excludes events originating in Asia for Hong Kong and Singapore; Argentina and Brazil for Chile and Argentina
2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Change in Brady Bond Yield for Argentina and Mexico.
3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore
4/ PRE-1 rate, 2-day window.

Table A4b. Impact Effect of Shocks to International Risk Premia on Exchange Rates, Controlling for US Interest Rate Shocks (measured by FF2CONT)
(Dependent Variable: percentage change in bilateral exchange rate (domestic currency per US$); t values in italics, number of observations in parentheses)

	Using EMBI to measure shock												Using Country Bond or Subindex, 2/					
	Sample Period: 1994 - 2000						Sample Period: 1998 - 2000						Sample Period: varies by country 3/					
	Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/		
	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant
Singapore	0.00	0.10	0.00	0.01	0.08	0.00	0.00	-0.08	0.00	-0.01	-0.13	-0.01	-0.02	-0.08	0.00	-0.02	-0.11	0.00
	1.34	*0.65*	*-0.67*	*1.38*	*0.49*	*-0.58*	*-1.07*	*-0.44*	*-0.24*	*-1.21*	*-0.63*	*-0.64*	*-1.34*	*-0.42*	*-0.03*	*-1.25*	*-0.52*	*-0.40*
		(40)			(35)			(19)			(15)			(19)			(15)	
Australia	-0.06	3.74	0.04	...	...	...	0.13	8.50	0.21	...	...	...	...	...	...	...	...	...
	-0.59	*0.92*	*0.24*				*0.89*	*1.39*	*0.88*									
	(40)						(19)											
Canada	0.16	2.89	0.05	...	...	...	0.25	7.65	0.07	...	...	...	...	...	...	...	...	...
	2.55	*1.15*	*0.52*				*2.24*	*1.70*	*0.40*									
	(40)						(19)											
New Zealand	-0.07	1.81	0.07	...	...	...	-0.08	5.45	0.34	...	...	...	...	...	...	...	...	...
	-0.99	*0.65*	*0.70*				*-0.72*	*1.23*	*1.96*									
	(40)						(19)											
Chile	0.02	-2.26	0.04	0.01	-1.30	0.13	0.06	-0.67	0.03	0.13	0.14	0.05	...	...	...	...	...	...
	0.39	*-1.41*	*0.69*	*0.22*	*-0.75*	*1.83*	*1.21*	*-0.31*	*0.40*	*2.22*	*0.07*	*0.60*						
	(40)			(26)			(19)			(11)								
Mexico	2.01	-13.78	-0.48	1.07	-3.24	0.41	1.14	0.85	0.01	1.07	1.23	0.12	2.01	-18.65	-0.42	1.65	-6.45	0.28
	4.59	*-0.79*	*-0.73*	*4.39*	*-0.44*	*1.22*	*7.66*	*0.14*	*0.05*	*6.72*	*0.21*	*0.51*	*5.12*	*-1.13*	*-0.67*	*5.26*	*-0.96*	*0.91*
		(40)			(26)			(19)			(18)			(40)			(26)	

1/ Excludes events originating in Asia for Singapore, Argentina and Brazil for Chile.
2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Brady Bond Yields for Argentina and Mexico.
3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore

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