Labor Market Rigidity and Structural Shocks: An Open-Economy Approach for International Comparisons*

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Abstract

We construct performance-based measures of labor market rigidity considering an open economy framework. We derive and estimate an indicator that depends exclusively on the theoretical measure of unions' bargaining power, with which we rank a sample of 18 heterogeneous countries. The indicator is obtained from unemployment persistence to structural shocks identified using a SVAR with long-run restrictions. We find that Korea, Hong Kong, Chile and the US are relatively flexible, while Germany, Sweden, Spain and Colombia are among the most rigid labor markets. Our index shows high correlation with labor market performance and institutional regulation variables, mainly associated to union representation.

Resumen

Construimos medidas de rigidez del mercado laboral basado en indicadores de desempeño, en un marco de economía abierta. Derivamos y estimamos un indicador que depende exclusivamente en la medida teórica del poder de negociación salarial de los sindicatos, con el que rankeamos una muestra de 18 países heterogéneos. El indicador es la persistencia del desempleo frente a shocks estructurales, identificados por medio de un SVAR con restricciones de largo plazo. Encontramos que Corea, Hong Kong, Chile y Estados Unidos están entre las economías con mercados laborales más flexibles, mientras que Alemania, Suecia, España y Colombia están entre las más rígidas. Nuestro ranking tiene alta correlación con medidas de desempeño y de regulación en los mercados laborales de los respectivos países analizados, principalmente asociadas a representación sindical.

JEL classification: C32, E24, J5

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1. Introduction

The ability of a country to recover in the aftermath of structural shocks is largely given by the flexibility of factor relocation and price rigidities in different markets. A usual concern in the developing world as well as in several European economies is the relative slowness with which labor seems to adjust in such circumstances. This persistence of unemployment comes in great contrast with the behavior of labor in some south-east Asian economies, which despite suffering important recessions at the outset of the Asian crisis, had an impressive recovery of output and employment to their pre-crisis levels in few years time.

These striking differences of labor market responsiveness to shocks across countries has led to the proliferation of theoretical and empirical work that aims to capture some measure of labor market rigidity that can account for such behavior. An earlier approach has been to compute indexes from some weighted average of institutional characteristics of labor markets[2] -unemployment insurance, severance payments, firing costs and others-. The difficulty of differentiating the "de jure" from the "de facto" reach of labor institutions in each country, though, has motivated an alternative line of labor rigidity assessment based on employment performance indicators. Such indicators have been built both on microeconomic panel data of employment flows at the firm and employee level[3], as well as on macro data including the interaction of employment with wages, prices and other relevant variables. However, the lack of comparable micro-level data across a broad spectrum of countries makes the macro approach more suitable for international assessments.

This approach is based on disentangling labor market rigidity from structural shocks, that is, discriminating between the persistence caused by a sequence of shocks from the rigid response of long-memory unemployment after a single event. This is achieved by using a Structural VAR (SVAR) identification *a là* Blanchard-Quah (1989), where the appropriate long run restrictions are formally derived from structural models. In this line, the work by Dolado and Jimeno

[2] See Layard, Nickell and Jackman (1991) and Heckman and Pagés (2000).
[3] See Abowd and Kramarz (1997) and Caballero et al. (2003).

(1997), and Balmaseda, Dolado and Lopez-Salido (2000) impose long run restrictions to the impact of different shocks in a simple, closed-economy framework. They compute an index of labor market rigidity related to the dynamics of unemployment and wages in the face of the identified shocks, with which they rank groups of OECD member countries.

The present work follows this latter line of research, but with two mayor changes. First, since we seek to compare a large sample of developing and developed countries, the structural identification of the shocks derived from a closed economy framework is no longer satisfactory. This stems from the fact that many of the countries included are usually affected by movements in the terms of trade, while the real exchange rate is a highly relevant transmission mechanism of external shocks. Therefore, we construct an open economy model. Second, we propose an index that depends only on the labor market rigidity implied in our theoretical framework: Unions' bargaining power in wage setting. Previous measures depend also on other structural parameters, such as the slope of the labor supply curve and (in an open-economy setup) the degree of openness. These parameters vary widely between the countries considered in our sample, and failing to control for them could introduce important biases.

The rigidity indicator we compute is the half-life of unemployment after the economy is hit by a shock, which is compatible with the cyclical rigidity this article is concerned with. The faster unemployment converges to its natural rate after a shock, the more flexible the country will be ranked, no matter what that natural rate might be. In this sense, we do not deal with the kind of rigidity that would explain differences in the natural rate of unemployment across countries, although they might be related.

The model we build to interpret the shocks and identify the dynamics and the long-run restrictions assumes that wages are set in a bargaining framework, where insiders and outsiders interact in the spirit of Blanchard and Summers (1986) and Blanchard (1991). This setting is used to introduce rigidity in the labor market that prevents nominal wages from adjusting rapidly to equilibrium and leading to partial hysteresis of the unemployment rate. Over the very long run, however, unemployment should be zero —after normalizing for country-specific natural rate of unemployment—, which is compatible with a vertical aggregate supply and the natural rate of unemployment having no trend.

The empirical strategy based on the SVAR approach allows us to study the dynamics of the real wage, the real exchange rate, output, and the persistence of unemployment. To capture the latter, we focus on the impulse response functions of unemployment triggered by productivity, terms-of-trade, labor-force and monetary shocks. A first conclusion is that the labor markets of Korea and Hong Kong are the most flexible, followed by Chile, the US and Mexico. At the other end of the ranking, Germany, Sweden, Spain and Colombia were found to be among the most rigid.

The final exercise consists in analyzing the correlation and ranking similarity between our index and the other indicators of labor market rigidity taken from Rama and Artecona (2002), a recent database rich in both the temporal and the cross-country dimension. We find high correlations with some performance measures such as average unemployment rates and hours worked. Regarding legal and institutional indicators, the labor force coverage of collective bargaining and the ratio of unemployment benefits to wages (substitution ratio) seem to be among the most relevant variables explaining unemployment persistence variability across countries. Weaker and non-significant correlations were observed with the level of minimum wages and other unemployment benefits, respectively.

The rest of the paper is structured as follows. The second section presents the model. The third one describes the empirical strategy and main results. The fourth section assesses the labor market index and the last part of the paper concludes.

2. The Model

2.1 The basic framework

2.1.1 Aggregate supply and demand

The economy is characterized by the supply of a domestic tradable good by firms, which hire labor as the only factor of production. Technology is assumed to be of constant returns. Aggregate supply is given by

$$y_t = n_t + x_t \qquad (1)$$

where x is the productivity of labor, and n is aggregate employment (all variables in natural logs, from now on). Consumption is divided into the domestic good and an imported good. To obtain the aggregate demand, we use the traditional IS-LM analysis for an open economy. Saving-investment equilibrium is given by

$$y_t = -aE[r_t] + \eta_z z_t + \eta_x x_t + q_t + \tau_t \qquad (2)$$

where r is the real interest rate, q is the real exchange rate, z is the relative price of domestic to foreign good (terms of trade), x is the level of factor productivity and τ is a labor force shock[4].

Money market equilibrium is described by

$$m_t - p_t = -bi_t + y_t \qquad (3)$$

where i is the nominal interest rate. Given perfect capital mobility, nominal interest rates on bonds are set at the beginning of each period at

$$i_t = \bar{i}_t + E[s_{t+1}] - s_t \qquad (4)$$

where $\bar{i}$ is the external interest rate. For simplicity, the external real interest rate and inflation are normalized to zero[5]. Expected real interest rates, on the other hand, are given by the Fischer equation,

$$r_t = i_t - E[p_{t+1} - p_t] \qquad (5)$$

Substituting this relation in (2), and using i_t from (3), yields aggregate demand

$$y_t = \frac{a}{a+b}(m_t - p_t) + \frac{ab}{a+b}E[p_{t+1} - p_t] + \frac{b}{a+b}(q_t + \eta_z z_t + \eta_x x_t + \tau_t) \qquad (6)$$

[4] These different shocks are included separately as they can conceivably affect aggregate demand through different channels. For example, productivity and the terms of trade affect permanent income, while the real exchange rate has a role in determining aggregate demand thanks to expenditure-switching effects and balance-sheet effects. The labor supply shock is included as a scaling factor.

[5] Therefore, in the absence of shocks, domestic real interest rates are also equal to zero.

2.1.2 Prices and the exchange rate

The price of the domestic good is equal to unit labor costs, which are given by the difference between wages and labor productivity

$$p_t^p = w_t - x_t \tag{7}$$

The consumer price level is then a weighted average of domestic and foreign prices:

$$p_t = \gamma p_t^p + (1-\gamma)s_t \tag{8}$$

where s is the nominal exchange rate, and γ is the imported fraction of aggregate consumption. The real exchange rate is given by

$$q_t = s_t - p_t \tag{9}$$

Using (9) and (7) in (8), the real wage perceived by consumers (real consumer wages, from now on) is given by

$$w_t - p_t = x_t - \frac{(1-\gamma)}{\gamma} q_t \tag{10}$$

which differs from the real wage perceived by firms (real producer wage) that can be obtained by rearranging (7), as it depends not only on productivity but also on the real exchange rate.

2.1.3 Wage setting

In a similar spirit to labor market settings in precedent papers, such as Blanchard and Summers (1986), nominal wage bargaining is a function of union power. In our particular framework, unions set nominal wages one period in advance trying to keep real wages equal to last period's level, as opposed to the real wage that clears the market, $(w-p)^*$[6]. This is represented by the following wage setting condition;

$$E\left[w_t - p_t\right] = \lambda(w_{t-1} - p_{t-1}) + (1-\lambda)(w-p)^* \tag{11}$$

where λ stands for unions' bargaining power[7].

[6] In reality the bargaining process is probably asymmetric depending on the sign of the shock, which is not well represented in this simple setup. The above equation makes sense only in the presence of shocks that require downward nominal wage adjustments, a flaw shared by previous settings as well.

[7] Our equation differs from the original wage setting framework, where unions' objective is past level of employment, as opposed to past level of labor supply. We choose the alternative for simplicity purposes in the

Labor supply is modeled as a function of real wages and a labor force shock,

$$l_t = c(w_t - p_t) + \tau_t \tag{12}$$

where c is the elasticity of labor supply to real consumer wages. Unemployment is then given by

$$u_t = l_t - n_t \tag{13}$$

This basic framework therefore defines a long-run equilibrium level of real and nominal variables that depends on four exogenous state variables, namely productivity, terms of trade, labor supply and the quantity of money. Each variable is assumed to follow a random walk process:

$$\begin{aligned} \Delta \mathrm{x} &= \varepsilon_{\mathrm{x}} \\ \Delta \mathrm{z} &= \varepsilon_{z} \\ \Delta \tau &= \varepsilon_{\tau} \\ \Delta m &= \varepsilon_{\mathrm{m}} \end{aligned} \tag{14}$$

where ε_x, ε_z, ε_τ and ε_m are all uncorrelated i.i.d. shocks.

Starting from an initial equilibrium position, the purpose of the model is to highlight how labor market rigidities affect the convergence of the system to a new steady state. The timing of events is the following:

1. Unions and firms negotiate contracts (nominal wages) at the beginning of the period. Since the economy starts at steady-state equilibrium and all shocks have zero mean, wages are set at the previous period's level.

2. The economy is hit by any of the four shocks, which call for a downward adjustment of the real wage to reach the new long-run equilibrium. Since nominal wages are fixed for the present period, prices adjust only partially (through the response of the nominal exchange rate), holding back aggregate demand and causing positive unemployment.

3- At the beginning of the next period, nominal wage is negotiated again, taking account of previous real wage level (union’s objective) and the new steady-state value (market pressure).

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solution of the model, without loss of generality. In fact, our approach delivers the same persistence of

2.2 Dynamics

2.2.1 The long run

In the long run, real variables such as real wages, output, the real exchange rate and employment depend on real determinants only, namely productivity, terms-of-trade and labor-supply shocks, through the values of x, z, and τ. From (10) the workers' long run real wage is

$$(w-p)^* = x - \frac{(1-\gamma)}{\gamma} q^* \tag{15}$$

where a star represents a long run value. Given the normalization of r^* to zero in the steady state, equating supply and demand renders

$$q^* = \frac{(1+c-\eta_x)x - \eta_z z}{1+c(1-\gamma)/\gamma} \tag{16}$$

Using (15) and (16) in (12), and setting $l = n$ in the long run, we get output's steady state value

$$y^* = \left(1 + c(1 - \frac{(1-\gamma)(1+c-\eta_x)}{\gamma + c(1-\gamma)})\right)x + \left(\frac{c(1-\gamma)\eta_z}{\gamma + c(1-\gamma)}\right)z + \tau \tag{17}$$

Nominal variables, therefore, adjust to (15), (16) and (17), given the monetary stance, so that the price level in the long run is given by

$$p^* = m - y^* \tag{18}$$

Nominal wages and the nominal exchange rate are finally obtained by substituting (18) in (15) and (9), respectively.

This specification of the shocks allows us to derive long-run identifying restrictions, by solving the model above and reducing it to a system of four equations. These are (7), (16), (17) and (13), relating real producer wages (labor cost), the real exchange rate, output and unemployment to the four exogenous shocks given by (14). In the long run, labor costs depend on productivity shocks only, the real exchange rate on productivity and terms-of- trade shocks, output depends on the first two plus labor-supply shocks, while unemployment responds only temporarily to all shocks, being zero in steady state. The long-run equilibrium, therefore, has no role for the

unemployment after a given shock, as implied by previous frameworks.

nominal rigidity introduced by wage bargaining. This comes from the assumption that there is partial hysteresis ($\lambda < 1$). Otherwise, the system's equilibrium would be permanently ruled by the short run dynamics described in the next section.

2.2.2 The short run

It is interesting to analyze the dynamics that start when the system is hit by any of the four shocks, calling for an adjustment in nominal variables in order to reach the new steady state. Although the rigidity introduced in wage bargaining produces symmetric responses of output and employment below and above their long run levels, we will focus only on situations that cause temporary unemployment, that is, shocks that call for a downward nominal wage adjustment. For simplicity, we normalize each variable to zero in the initial state.

To construct the aggregate demand for labor, we replace q_t from (10) in (6), which yields

$$n_t = \frac{a}{a+b}(m_t - p_t) + \frac{ab}{a+b}E[p_{t+1} - p_t] + \frac{b}{a+b}\left(-(w_t - p_t)\frac{\gamma}{1-\gamma} + \eta_z z_t + \tau_t\right) + \frac{b}{a+b}(\frac{\gamma}{1-\gamma} + \eta_x - 1)x_t \qquad (6)'$$

To find the unemployment dynamics originated in the bargaining process, we take l from (12) and n from (6)'. Unemployment at the period of the shock can be simplified (using (15) and (16), supposing no further shocks) to

$$u_t = [(w_t - p_t) - (w-p)^*](c + (1 + a(1-\lambda))\gamma/(1-\gamma)) \qquad (19)$$

While its level at period $t+s$ is given by

$$u_{t+s} = \lambda^s u_t \qquad (20)$$

which depends positively on labor market rigidity, and approaches 0 as $s \to \infty$. Therefore, unemployment follows a gradual path to its natural level, with a persistence that reflects the degree of unions' power, λ.

To solve for unemployment in the period of the shock, the model can be summarized to a first order difference-equations system. The first is given by substituting (6) and (8) in (3), which represents the dynamic relation between nominal wages and the nominal exchange rate

$$(1+b+a\gamma)s_t-(b+a\gamma)E\left[s_{t+1}\right]-a\gamma w_t+a\gamma w_{t+1}=-x_t\eta_x-z_t\eta_z-\tau_t+m_t \qquad (21)$$

The second relation is obtained through the wage setting equation. Substituting the price level from (7) and (8) in (11), we form

$$(1-\lambda)E\left[w_{t+1}-s_{t+1}\right]+\gamma x_{t+1}=\lambda\left[(1-\gamma)(w_t-s_t)+\gamma x_t\right]+(1-\lambda)(w-p)^* \qquad (22)$$

The functioning of the model can be illustrated by a labor demand and supply representation on the employment/real consumer wage space. Panel a) of figure 1 shows the comparative-statics analysis, for shocks in productivity, terms of trade, labor supply and the monetary stance, described below. The dynamic simulations for each shock, comparing different values of labor market rigidity, are reported in panel b). They were obtained from (21) and (22) using the Anderson and Moore (1985) algorithm for solving dynamic systems, with parameter values specified in figure 1.

The general intuition behind the dynamic behavior of the main variables is the following: Given the stickiness originated in the wage bargaining process, prices follow a gradual adjustment path to their full-employment level. Because the asset channel reacts without this delay, the real exchange rate departs from its long-run level. If as a result of a shock, the real exchange rate is below such level, so will aggregate demand and employment. In contrast, labor supply will temporarily rise with respect to its new equilibrium given higher real wages (that depend negatively on q), causing a sharp increase in unemployment. Thus, output and unemployment are demand-determined in the short run.

Of course, every shock has its own dynamics, which deserve individual explanations:

An increase in productivity

When productivity conditions improve, the long-run real exchange rate will generally appreciate and real wages increase, given "normal" values of the main parameters of the model (see appendix for details). As output increases as well, long-run price level will eventually fall, for a given monetary stance. The net effect on long-run nominal wages, therefore, is not clear-cut. For the parameters assumed in the appendix, aggregate demand and supply responses are such that the increase in real wage is actually obtained with a fall in nominal wages, given the sharp reduction in the price level. As nominal wages are fixed in the period of the shock, however, prices fall only partially (in response to nominal exchange rate appreciation). This holds back labor demand with respect to its long-run level, causing unemployment at a higher real wage. As future negotiations push nominal wages down, prices and labor demand gradually converge to their new equilibrium, closing the gap in unemployment at a speed that depends on unions' bargaining power, λ.

A fall in terms-of-trade

When the terms of trade fall, the long-run real exchange rate depreciates, reducing real consumer wages, labor supply and long-run output. Under a standard range of values for labor supply elasticity to real wages, the new long-run nominal wage should adjust downward. Using the same argument as above, the gradual adjustment of nominal —and real— wages causes a wedge between labor demand (restrained by aggregate demand) and supply, producing unemployment in the short run.

A rise in labor supply

An increase in labor supply, in contrast to the preceding cases, has no long-run effect on real consumer wages and the real exchange rate. As long-run output rises, however, prices must fall to accommodate production for a given quantity of money. The necessary nominal wage downward adjustment therefore unravels the dynamic process outlined before, causing temporary unemployment.

A monetary contraction

When the supply of money decreases, labor demand moves as a result of the combination of two driving forces: the direct impact of money supply, which lowers demand, and the fall in prices caused by the instantaneous nominal appreciation, partially offsetting the effect. As nominal wages are fixed at the time of the shock, though, the offsetting is not enough, ensuring a negative dominant effect on labor demand, for a given real wage. On the other hand, as prices fall, real wage increases, and so does labor supply. The result is an increase in unemployment. In the new equilibrium, of course, the impact of money supply can only be traced by the proportional adjustment in prices, nominal exchange rate and nominal wages, having no effect on real variables.

2.3 Building an index of labor market rigidity

In order to have a measure that captures the cyclical persistence of the labor market, we need to build an index that satisfies two necessary conditions. First, it must be related to λ. Second, and less obvious, it must be related to λ *only*. This comes from the fact that two economies that share the same measure of labor rigidity may show quite different responses for output, wages and unemployment for a given shock, arising from other structural parameters such as c (the response of labor supply to real wage), and/or γ (the relative importance of the tradable sector).

A standard measure used in the literature is the "wage rigidity index", which computes the ratio of accumulated response of unemployment to the real wage change after the shock. This type of measure is not appropriate in our current framework because it depends on c and γ as well. As an illustration, consider its traditional construction, first introduced in the literature with the work of Layard *et al.*, estimated from a standard wage equation. In response to a productivity shock in period t, it would be computed as

$$\lim_{k\to\infty} \frac{\sum_{k=0}^{\infty} \partial u_{t+k} / \partial \varepsilon_{xt}}{\partial (w - p^{p})_{t+k} / \partial \varepsilon_{xt}} \tag{23}$$

From (7), the denominator is simply 1. The accumulated response of unemployment, however, depends on λ and the initial level of unemployment given by (19), which itself depends on the mentioned parameters.

While the assumption of a constant value of c over a rather homogenous sample of OECD countries seems acceptable, it becomes quite less satisfactory as the sample extends to less-developed countries. By the same token, assuming similar degrees of openness further deteriorates the power of the measure.

For these reasons, we use an alternative measure that depends only on λ: the half life of unemployment after a shock, i.e., the number of periods unemployment takes to decrease to one half of its maximum value. From (20), unemployment becomes one-half of its initial level at period s^*, where

$$s^* = \frac{\ln(1/2)}{\ln \lambda} \tag{24}$$

which depends positively and solely on the value of our measure of labor market rigidity.

3. The Empirical Strategy

Since our purpose is to measure unemployment persistence in the presence of shocks, we use the SVAR methodology, which allows determining whether a high degree of observed unemployment persistence for a given country should be attributed to its labor market functioning or to continuous adverse events. For doing so, we identify the shocks following Balmaseda et al., identifying the VAR with long-run restrictions as in Blanchard and Quah (1989) and Clarida and Galí (1995). These authors assume that some shocks have permanent effects on some variables, and a transitory one on others. There could also be shocks with no permanent effect on any variable. This procedure fits perfectly well the intuition of a growing economy where unemployment goes back to its natural rate, even though wages and employment may change due to structural factors, and the supply curve is vertical in the long run.

3.1. Structural identification

The structural VAR identification, as well as the interpretation of the shocks, is derived directly from the model. For clarity, it is useful to rewrite several equations taken from the long-run equilibrium:

$$\Delta(w - p^p) = \varepsilon_x \tag{25}$$

Only productivity shocks affect producer's real wage in the long run.

$$\Delta q = \frac{(1 + c - \eta_x)\varepsilon_x}{1 + c(1-\gamma)/\gamma} - \frac{\eta_z \varepsilon_z}{1 + c(1-\gamma)/\gamma} \tag{26}$$

The real exchange rate depends only on productivity and the terms of trade.

$$\Delta y = \left(1 + c(1 - \frac{(1-\gamma)(1 + c - \eta_x)}{\gamma + c(1-\gamma)})\right)\varepsilon_x + \left(\frac{c(1-\gamma)\eta_z}{\gamma + c(1-\gamma)}\right)\varepsilon_z + \varepsilon_t \tag{27}$$

Output is affected in the long run by productivity, the terms of trade and the evolution of the labor force.

$$u = 0 \tag{28}$$

Finally, although all shocks affect unemployment in the short run, none of them has a permanent effect on it since it is stationary in a partial hysteresis setting.

The identification is based on the assumption that the matrix of structural long-run multipliers, $C(1)$, is lower triangular. To find $C(1)$ it is necessary to first build the matrix $\varphi(1)\Sigma\varphi(1)'$ from the reduced form estimation, where $\varphi(1)$ is the sum of the coefficients, and Σ is the variance-covariance matrix obtained. It is possible to show that $C(1)$ is the Choleski factor of $\varphi(1)\Sigma\varphi(1)$'. Once $C(1)$ is found, it is easy to compute all the structural coefficients, C, which are used to build the impulse-responses, because $C_0 = \varphi(1)^{-1}C(1)$, and with C_0 all C_s can be computed, given $C(L) = \varphi(L)C_0$.[8]

[8] For a detailed explanation see Clarida and Galí (1994) and also Enders (1995).

3.2 Data

We use quarterly data from 1980.1 to 2002.4 for real producer wages (computed with the GDP deflator), the real exchange rate, output, and unemployment. Most countries' data sets come from the OECD database. For non-OECD countries, data were found in the respective central bank's web site and, in some cases, in the IMF's International Financial Statistics data set. Table 1 reports the source of the time series for every country. The model assumes that real wages, real exchange rates and output are integrated processes[9], while unemployment is stationary. Dickey-Fuller tests were run for all variables, but in several countries the null hypothesis of a unit root for the unemployment rate could not be rejected (table 2). However, we follow Balmaseda et al. by treating unemployment as I(0) process, despite its severe persistence in the short run. From a theoretical perspective, unemployment can hardly be seen as a variable with a forecast of infinite variance.[10]

We estimated the following stationary VAR: $\left[\Delta(w-p^{p}),\Delta q,\Delta y,u\right]$', imposing the long-run restrictions described above. Most VARs were estimated using two lags based on the regular criteria (AIC, SW, HQ)[11] and the LM multivariate residual test for autocorrelation.

3. 3 Estimation results

3.3.1 Impulse responses

Given the large number of economies in our sample, we decided to report the impulse responses of a small subgroup of countries with a wide range of labor market flexibility (figure 2). The confidence intervals were obtained with a bootstrap procedure using 500 replications.[12] In general, with a positive productivity shock, real wages increase in the short and long run. When a terms-of-trade shock hits the economy, real producer wages increase only in the short run. In the case of positive labor force shocks, the response of real wages tends to be negative in the

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[9] The Dickey-Fuller test rejects the unit root hypothesis for the real exchange rate of Denmark and Holland. Therefore, we run the stationary VAR [$\Delta(w-p^{p}),q,\Delta y,u$] for these two countries.

[10] We also performed cointegration tests for all countries as in Balmaseda et al., and the null hypothesis of no cointegration among the integrated variables [w-p,q,y] was not rejected.

[11] Kilian and Ivanov (2000) analize which criterium performs better for VARs with different sample sizes.

[12] See Benkwitz and Lütkepohl (2001) for an analysis of alternative bootstrap procedures.

short run but in several cases it is non-significant. Real wages also fall when there is a monetary shock (expansion). In fact, wages fall in the presence of a monetary shock in the cases of Chile, Colombia, and the US. In Korea and Sweden wages are procyclical, and do not move in the UK.

The real exchange rate tends to appreciate in response to positive productivity shocks. After a positive terms-of-trade shock, the real exchange rate appreciates in both the short and the long run. The response of the real exchange rate after a labor force shock is seldom significant. The real exchange rate tends to increase in the short run as a result of a monetary expansion shock. Finally, the response of unemployment after a positive productivity shock is not clear-cut. In many countries unemployment decreases, but it goes the other way in several others. Unemployment tends to increase after a labor-supply shock and to decrease with a terms-of-trade shock and a positive monetary disturbance, but there are exceptions.

3.3.2 Labor-market rigidity index

Table 3 shows the rankings we built by computing, for all shocks, the average half life (in quarters) of the unemployment responses (AGR). Korea and Hong Kong appear as the most flexible countries, followed by Chile, Mexico, and the US. This is consistent with recent evidence for the Korean economy, where unemployment peaked after the Asian crisis but quickly returned to its previous level. The results for the US are also in line with the common wisdom of being the most flexible labor market among developed economies. At the other end of the table, Germany, Sweden, Spain and Colombia are ranked as the most rigid labor markets. In the middle range of rigidity are Austria, Australia, Holland, Denmark and Belgium, among others.

4. Assessment of the labor-market rigidity ranking

4.1 Alternative measures of labor-market rigidities

A central element in the recent discussion about the effects of labor market regulations on economic efficiency has been the need to discriminate between the “de jure” and the “de facto” reach of legal institutions. A certain package of regulations can have quite heterogeneous effects across countries depending on, among other elements, the actual enforcement of such regulations.

To put our results into perspective, this section compares our ranking with measures used in recent empirical work to assess labor market rigidities. Probably the most complete and updated source for such purpose is the database constructed by Rama and Artecona (2002), which includes 44 different indicators of labor market conditions for a group of 121 countries, running in 5-year period averages from the mid forties to the late nineties.

The variables used include the following:

1. Performance indicators: The average unemployment rate (UMPR) and hours worked (HRS).
2. Minimum wages: The ratio of minimum to average wages in manufacturing (WGEM/WGEIND).
3. Working conditions and benefits: Firing advance notice with payment (ANP), social security contributions of employers and workers (SSC), and the ratio of monthly unemployment benefits to previous earnings (BFT/EAR).
4. Union activity and labor standards: Percent of salaried work force covered by collective bargaining agreements (COLCOV) and the number of ILO labor conventions signed by the country (ILO).

The analysis is done with simple correlations and with the Wilcoxon methodology, a non-parametric procedure designed to test the null hypothesis that two samples are similar. This latter exercise is adequate when analyzing rankings whose internal magnitudes might not be strictly comparable (cardinal vs. ordinal measures). This test takes into consideration the magnitude of the differences among pairs, giving relatively more weight to more dissimilar pairs. The contrast is based on the absolute values of such differences, appropriately weighted. Table 3 shows the main results of both approaches.

Regarding performance, our indicator is highly related to unemployment and hours worked, as can be expected. Though the rigidity referred to in this paper is of a cyclical nature, a positive correlation with average unemployment can be supported by previous studies. As described in Blanchard (1991), long periods of unemployment increase the proportion of long-term unemployed workers. These workers tend to loose skills and become less effective in their search, both effects weakening their “outsider” bargaining power[13] and therefore increasing the natural rate of unemployment. Alternatively, if the speed of adjustment is different at the face of negative and positive shocks, given potential asymmetries in upward and downward wage bargaining, even if shocks are evenly distributed the average unemployment rate would tend to be biased upwards, in a magnitude directly related to unemployment persistence. Regarding hours worked, a plausible story could be that strong unions tend to favor not only higher wages, but also shorter working days. Besides the strong intuition behind this statement, there is some empirical evidence supporting it. Earle and Pencavel (1990) classify industries in the United States into two groups, according to their degree of unionization, and find that unionized workers tend to work consistently fewer hours[14]. Such finding is consistent with bargaining theories where overtime wage premium is an important bargaining tool for unions.

Regarding regulations, our results are pretty much in line with the argument posed above. On the one hand, “de jure” measures, represented by the number of ILO labor regulations signed by a country, is only weakly associated to our persistence indicator. On the other, it seems important to distinguish between the relevance of different “de facto” measures. Particularly appealing to the model developed in this paper is the strong correlation found with collective bargaining coverage, as one could expect this variable to be a reasonable candidate (among

[13] The so called “threat effect” becomes less binding.
[14] The difference ranging from -6% to -15%.

others) to a proxy of our theoretical measure of bargaining power, λ. Within working conditions and unemployment benefits, only the substitution ratio seems to be related to persistence (figure 3). Minimum wages also seem weakly (though significant in the margin) related.

Our results are also consistent with recent empirical work. Calderón and Chong (2004) study the relationship between labor regulations and long-term growth. They build aggregate measures of labor market regulations classified into two groups, regulations in paper and regulations in practice. They find that the former matter only for industrial countries, while the latter matter for industrial as well as for developing economies. Forteza and Rama (2002) study the impact of economic reforms on growth conditional on the level of labor market regulation, finding that in countries where regulation is stricter, output exhibits weaker recoveries after reforms are implemented. Their results also point to the level of unionization as a critical factor, while minimum wages and mandated benefits appear as irrelevant. Again, Calderón and Chong (2004) find that regulations have different effects depending on countries' level of development. Social security provisions deter growth only in industrial countries, while government employment ratios, minimum wages and trade union membership affect growth in both groups.

5. Conclusions

We used a performance-based measure of labor market rigidity to rank a group of 18 countries including developing and industrial economies, based on the dynamic responses of unemployment in the presence of macro shocks obtained with a structural VAR *a là* Blanchard-Quah. The setting of the empirical approach and the interpretation of the shocks are based on a model with rigidity in the labor market through the insider-outsider bargaining setup. This framework was extended for an open economy to take account of shocks in the terms of trade and the real exchange rate transmission channel.

The restrictions derived from the model imply that, in the long run, real wages, the real exchange rate and output depend on structural determinants, while unemployment goes back to its natural rate. We build an indicator that depends exclusively on the rigidity coefficient of the wage-setting equation, given by unions' bargaining power: the half-life of unemployment after the shocks, which is appropriate for assessing the cyclical persistence of shocks on the labor market.

We found that the labor markets of Korea and Hong Kong are the most flexible, followed by Chile, the US and Mexico. At the other end of the ranking, Germany, Sweden, Spain and Colombia were found to be the most rigid.

Simple correlation analyses and similarity tests between our ranking and measures of labor market institutions and performance show strong associations with unemployment and hours worked, in line with natural unemployment rate and bargaining theories. The coverage of collective bargaining and the substitution ratio seem to be among the most relevant variables behind unemployment persistence variability across the countries in our sample, which is consistent with previous findings.

Appendix

Whether real or nominal shocks have positive effects on unemployment is given by the necessary adjustment of the nominal wage to reach the new equilibrium conditions. To predict the new steady state nominal wage, in turn, it is necessary to derive real conditions that, together with the monetary stance, will determine the consistent level of nominal variables.

I. Real variables

1. The real exchange rate

In the long run, the real exchange rate is determined by equating aggregate demand and supply. Recalling (16), the sign of the effect of productivity shocks on q^* depends on whether, for an initial value of q, the response of aggregate supply ($1+c$) is greater than the wealth effect reflected on aggregate demand (η_x). Any difference between these two moves q to reach the new equilibrium.

In the case of a (negative) terms-of-trade shock, only aggregate demand responds with elasticity η_z to the wealth effect, for a given value of q. The real exchange rate, therefore, depreciates in the long run in order to make labor supply contract accordingly (through the fall in real consumer wages, as shown below). As (16) shows, no other shocks alter the steady state of the real exchange rate.

2. The real consumer wage

Using (16) in (15), we can express the real consumer wage in terms of the structural shocks,

$$(w-p)^* = \left(1 - \frac{(1-\gamma)(1+c-\eta_x)}{\gamma + c(1-\gamma)}\right)x + \left(\frac{(1-\gamma)\eta_z}{\gamma + c(1-\gamma)}\right)z \qquad (15)'$$

which, in contrast to the real producer wage, depends also on the terms of trade through their impact on relative prices of foreign goods.

Again, the effect of productivity seems less clear-cut in response to productivity shocks, depending on the effect in the real exchange rate (the second term in the first parenthesis). However, even in the odd case that rises in productivity depreciate the real exchange rate, this effect should be rather small for a "standard" parameter range, assuring the expected positive effect on real wages.

Once again, the effect of terms of trade is unambiguous. A decrease in the relative price of foreign goods increases purchasing power among consumers, through its impact on the price level.

3. Aggregate output

From (17), it is easy to see that the three real shocks have a long-run effect on output. Productivity shocks, besides their effect on labor supply through the increase in real wages (second term in first parenthesis), affect production directly through technology. The effect of a terms-of-trade shock works only through the aforementioned effect on real consumer wages, which raise output scaled by the wage elasticity of labor supply. Finally, labor supply shocks have a proportional scaling impact on production.

II. Nominal variables

1. The price level

It is clear from (18) that the price effect of the different real shocks is exactly the opposite of the response of output for a given quantity of money. The relevant question, therefore, is whether the necessary adjustments of the real wage are actually done entirely by prices, or need an extra response of the nominal wage, where the basic rigidity is introduced in the model.

2. Nominal wages

The effects of the different shocks on the nominal wage can be obtained by adding (15)' and (18) together,

$$w^* = \left(-\frac{(1-\gamma)(1+c-\eta_x)}{\gamma + c(1-\gamma)}(1-c) - c \right) x + \left(\frac{(1-\gamma)\eta_z}{\gamma + c(1-\gamma)}(1-c) \right) z - \tau + m \qquad (29)$$

Therefore, the effects of productivity and terms of trade on nominal wages depend on parameter specification, and so does the sign of the unemployment effects in the short run. In contrast, labor force shocks and monetary conditions have a clear sign.

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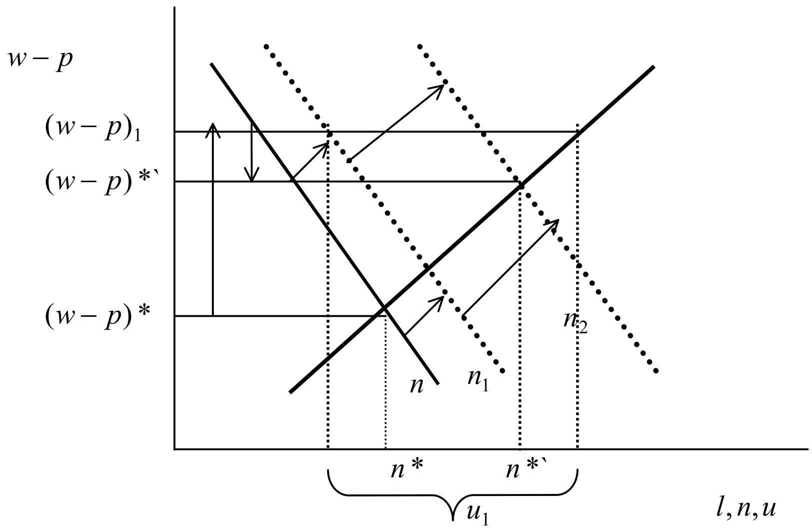
Figure 1

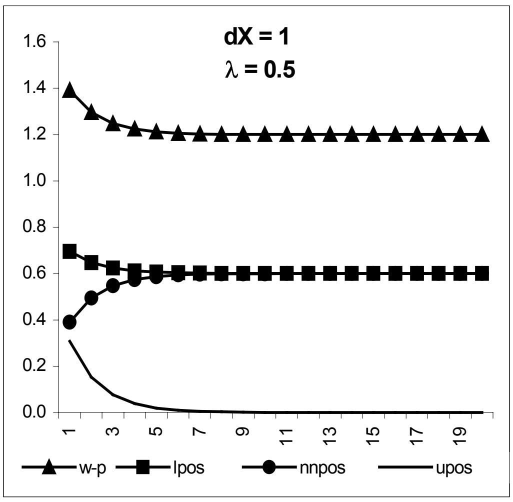
Shock Responses: Comparative Statics and Dynamic Simulation*

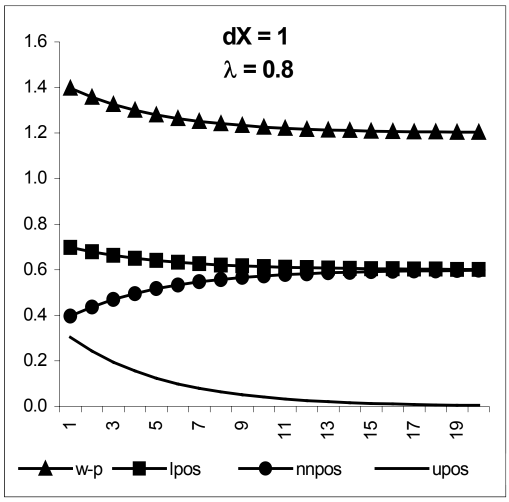
1. A rise in productivity

a) Comparative statics:



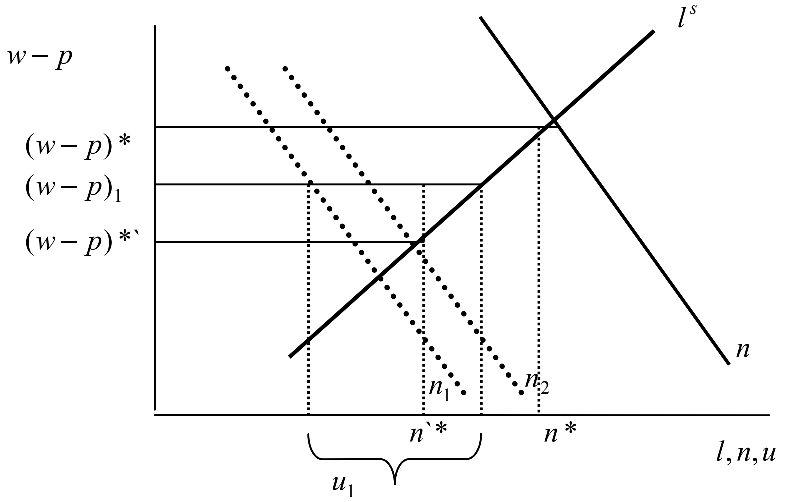
b) Dynamic Simulation:



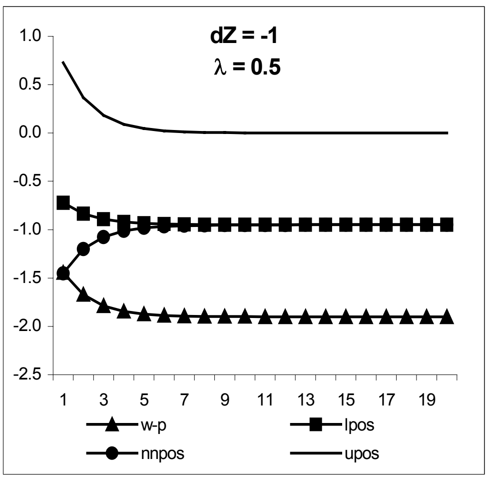


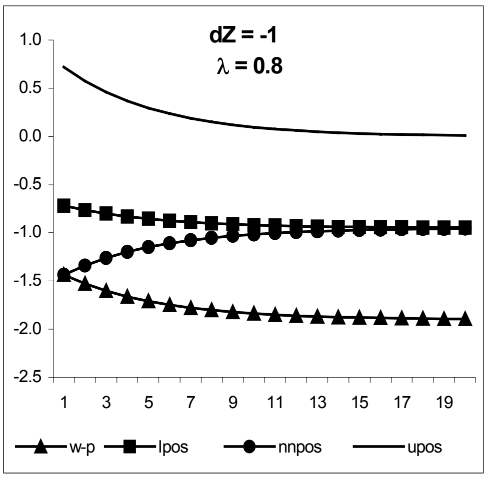
2. A fall in terms of trade

a) Comparative statics:



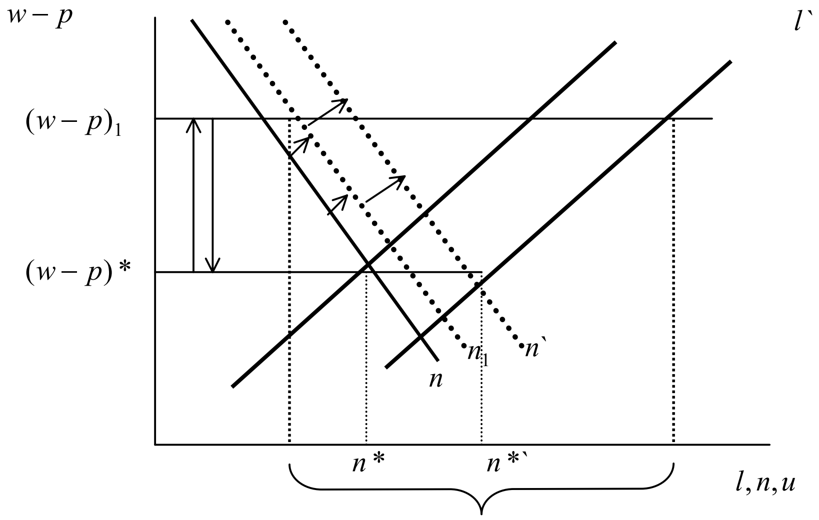
b) Dynamic Simulation:



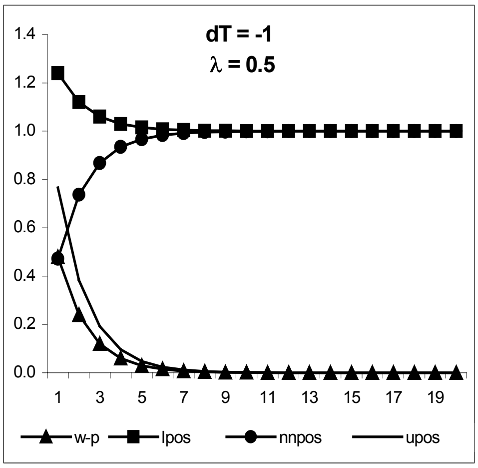


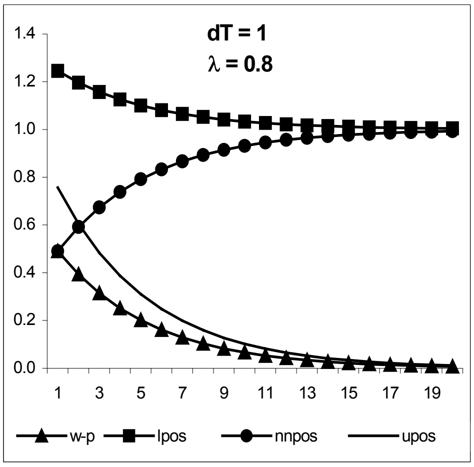
3. A rise in labor force

a) Comparative statics:



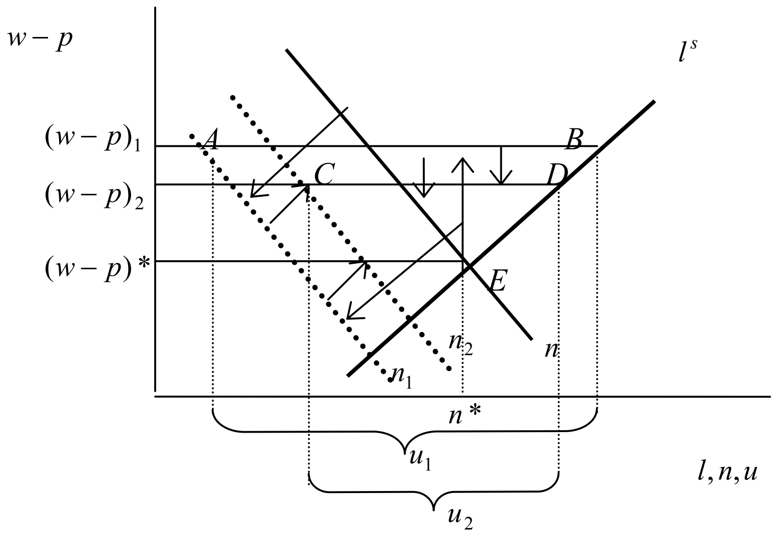
b) Dynamic Simulation:



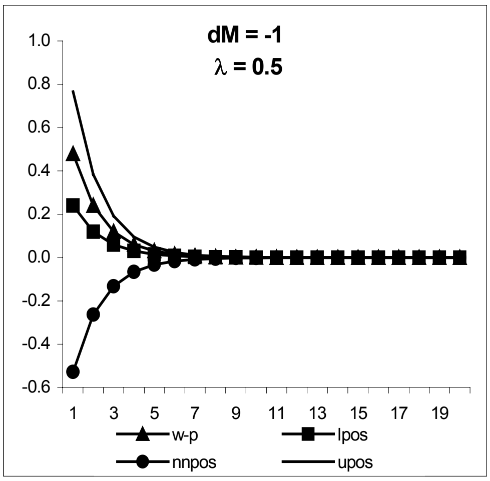


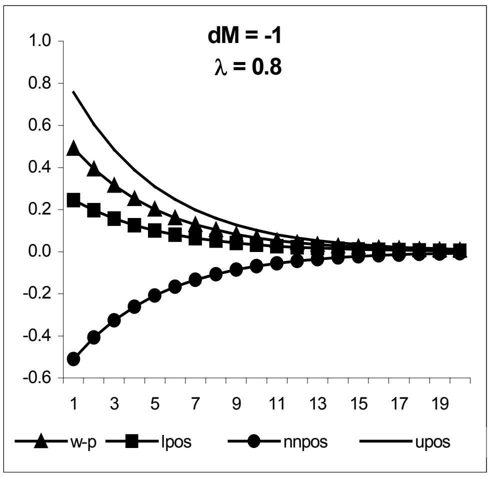
4. A monetary contraction

a) Comparative statics:



b) Dynamic simulation:



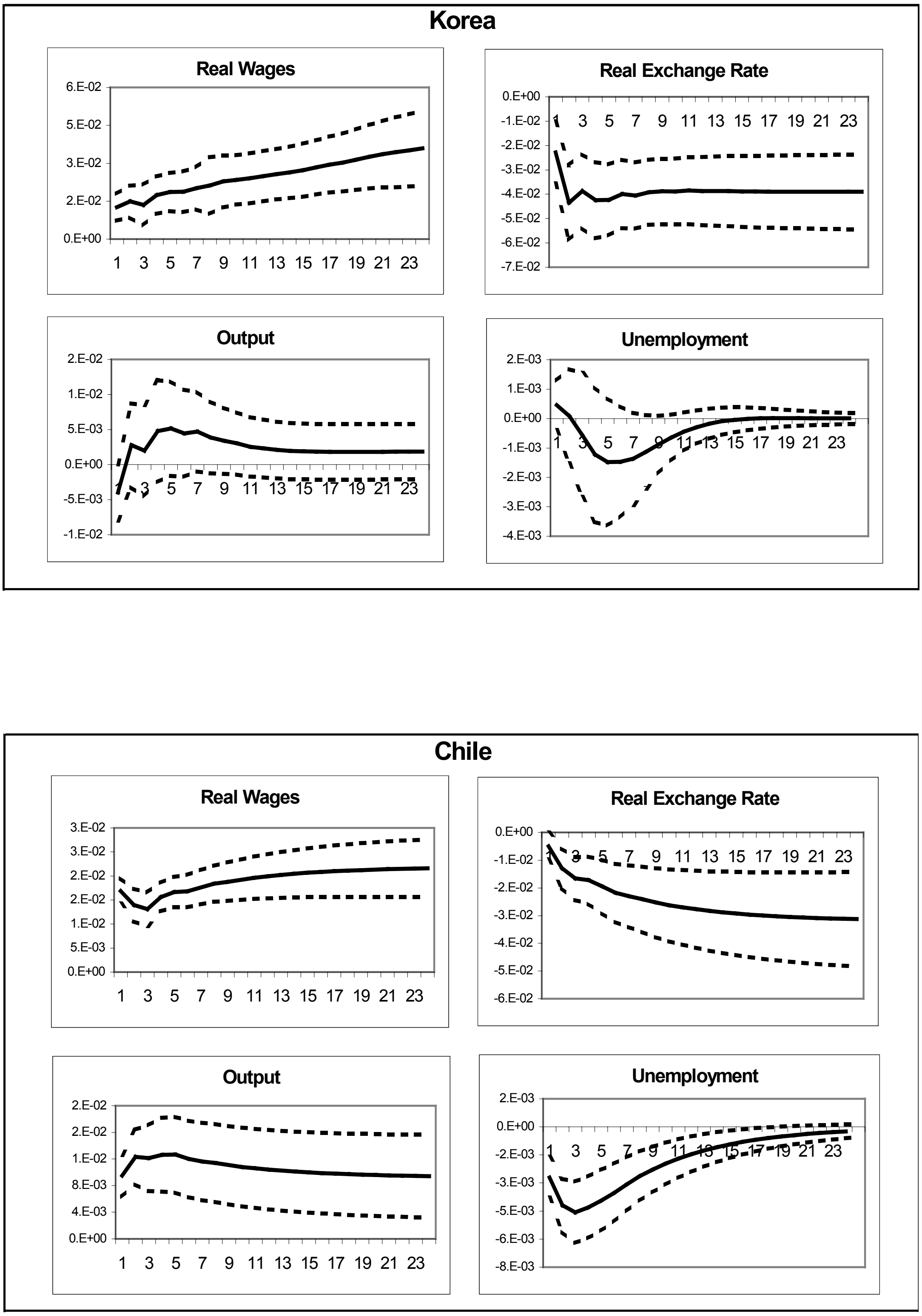


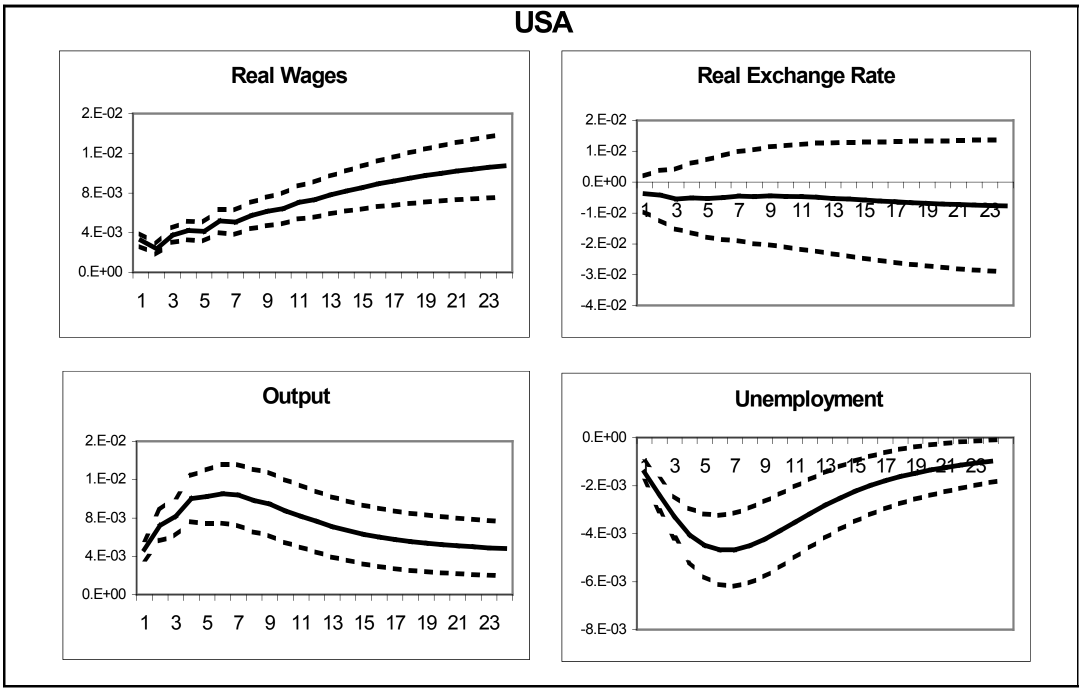
* Figures simulated with the following parameters:

γ	c	η_x	η_z	a	b
0.5	0.5	1.8	2.85	0.2	0.3

Figure 2

Estimated Impulse-Response Simulations: Selected Countries




USA
Real Wages
2.E-02
1.E-02
8.E-03
4.E-03
0.E+00
1 3 5 7 9 11 13 15 17 19 21 23
Real Exchange Rate
2.E-02
1.E-02
0.E+00
-1.E-02
-2.E-02
-3.E-02
-4.E-02
1 3 5 7 9 11 13 15 17 19 21 23
Output
2.E-02
1.E-02
8.E-03
4.E-03
0.E+00
1 3 5 7 9 11 13 15 17 19 21 23
Unemployment
0.E+00
-2.E-03
-4.E-03
-6.E-03
-8.E-03
1 3 5 7 9 11 13 15 17 19 21 23

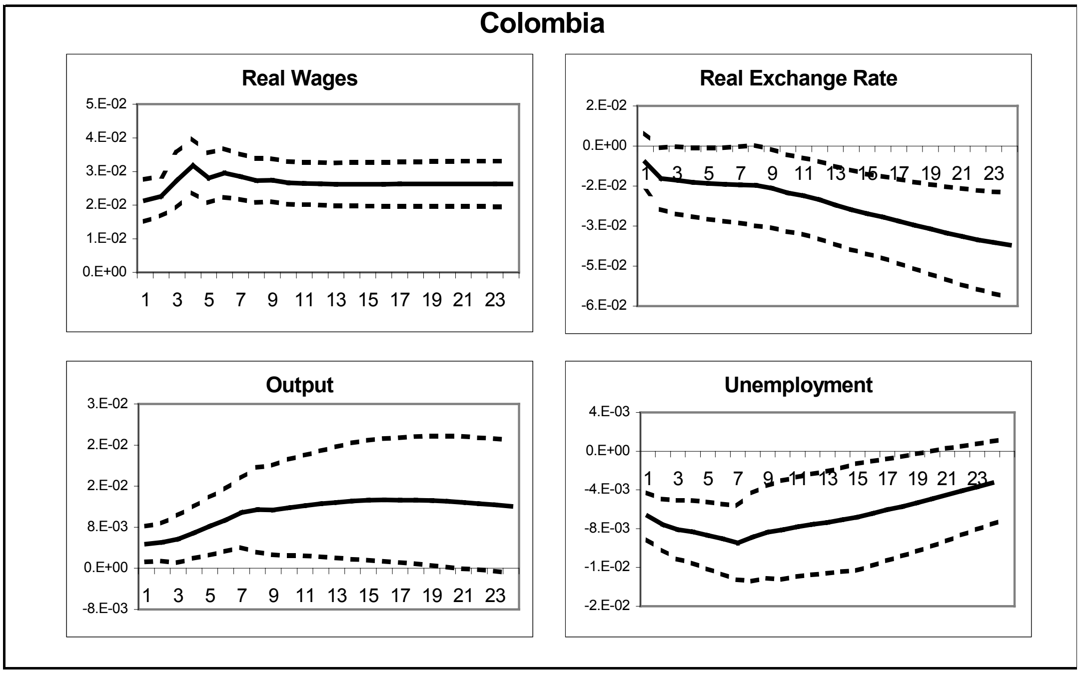

Colombia
Real Wages
5.E-02
4.E-02
3.E-02
2.E-02
1.E-02
0.E+00
1 3 5 7 9 11 13 15 17 19 21 23
Real Exchange Rate
2.E-02
0.E+00
-2.E-02
-3.E-02
-5.E-02
-6.E-02
1 3 5 7 9 11 13 15 17 19 21 23
Output
3.E-02
2.E-02
2.E-02
8.E-03
0.E+00
-8.E-03
1 3 5 7 9 11 13 15 17 19 21 23
Unemployment
4.E-03
0.E+00
-4.E-03
-8.E-03
-1.E-02
-2.E-02
1 3 5 7 9 11 13 15 17 19 21 23

Figure 3

Unemployment Persistence and Selected Indicators

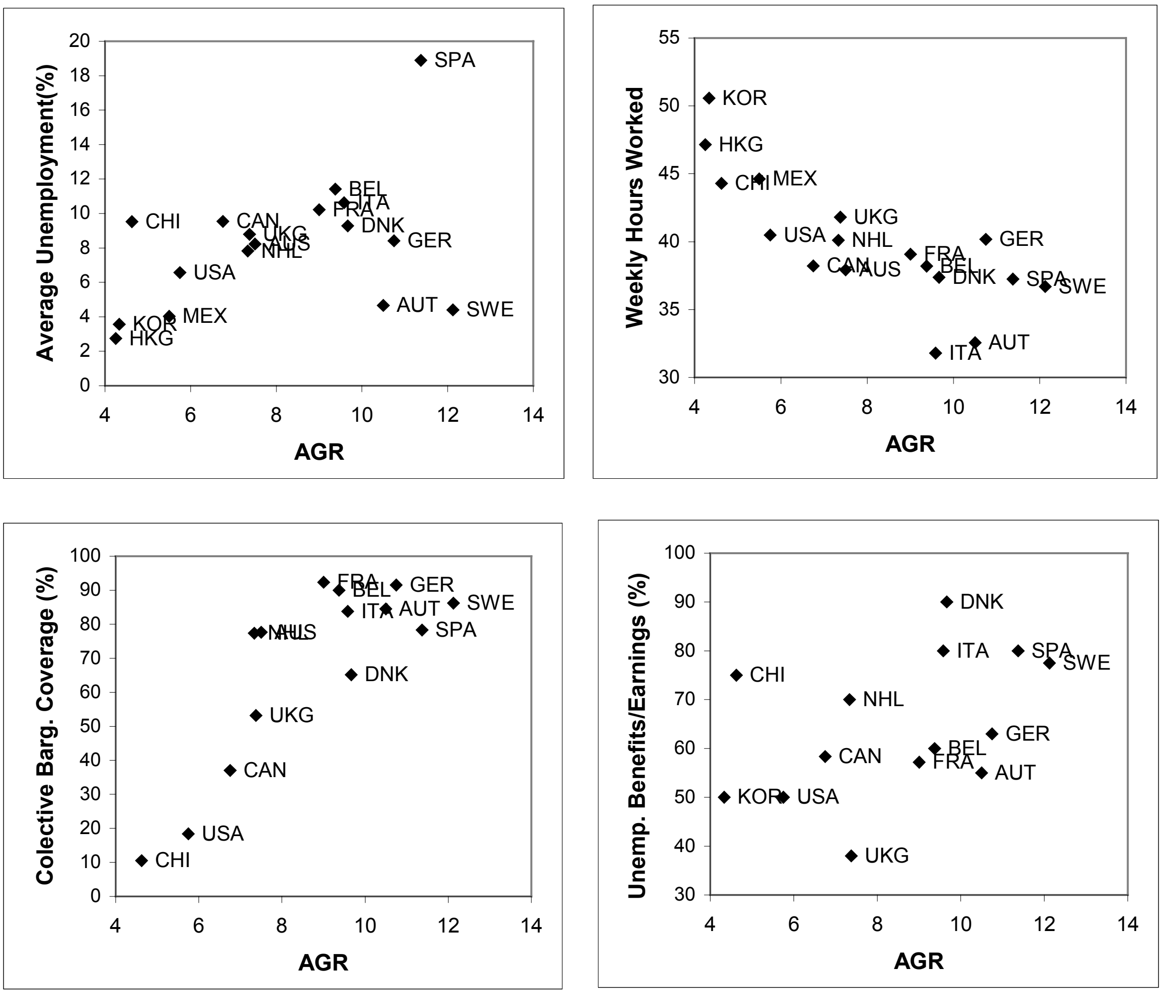


Table 1

Quarterly Series Source

	Data Spam	Unemployment	GDP	GDP Deflator	Nominal Wages	Real Exchange Rate
Australia	84.1 - 02.4	OECD	OECD	OECD	OECD *	OECD
Austria	80.1 - 02.4	OECD	IMF	IMF	OECD **	OECD
Belgium	80.1 - 02.4	OECD	OECD	OECD	OECD ***	OECD
Canada	80.1 - 02.4	OECD	OECD	OECD	OECD ***	OECD
Chile	86.1 - 02.4	NSO	Central Bank	Central Bank	NSO *	Central Bank
Colombia	84.1 - 02.4	Central Bank	Central Bank	Central Bank	Central Bank **	Central Bank
Denmark	88.1 - 02.4	OECD	OECD	OECD	OECD ***	OECD
France	80.1 - 02.4	OECD	OECD	OECD	OECD *	OECD
Germany	80.1 - 02.4	OECD	IMF	IMF	OECD ***	OECD
Hong Kong	86.1 - 02.4	HKMA	HKMA	HKMA	HKMA *	IMF"
Italy	80.1 - 02.4	OECD	OECD	OECD	OECD **	OECD
Korea	83.1 - 02.4	NSO	Bank of Korea	Bank of Korea	NSO *	IMF
Mexico	81.1 - 02.4	OECD	OECD	OECD	OECD ***	OECD
Netherlands	80.1 - 02.4	OECD	OECD	OECD	OECD ***	OECD
Spain	80.1 - 02.5	OECD	OECD	OECD	OECD *	OECD
Sweden	80.1 - 02.4	OECD	OECD	OECD	OECD ***	OECD
United Kingdom	80.1 - 02.4	OECD	OECD	OECD	OECD *	OECD
United States	80.1 - 02.4	OECD	OECD	OECD	OECD *	OECD

* All Sectors
** Industry
*** Manufacturing
" Constructed based on trade participation.
OECD Unemployment corresponds in all cases to the standarized rate.
NSO: National Statistics Office.

Table 2

Unit Root Tests*

	Real Wage		Q		Y		U	
Australia	-1.75	(-3.46)	-2.81	(-2.89)	-1.68	(-3.46)	-2.81	(-2.90)
Austria	-2.02	(-3.46)	-1.93	(-2.89)	-2.56	(-3.47)	-3.08	(-2.89)
Belgium	-1.12	(-3.46)	-3.19	(-3.46)	-2.89	(-3.46)	-4.2	(-3.47)
Canada	-2.43	(-3.46)	-2.32	(-3.46)	-2.4	(-2.90)	-3.86	(-3.47)
Chile	-1.14	(-2.90)	-1.37	(-2.91)	-2.4	(-2.91)	-2.82	(-2.90)
Colombia	-2.47	(-3.47)	-1.91	(-2.90)	-1.86	(-2.90)	-2.75	(-2.90)
Denmark	-2.28	(-3.49)	-4.78	(-2.91)	-2.89	(-3.49)	-2.74	(-3.49)
France	-2.61	(-3.46)	-2.52	(-2.89)	-2.57	(-3.46)	-2.1	(-2.90)
Germany	-2.94	(-3.46)	-1.94	(-2.89)	-0.66	(-2.89)	-2.63	(-2.89)
Holland	-1.18	(-2.89)	-4.73	(-3.46)	-0.65	(-2.90)	-4.21	(-3.46)
HongKong	-1.84	(-2.90)	-1.46	(-2.90)	-1.39	(-2.89)	-3.78	(-3.48)
Italy	-2.72	(-2.90)	-1.96	(-2.90)	-1.94	(-3.46)	-2.54	(-2.89)
Korea	-2.46	(-3.47)	-2.77	(-2.90)	-1.61	(-2.89)	-3.44	(-2.89)
Mexico	-1.47	(-2.91)	-2.52	(-2.91)	-2.85	(-3.48)	-2.44	(-2.89)
Spain	-2.86	(-3.47)	-1.85	(-2.89)	-2.69	(-3.46)	-2.21	(-2.89)
Sweden	-1.48	(-3.46)	-2.87	(-3.46)	-1.93	(-3.46)	-2.17	(-2.89)
UK	-2.14	(-3.46)	-2.23	(-2.89)	-2.4	(-3.46)	-4.14	(-3.46)
USA	-0.25	(-3.46)	-1.55	(-2.89)	-3.01	(-3.46)	-3.04	(-3.46)

* 5% critical value in parenthesis.
Source: author's own computation.

Table 3

Labor Market Indicators

	Unemployment Persistance	Unemployment & Hours Worked		Minimum Wage	Working Conditions and Benefits			Union Activity and Labor Standards	
Country	AGR	UNMPR	HRS	WGM/WGIND	ANP	SSC	BFT/EAR	COLCOV	ILO
Hong Kong	4.3	2.7	47.1						1
Korea	4.3	3.6	50.6	46.3	8.0	0.9	50.0		3
Chile	4.6	9.5	44.3	20.6	15.0	2.0	75.0	10.5	43
Mexico	5.5	4.0	44.6	18.8	6.0	1.9			69
United States	5.8	6.6	40.5	28.4	12.0	6.6	50.0	18.4	9
Canada	6.8	9.5	38.2	28.7	12.0	3.0	58.3	37.0	27
Netherlands	7.3	7.8	40.1	46.0	28.5	19.0	70.0	77.3	90
United Kingdom	7.4	8.8	41.8		23.5	6.1	38.0	53.2	79
Australia	7.5	8.2	37.9	60.2	17.5			77.7	49
France	9.0	10.2	39.1	40.9	25.0	17.4	57.2	92.3	111
Belgium	9.4	11.4	38.2	66.8	21.0	15.0	60.0	90.0	82
Italy	9.6	10.6	31.8		23.8	12.3	80.0	83.8	100
Denmark	9.7	9.3	37.4	63.8	26.5	1.5	90.0	65.2	60
Austria	10.5	4.7	32.6		24.5	13.1	55.0	84.5	47
Germany	10.8	8.4	40.2		29.0	14.9	63.0	91.5	70
Spain	11.4	18.9	37.3	35.7	22.3	11.7	80.0	78.3	118
Sweden	12.1	4.4	36.7	70.3	27.2	13.4	77.5	86.2	79
Colombia	22.8	12.90		42.6	15.0	1.1			48
Correlation		0.48**	-0.78**	0.30**	0.29**	0.07	0.43**	0.82**	0.32**
Wilcoxon Test of Rank Similarity		-	-	0.94*	0.87	0.71	0.97**	0.97**	0.91*

* Significant at 10%

** Significant at 5%

Source: Aithuors' own computations, and Rama and Artecona (2002)