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ACCOUNTING FOR SPANISH BUSINESS CYCLES

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We apply the business cycle accounting methodology proposed by Chari, Kehoe, and McGrattan to identify the sources of Spanish business fluctuations during two outstanding cyclical episodes: the recession alongside the transition to democracy in 1977 and the great recession of 2008. We find that the labor wedge played a key role during both recessions and that taxes and labor market institutions are likely behind the wedge movements. We conclude that any model that tries to understand the causes of recessions that occurred in the last three decades should focus on the labor wedge.

Keywords: Business Cycle Accounting, Efficiency Wedge, Labor Wedge, Investment Wedge

1. INTRODUCTION

We apply the *business cycle accounting* methodology (BCA) proposed by Chari et al. (2007) to identify the sources of Spanish business fluctuations during two pronounced cyclical episodes: the recession alongside the transition to democracy in 1977 and the great recession of 2008. The BCA methodology uses the equilibrium conditions of a prototype closed economy model to point out the main distortions that account for movements in output, hours worked, and investment.[1] The distortions can be classified into four categories: (i) those affecting the resource constraint of the economy—the feasibility wedge; (ii) those affecting the production function of the economy—the efficiency wedge; (iii) those affecting the intratemporal condition that substitutes consumption and leisure—the labor wedge; and (iv) those affecting the intertemporal substitution of consumption—the investment wedge.

We show that the labor wedge plays a key role in accounting for Spanish business cycles. In the recession episodes under consideration, the fluctuations

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induced by the labor wedge essentially replicate the observed movements in output, hours worked, and investment. Using regression analysis, we find that the labor wedge evolution is correlated with several institutions that were created under the rubric of the *welfare state* after 1976: a notable increase in the level of taxation, unemployment benefits, the temporary employment rate, and the relative distribution of power in collective bargaining. Other factors that could also have an impact on the labor wedge, such as credit constraints or labor union coverage, are found not to be statistically significant in the estimated regressions.

The efficiency wedge (which can also be interpreted as total factor productivity, TFP) plays little or no role in accounting for the observed fluctuations. Moreover, a growth accounting exercise reveals that the trend component in TFP suffered a considerable change during the mid-1990s. We conclude that the role of efficiency should not be regarded as a cyclical phenomenon but as a permanent component. Consistent with other studies [e.g., Chari et al. (2007)], the business cycle fluctuations induced by the investment and feasibility wedges account for a minimum fraction of the observed movements in Spanish time series.

We verify the validity of our results using a simple exercise where we calibrate the prototype model to the Spanish economy and simulate it considering two shocks only: one to the efficiency wedge and another to the labor wedge. We find that an important bulk of the variability in output and hours can be accounted for by the shock to the labor wedge. Such a simulation produces a negative correlation between wages and productivity, which is observed in the Spanish economy.[2]

In an influential contribution, Boldrin et al. (2010) conclude that the neoclassical growth model is not a good framework for explaining Spanish business cycles. Our findings suggest that the neoclassical growth model is indeed usable in helping to understand Spanish business cycles, but only if paired with a careful specification of shocks: any model that tries to understand the causes of recessions in Spain in the last three decades should focus on the labor wedge.

The rest of the paper is organized as follows: Section 2 performs both growth accounting and business cycle exercises that allow us to identify trends and patterns of fluctuations in output, productivity, and hours worked. Section 3 offers a description of the BCA methodology, which we put to use in Section 4. Section 5 puts forward a two-shock model in order to verify the extent to which labor and efficiency shocks can replicate some well-known business cycle facts in Spain. In Section 6 we try to identify the institutions and indicators that can help explain the particular evolution of the labor wedge in Spain. Section 7 concludes and suggests some policy implications.

2. GROWTH AND BUSINESS CYCLE FACTS, 1976:3–2012:3

In this section we study some of the properties of economic growth and employment and characterize the cyclical phases of the period under consideration, 1976:3–2012:3, using a Hodrick–Prescott (HP) filter.

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2.1. Growth Accounting Exercise

To study the long-run properties of Spanish GDP according to a growth accounting methodology, we start by assuming a Cobb–Douglas production function of the form

$$Y_t = K_t^{\theta} (Z_t H_t)^{1-\theta} = A_t K_t^{\theta} H_t^{1-\theta}, \quad (1)$$

where Y_t denotes output, $A_t \equiv Z_t^{1-\theta}$ denotes TFP, K_t represents the stock of capital, and H_t represents the labor input. In turn, labor represents total hours worked, i.e., $H_t = h_t L_t$, with h_t being the average hours worked per worker and L_t being the number of workers at time t.

From (1), output per hour worked can be decomposed into TFP times the contributions from the capital-to-labor ratio:

$$\frac{Y_t}{H_t} = A_t \times \left(\frac{K_t}{H_t}\right)^{\theta}. \quad (2)$$

Let P_t denote population over 16. Output per capita can now be written as

$$\begin{aligned} \frac{Y_t}{P_t} &= A_t^{1/(1-\theta)} \times \left(\frac{K_t}{Y_t}\right)^{\theta/(1-\theta)} \times \frac{H_t}{P_t} \\ &= Z_t \times \left(\frac{K_t}{Y_t}\right)^{\theta/(1-\theta)} \times \frac{H_t}{P_t}. \end{aligned} \quad (3)$$

Equation (3) shows that the capital-to-output ratio (K_t/Y_t) and the total hours per capita (H_t/P_t) must be constant along the balanced growth path.[3] (Section A in the Online Technical Appendix describes the data set and details the construction of the variables used in our exercise.) Using the EU KLEMS database, we calibrate a capital income share of $\theta = 0.3638$.

After log-linearization and differentiation, equations (1) through (3) can be expressed in growth terms. The three decomposition exercises are reported in Table 1 using quarterly observations for 1976:3–2012:3 (γ's denote growth rates), where all the values are expressed in annualized terms. The sample is split into three periods: the transition to democracy, 1976 to 1985; the entry into the European Economic Community (EEC), 1986 to 1994; and the final period of transition and adoption of the euro, 1995 to 2012.

The fourth column in the upper panel of Table 1 shows that output has steadily grown at a rate of 2.24% across the entire period. During the years following the advent of democracy (also characterized by a low degree of openness and globalization), the growth rate was lower than the long-term average at 1.47%. About two-thirds of this long-term growth can be attributed to capital input. Although the contribution of labor was negative during the transition to democracy, it increased (still to a low value) after Spain's entry into the EEC, and remained high during the years that followed the European Monetary Union (EMU), when a large number of jobs were created. Regarding TFP, two phases are evident. The

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TABLE 1. Growth accounting 1976:3–2012:3

			1976:3–2012:3	1976:3–1985:4	1986:1–1994:4	1995:1–2012:3
		Output growth decomposition				
Output growth	γ_Y	$(a_1 + a_2 + a_3)$	2.24	1.47	2.90	2.27
TFP growth	γ_A	a_1	0.57	2.13	0.79	−0.35
Capital contribution	$\theta\gamma_K$	a_2	1.50	1.18	1.64	1.54
Labor contribution	$(1-\theta)\gamma_H$	a_3	0.17	−1.84	0.46	1.07
		Productivity growth decomposition				
Productivity growth	$\gamma_Y - \gamma_H$	$(b_1 + b_2)$	1.97	4.36	2.17	0.59
TFP growth	γ_A	b_1	0.57	2.13	0.79	−0.35
Capital/labor contribution	$\theta(\gamma_K - \gamma_H)$	b_2	1.40	2.24	1.38	0.93
		Output per capita growth decomposition				
Output per capita growth	$\gamma_Y - \gamma_P$	$(c_1 + c_2 + c_3)$	1.10	0.17	1.82	1.18
TFP contribution	$\gamma_A/(1-\theta)$	c_1	0.90	3.34	1.25	−0.54
Capital/output contribution	$(\theta/(1-\theta))(\gamma_K - \gamma_Y)$	c_2	1.05	1.02	0.93	1.13
Labor/population growth	$\gamma_H - \gamma_P$	c_3	−0.85	−4.19	−0.36	0.59

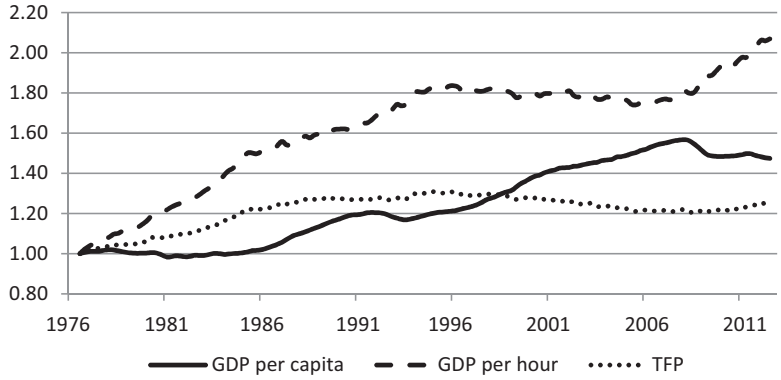


FIGURE 1. Quarterly series 1976:3–2012:3.

first one covers 1976 to 1994 and is characterized by a positive growth rate. The second phase, currently ongoing, is characterized by a negative growth rate.

The middle panel of Table 1 decomposes productivity (GDP per hour) according to (2). Although enjoying a high growth rate at the beginning of the sample (4.36%), productivity slowed after 1986: the growth rate for 1995 to 2012 was remarkably low at 0.59%.[4] For 1976 to 1985, growth in the capital-to-labor ratio accounts for a sizable fraction of productivity growth. As the Spanish economy opened up after its EEC entry (1986), the role of capital became increasingly small as the inflow of capital increased.

The bottom panel of Table 1 shows that the dynamics of GDP per capita (according to (3)) is disconnected from that of productivity. This can be seen in more detail in Figure 1, which reports GDP per capita, GDP per hour, and TFP (all first observations have been normalized to one). Figure 1 shows that the growth rate of output per capita accelerated after 1986, increasing from 0.17% to 1.82% (from Table 1), and remained at 1.18% after 1995. The bulk of the GDP per capita growth rate can be accounted for by a stable contribution from the capital-to-output ratio, which implies a sustained divergence from the balanced growth path. The average contribution of the ratio, 1.05%, was stable across the sample; this is a discrepancy from the neoclassical growth model, as highlighted by Boldrin et al. (2010).

2.2. Hours Worked and Employment

Let N_t denote the labor force. Hours per capita $h_t L_t / P_t$ can be decomposed as the product of hours per worker, the employment rate, and the participation rate:

$$\frac{H_t}{P_t} = \frac{h_t L_t}{P_t} = h_t \times \frac{L_t}{N_t} \times \frac{N_t}{P_t}.$$

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FIGURE 2. Hours and activity 1976:3–2012:3.

The series may offer some insights into an agent's decision to participate in the labor market. Figure 2 presents the evolution of the hours per capita $h_t L_t / P_t$, the weekly average hours per worker h_t, the activity rate N_t / P_t, and the employment rate L_t / N_t (all first observations have been normalized to unity). There was a significant fall in hours per worker, employment rate, and activity rate between 1976 and 1986, whereas the unemployment rate increased from 4.6% to 20.5% in the same period. Hours per capita and the employment rate started on an upward trend in the early 1990s (most likely as a side effect of the expansions at the end of the 1980s and after the Euro adoption in 1999), yet this has clearly reversed in the last quarters of the sample as an effect of the Great Recession.

The participation rate declined slightly in the first ten years of the sample, displaying a sluggish recovery from 1987 to 1996 (which can be attributed to the increase in female participation in the labor market) and a vigorous upward trend during the last years of the sample (which can be associated with an increase in female and immigrant participation). During the Great Recession, the pattern of this relationship changed: the participation rate continued to grow, whereas the employment rate declined.

2.3. Unemployment Rates

Table 2 presents unemployment rates for Spain and seven other countries (France, Germany, Ireland, Italy, Japan, the United Kingdom, and the United States) at relevant periods in our analysis. The evolution of the Spanish unemployment rate contrasts with that in the other countries: throughout the 1970s, unemployment rates were quite low and below the average for the remaining countries. A decade later (1986), the rate was four times higher and almost twice the average at 20.5%; the Spanish unemployment rate has been by far the highest since that time. By 2007:2 the rate had converged toward the levels of the remaining countries, 7.95%.

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TABLE 2. Unemployment rates

	1970	1976	1986	1992	1996	2004	2007:2	2009:2	2012:4
France	1.7	4.3	10.3	10.0	12.0	9.9	8.1	9.2	10.2
Germany	0.6	3.9	6.6	4.8	7.2	9.8	8.6	7.8	6.6
Ireland	6.9	9.1	17.0	15.3	11.5	4.4	4.8	12.2	13.7
Italy	3.2	4.7	11.2	10.9	11.5	8.0	5.7	7.3	11.2
Japan	1.1	2.0	2.8	2.3	3.3	4.7	3.8	5.2	4.0
Spain	2.0	4.6	20.5	18.9	21.8	11.0	8.0	18.0	26.0
UK	n.a.	n.a.	11.1	9.5	7.9	4.6	5.3	7.7	7.7
USA	4.9	7.8	6.8	7.1	5.3	5.5	4.4	9.1	7.5
Mean	2.9	5.2	10.8	9.8	10.1	7.2	6.1	9.6	10.9
Std.dev.	2.3	2.4	5.7	5.4	5.7	2.7	1.9	4.0	6.8

Source: OECD labor market statistics database, IMF-IFS, and own calculations. Figures for 1976, 1986, 1993, and 1996 represent a centered three-year moving average.

However, by 2009:2 the rate was again hovering around 18%, and reached 26% in 2012:4.

2.4. Spanish Business Cycle Facts

Our business cycle analysis starts with a brief look at the growth rates of GDP, employment, and the real wage. The series are plotted in Figure 3 in yearly terms. For the nominal wage, we use an index of wages negotiated under collective bargaining divided by the consumer price index (CPI). In Spain, the percentage of workers whose wages result from collective bargaining increased from 65% in 1976 to about 90% currently. As we highlighted previously, GDP has grown at a rate of 2.24% during this period. Figure 4 plots the (log of) GDP together with its trend, estimated using the HP filter. The trend follows a downward pattern after 2008, when GDP swings below it.

Referring to Figure 3, the dashed line represents the growth rate of employment, which clearly exhibits procyclical behavior and more volatile dynamics. This points to the fact that employment grows sluggishly in expansions and abruptly diminishes during the early quarters of a recession. Finally, the dotted line in Figure 3 shows the real wage growth rate. The series seems to be disconnected from the evolution of GDP, especially after 1994. As an example, real wages grew by 3% during 2009 and 2010, while GDP and employment were falling by a similar amount. The overall conclusion from Figure 3 is that the wage mechanism has played an inadequate role in absorbing fluctuations.

The trend and observed GDP series shown in Figure 4 allow us to identify three cycles. The first is a long recession from 1981:1 through 1987:2, when the Spanish economy underwent its major structural reforms (such as the entry into the EEC and the consolidation of democracy). Although output fluctuated above its trend at the beginning of the sample, output per capita remained flat during the period (see

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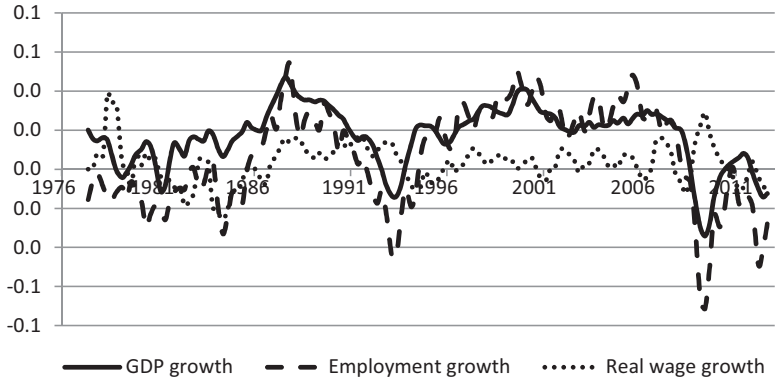


FIGURE 3. Annual growth rates 1976:3–2012:3.

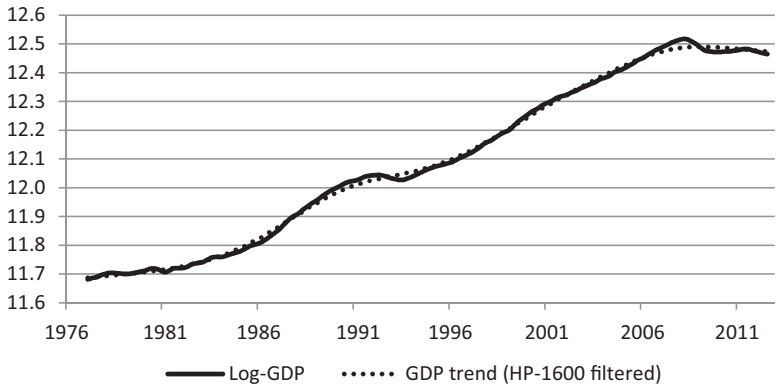


FIGURE 4. Fluctuations in Spain 1976:3–2012:3.

Figure 1); for this reason, we prefer to examine the entire transition period of to democracy, 1976:1–1985:4. The recession has an associated expansion that takes place at the time of the EEC entry and the Single European Act, 1986:1 to 1992:1. The second is a short-lived recession lasting from 1992:2 to 1994:4, and also affects the other European countries; the corresponding expansion coincides with the launch of the Euro in 1999. Finally, we identify the current recession, which for Spain began in 2008:2 (after a peak in 2007:2). We apply the BCA methodology to analyze the first and the last of the three recessions: the transition-to-democracy recession in 1976 and the Great Recession of 2008.

We take the series discussed so far, HP-filter them, and calculate their basic statistical properties in Tables 3 and 4. The first and second columns in Table 3

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present the absolute standard deviations, σ, and the standard deviations relative to that of output, σ/σ_y, whereas the remaining columns show the cross correlations with output at several leads and lags. For the trade balance, we take the ratio over GDP, both in nominal terms. In Table 4, we report several correlations of interest for the entire sample and several of its subsets.

The autocorrelation of cyclical output is 0.94 at one lag, pointing to substantial persistence in Spanish business cycles. Private consumption and investment are strongly procyclical. Moreover, consumption volatility is 23% higher than that of GDP, whereas investment volatility is four times larger.[5] Public consumption is weakly procyclical and lags the business cycle; the correlation with GDP increases from 0.26 to 0.47 with the lead of output. Exports and (especially) imports are procyclical and lead output fluctuations.

Labor force, employment, workers, and total hours worked are strongly procyclical and more volatile than output. Although the real wage is acyclical when the complete sample is considered, Table 4 shows that the same correlation takes positive values for the first two subsamples (although somewhat decreasing), but becomes negative after 1995. Another important issue (not shown in the table) is that the relative volatility of the real wage decreases after the mid-1980s, from 1.78 to 0.55.

The correlations of the real wage with employment and with total hours worked have changed over time (see Table 4). They hovered around 0.5 from 1976:3 to 1985:4, declined to 0.25 from 1986:1 to 1994:4, and turned negative, −0.25, during 1995:1–2012:3. The productivity gains at the beginning of democracy, combined with low elasticity in the labor supply, led to an upward adjustment in wages but weak job creation. After 1995 productivity growth came to a halt, the relative volatility of wages declined after 1986, and movements in employment were led by increases in the labor force: immigration and female labor market participation.[6] Licandro and Puch (1997) suggest introducing other shocks than those related to TFP in applications of the real business cycle (RBC) model to Spain to better understand the changing correlation between hours worked and productivity. As is well known, the standard RBC model predicts a positive correlation between the real wage and hours worked.

The most remarkable result, already noted by Boldrin et al. (2010), is that the correlations of output with both TFP and productivity per hour worked are negative throughout the sample, contrasting the experience of other advanced economies. Boldrin et al. (2010) note that this is a relatively new occurrence in Spanish business cycles, as the correlations were positive during the 1960s and turned negative by the end of the 1970s.

3. THE BCA METHODOLOGY

In this section we present a brief description of the BCA methodology of Chari et al. (2006, 2007). The BCA methodology has two components, an *equivalence*

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TABLE 3. Correlogram with respect to cyclical GDP (HP-1600 filtered), 1976:3–2012:3

Variable	σ	σ/σ_Y	-4	-3	-2	-1	0	1	2	3	4
GDP, Y	0.0106	1.00	0.48	0.65	0.81	0.94	1.00	–	–	–	–
Consumption, C	0.0131	1.23	0.49	0.65	0.77	0.85	0.86	0.78	0.66	0.52	0.38
Investment, X	0.0462	4.35	0.58	0.71	0.81	0.89	0.89	0.81	0.67	0.51	0.33
Government, G	0.0124	1.17	−0.11	−0.05	0.04	0.14	0.26	0.33	0.37	0.42	0.47
Exports	0.0305	2.87	0.23	0.33	0.41	0.43	0.36	0.22	0.04	−0.13	−0.27
Imports	0.0472	4.44	0.59	0.71	0.80	0.81	0.74	0.60	0.42	0.24	0.07
Trade balance	0.0104	0.98	−0.43	−0.53	−0.61	−0.64	−0.61	−0.52	−0.40	−0.28	−0.16
Workers, L	0.0170	1.60	0.54	0.68	0.80	0.89	0.92	0.87	0.75	0.62	0.47
Total hours, $H = h^*L$	0.0185	1.73	0.55	0.68	0.78	0.85	0.88	0.82	0.70	0.57	0.42
Real wage, W	0.0078	0.73	−0.01	−0.04	−0.04	−0.03	0.02	0.08	0.15	0.20	0.26
Labor force, N	0.0065	0.61	0.26	0.31	0.33	0.36	0.38	0.37	0.32	0.24	0.19
GDP per hour, Y/H	0.0104	0.98	−0.49	−0.54	−0.56	−0.55	−0.54	−0.49	−0.41	−0.34	−0.26
TFP, A	0.0062	0.58	−0.13	−0.13	−0.11	−0.10	−0.11	−0.15	−0.20	−0.26	−0.31

TABLE 4. Correlations (HP-cycles)

	Complete sample	Subsamples		
	1976:3–2012:3	1976:3–1985:4	1986:1–1994:4	1995:1–2012:3
corr(Output,Workers)	0.92	0.76	0.96	0.92
corr(Output,Hours)	0.88	0.72	0.95	0.87
corr(Output,Wage)	0.02	0.43	0.16	−0.31
corr(Output, Productivity)	−0.54	−0.40	−0.71	−0.52
corr(Output,TFP)	−0.11	−0.18	−0.11	−0.10
corr(Workers,Hours)	0.98	0.96	0.99	0.98
corr(Workers,Wage)	0.09	0.49	0.23	−0.27
corr(Workers, Productivity)	−0.79	−0.85	−0.87	−0.78
corr(Workers,TFP)	−0.43	−0.72	−0.32	−0.43
corr(Hours,Wage)	0.12	0.48	0.25	−0.24
corr(Hours, Productivity)	−0.87	−0.93	−0.89	−0.87
corr(Hours,TFP)	−0.54	−0.80	−0.38	−0.53
corr(Wage, Productivity)	−0.19	−0.39	−0.34	0.09
corr(Wage,TFP)	−0.39	−0.41	−0.59	−0.23
corr(Productivity, TFP)	0.83	0.96	0.70	0.84

result and an *accounting procedure*. The equivalence result shows that virtually any dynamic economic model can be mapped to a prototype stochastic growth model. The prototype economy is augmented by several wedges that represent distortions over the agents' decisions; the wedges play a key role in the analysis, as will be shown in the following.

In a second step, the accounting procedure uses the prototype model's equilibrium conditions and real-world observations to measure the wedges. The wedges are then plugged back into the prototype model, allowing us to quantify how many of the observed movements in output, labor, and investment can be attributed to each wedge.

3.1. The Benchmark Prototype Economy

The prototype economy consists of three agents: a representative household of size P_t, a representative firm, and a government. The population grows at a constant rate γ_P. At each period t, the economy experiences one of many states denoted by s_t. Denote the history of these states by $s^t = \{s_0, \ldots, s_t\}$. Let $\pi_t(s^t)$ be the time-0 probability of history s^t. We take the initial state s_0 as given.

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The economy has four exogenous stochastic wedges: efficiency $A_t(s^t)$, labor $\omega_{lt}(s^t)$, investment $\omega_{xt}(s^t)$, and feasibility $g_t(s^t)$. Note that all of these variables are functions of the state s_t.

Discretionary expansions of government spending or a shock affecting the trade balance are examples of the feasibility wedge. A shock that makes total factor productivity differ from its trend can be identified as a shock to the efficiency wedge. Examples of the labor wedge may include indirect taxation of consumption or direct taxation of labor income (or a combination of both) that affect the slope of the budget and the substitution between consumption and leisure, or labor market institutions that alter the number of hours worked (days of vacations, holidays) and/or the decision to participate in the labor market. Other examples include institutions that cause the real wage to move rigidly in response to a negative productivity shock, such as the market power of labor unions and firms, or, as recently proposed by Jermann and Quadrini (2012), credit constraints and financial frictions. Finally, an example of the investment wedge is taxation of capital or a shock to investment specific technological change, both of which affect the marginal product of capital.

Household. The representative household chooses per capita consumption c_t, labor l_t, and investment x_t to maximize its infinite lifetime expected utility,

$$\sum_{t=0}^{\infty}\sum_{s^t}\beta^t\pi_t(s^t)U[c_t(s^t), l_t(s^t)]P_t. \tag{4}$$

Household optimization is subject to the real budget constraint

$$c_t(s^t)+[1+\omega_{xt}(s^t)]x_t(s^t)=[1-\omega_{lt}(s^t)]W_t(s^t)l_t(s^t)+R_t(s^t)k_t(s^{t-1})+T_t(s^t) \tag{5}$$

and the law of motion for the per capita capital stock k_t,

$$(1+\gamma_P)k_{t+1}(s^t)=(1-\delta)k_t(s^{t-1})+x_t(s^t). \tag{6}$$

In the preceding, β is a discount factor, W_t is the real wage rate, R_t is the rental price of capital, T_t is per capita transfers, and δ is the depreciation rate.

Firm. The representative firm has access to the constant-returns-to-scale technology

$$A_t(s^t)F[k_t(s^{t-1}), z_t l_t(s^t)], \tag{7}$$

where $z_t \equiv (1+\gamma_z)^t$ represents labor-augmenting technical progress that grows at rate η. The firm chooses capital and labor inputs to maximize profits:

$$A_t(s^t)F[k_t(s^{t-1}), z_t l_t(s^t)]-W_t(s^t)l_t(s^t)-R_t(s^t)k_t(s^{t-1}). \tag{8}$$

Equilibrium. A competitive equilibrium in the prototype model is characterized by four equations. First, a resource constraint, including by the feasibility wedge

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$g_t(s^t)$:

$$y_t(s^t) = c_t(s^t) + x_t(s^t) + g_t(s^t). \tag{9}$$

We refer to $g_t(s^t)$ in (9) as the feasibility wedge [rather than the government wedge, as in Chari et al. (2007)], given that it is also influenced by the trade balance. In Spain, exports and imports represent an important percentage of GDP.

Second, the production technology, affected by the efficiency wedge $A_t(s^t)$:

$$y_t(s^t) = A_t(s^t)F[k_t(s^{t-1}), z_t l_t(s^t)]. \tag{10}$$

In what follows, let F_{jt} denote the partial derivative of the production function with respect to the production input $j = k, l$ and let U_{jt} denote the marginal utility of $j = c, l$. We also need to add an intratemporal condition affected by the labor wedge $\omega_{lt}(s^t)$,

$$-\frac{U_{lt}(s^t)}{U_{ct}(s^t)} = [1 - \omega_{lt}(s^t)]A_t(s^t)z_t F_{lt}(s^t), \tag{11}$$

and an intertemporal Euler equation affected by the investment wedge $\omega_{xt}(s^t)$,

$$[1 + \omega_{xt}(s^t)]U_{ct}(s^t) = \beta \sum_{s^{t+1}} \pi_t(s^{t+1}|s^t)U_{c,t+1}(s^{t+1}) \left\{A_{t+1}(s^{t+1})F_{k,t+1}(s^t) + (1 - \delta)[1 + \omega_{x,t+1}(s^{t+1})]\right\}. \tag{12}$$

3.2. The Accounting Procedure

Functional forms and decision rules. To make the accounting procedure operational, we select functional forms for household utility and the production technology. We assume that the utility function takes the form

$$U(c, l) = \log(c) - \psi \frac{l^{1+1/\upsilon}}{1 + 1/\upsilon}, \tag{13}$$

where the parameter υ stands for the Frisch isoelasticity of labor supply. Although this choice is standard in the literature, it differs from the log–log utility proposed by Chari et al. (2007). The log–log functional form is consistent with an unusually elastic labor supply, which makes it ill-suited for the Spanish labor market. In practice, we select a low value for this elasticity: $\upsilon = 1/3$ (the details of calibration are given in Section B of the Online Technical Appendix). We let the production technology follow a Cobb–Douglas specification as in equation (1).

After substituting the functional forms in (9)–(12), we can derive (log-linear) decision rules following standard perturbation methods. Denote the rules for output, hours, and investment by $y(s_t, k_t)$, $l(s_t, k_t)$, and $x(s_t, k_t)$.

Estimating the transition process. Assume that s^t follows a Markov process of the form $\pi(s_t|s_{t-1})$ and that the map from s^t to the wedges is both one-to-one and onto.

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In what follows, let y_t^d, l_t^d, x_t^d, and g_t^d denote real-world observations (in terms of a state-space representation, these are our observable variables). We use these values to estimate the parameters of the Markov process $\pi(s_t|s_{t-1})$; for this purpose, we specify a VAR for s_t of the form

$$s_{t+1} = P_0 + P_1 s_t + \epsilon_{t+1}, \tag{14}$$

where ϵ_t is i.i.d. normal with mean zero and variance–covariance matrix V. In practice, we actually estimate the lower triangular matrix Q, where $V = QQ^\top$. This implies a particular order of variables that cannot be viewed as the orthogonality conditions needed to identify structural shocks, as in a SVAR approach. Instead, this is used to guarantee that V remains positive semidefinite.

We use a standard maximum likelihood estimation procedure to obtain estimates of P_0, P_1, and V of process (14). As is standard, we combine the model's decision rules to form the likelihood function and use the data on output, investment, hours, and government expenditure as observable variables.

Uncovering the state. Next, we identify the state s_t by measuring the realized wedges. We can directly measure the feasibility wedge as the sum of observed government spending plus net exports, both in per capita terms. The remaining wedges are obtained using the observed data and the model's decision rules: the realized series s_t^d should solve

$$y_t^d = y\left(s_t^d, k_t\right), \quad l_t^d = l\left(s_t^d, k_t\right), \quad x_t^d = x\left(s_t^d, k_t\right), \tag{15}$$

where k_t follows from equation (6) using the values for x_t^d and a period-0 (observed) capital stock k_0^d. We solve for the remaining elements of s_t using (10)–(12). Once this is done, we have actually identified the states.

Considered simultaneously, the four wedges account for all of the movements in the observable variables. Plugging the wedges into the decision rules in (15) and using $g_t\left(s_t^d\right) = g_t^d$ together with the law of motion for capital (6) yields the original real-world observations.

Identifying the wedges' marginal effects. The last step of the BCA methodology requires us to isolate the marginal effects of the wedges. We allow one wedge to fluctuate while keeping the others constant. Starting from k_0^d, we use s_t^d, the decision rules, and the law of motion for capital to construct the realized sequences of output, labor, and investment when the particular wedge under analysis (and only that wedge) changes. We can then compare the predicted values with observed ones and assess the relative importance of the wedges over the economy. A variant of the identification exercise allows a subset of three wedges to fluctuate while keeping the remaining one constant. The predicted values show the importance of the omitted wedge in replicating observed data movements.

The BCA exercise we perform differs from a traditional SVAR decomposition, where a researcher estimates a VAR given some identifying (or orthogonality) restrictions provided by a model. The orthogonality conditions allow direct identification of the set of *structural* innovations affecting the VAR. Once this has been

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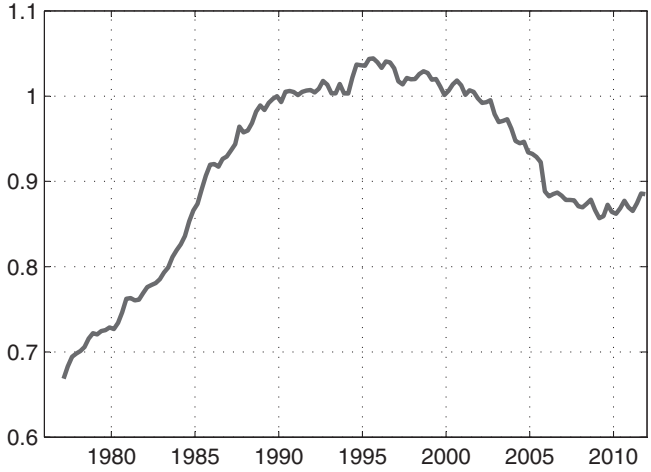


FIGURE 5. Efficiency wedge 1976:3–2011:2.

accomplished, it is straightforward to execute a variance decomposition exercise to assess the relative importance of the shocks.

The methodology we follow does not require orthogonality conditions. The BCA exercise identifies the source of frictions and distortions within the model that generate the fluctuations, i.e., the *wedges*. We use the VAR in (14) to derive a law of motion for the state variables that, when paired with the relevant policy functions and observed data, allows us to back out the state values. We can then feed each measured wedge to the model while keeping all others constant. [For a through exposition of the differences between the BCA and SVAR methodologies see Chari et al. (2007, p. 824).]

4. RESULTS

We show the identified wedges in Figures 5–8 and the graphical analysis of the BCA exercise in Figures 9 and 10. We split the sample into two data sets, 1973:3–1994:4 (first data set) and 1995:1–2011:2 (second data set), in order to overcome possible biases induced by the observed break in the TFP trend after 1994 (see Figure 1 and Table 1). The data sets also match the episodes under consideration: the transition-to-democracy recession (Figure 9) and the Great Recession of 2008 (Figure 10). (See Section A of the Online Technical Appendix for a discussion of the possible presence of break points in productivity trend on 1985 and 1994.)

4.1. Wedges, 1976:3–2011:2

We present the efficiency wedge, estimated as the Solow residual (i.e., TFP), in Figure 5. As we saw in Tables 3 and 4, the behavior of the efficiency wedge is

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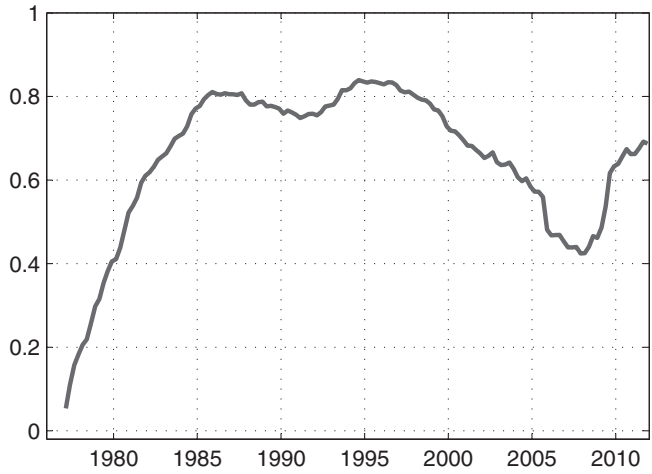


FIGURE 6. Labor wedge 1976:3–2011:2.

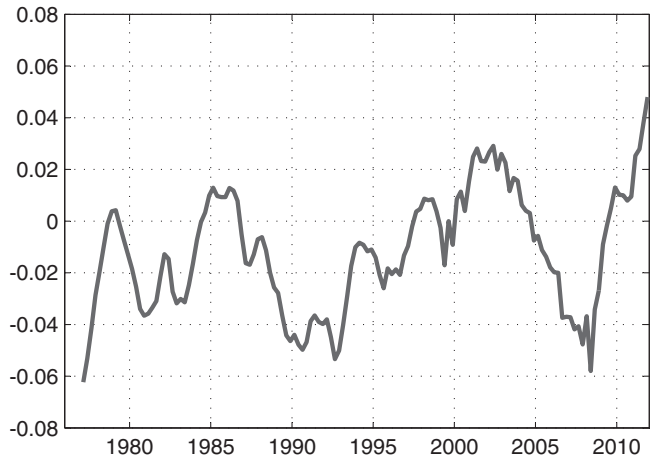


FIGURE 7. Investment wedge 1976:3–2011:2.

weakly countercyclical. We plot the labor wedge in Figure 6: we can see a significant increase in this distortion from 1975 to 1985 that decreases in the subsequent years. When the great recession starts in 2008, the labor wedge increases, so that it is almost on par with the average values of the late 1980s and early 1990s. The remaining two figures (Figures 7 and 8) display our estimates of the investment and feasibility wedges, which, according to our BCA analysis, play a minor role in accounting for Spanish fluctuations.

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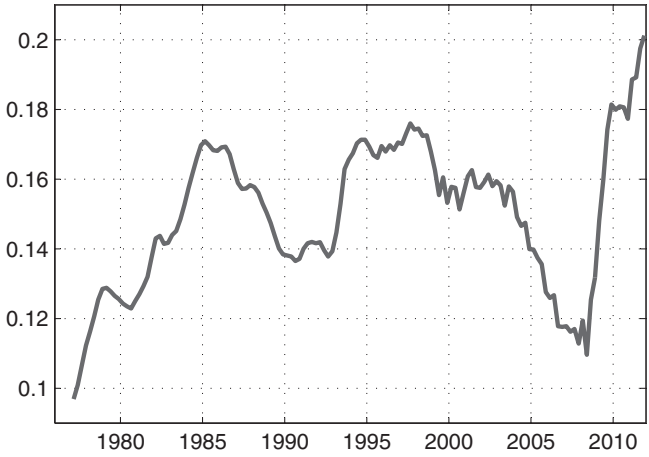


FIGURE 8. Feasibility wedge 1976:3–2011:2.

4.2. The Transition-to-Democracy Recession, 1976:3–1985:4

Throughout this section we refer to Figure 9. On the left-hand side of the figure we present observed output per capita, hours worked per capita, investment as a percentage of output, and the predictions of a model using *only one* of the four wedges. On the right-hand side, we present the observed series and the model predictions when one of the wedges is excluded.

As shown in the top set of graphs, the labor wedge plays a key role in the evolution of output and hours worked. Output per capita began to fall in the first half of 1978; the prediction of the model with a labor wedge follows the trend in the data, although the predicted output tends to overstate the observed decline. By 1985, observed output per capita is nearly 10% below trend, yet the model with a labor wedge predicts almost 25% below trend. When we feed the investment wedge into the model, output per capita stays in trend throughout the sample. The prediction of the model with a feasibility wedge sends output per capita in a opposite direction to that in the data, pointing to a small expansion (about 1% above trend) in the 1980s. Finally, the model with an efficiency wedge predicts a sizable expansion in output per capita: about 20% above trend by 1985.

Looking at the predictions of the model with all but one wedge, we can confirm that the labor wedge is the key element in the analysis. The model without a labor wedge predicts a large expansion in output per capita, about 15% above trend by 1985. The predictions of a model without an investment or a feasibility wedge follow the observed output per capita closely, and so do those of the model without an efficiency wedge (which, however, tends to overshoot the recession).

The middle set of graphs shows that a model with a labor wedge essentially accounts for all of the movements observed in hours worked per capita. Models with an efficiency or an investment wedge predict a reduction in hours, albeit the

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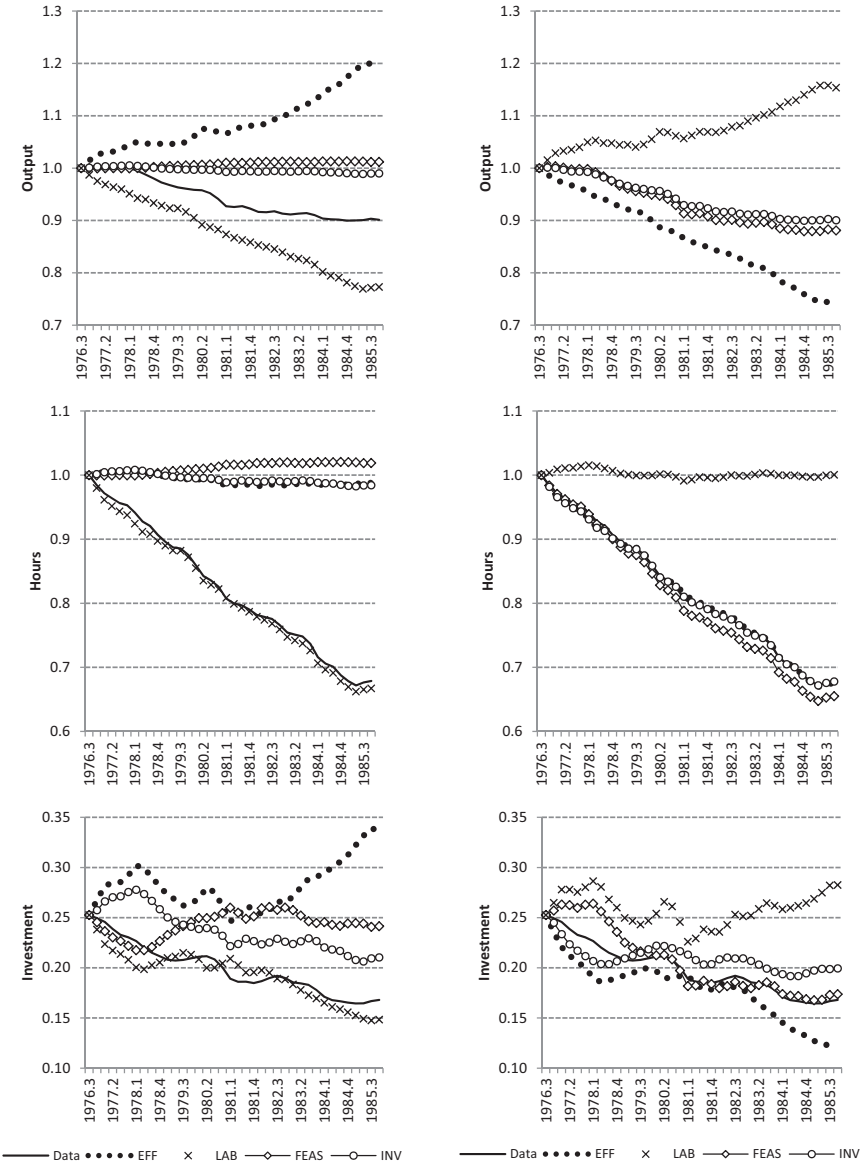


FIGURE 9. Data and model with (left graph) and without (right graph) one wedge, 1976:3–1985:4.

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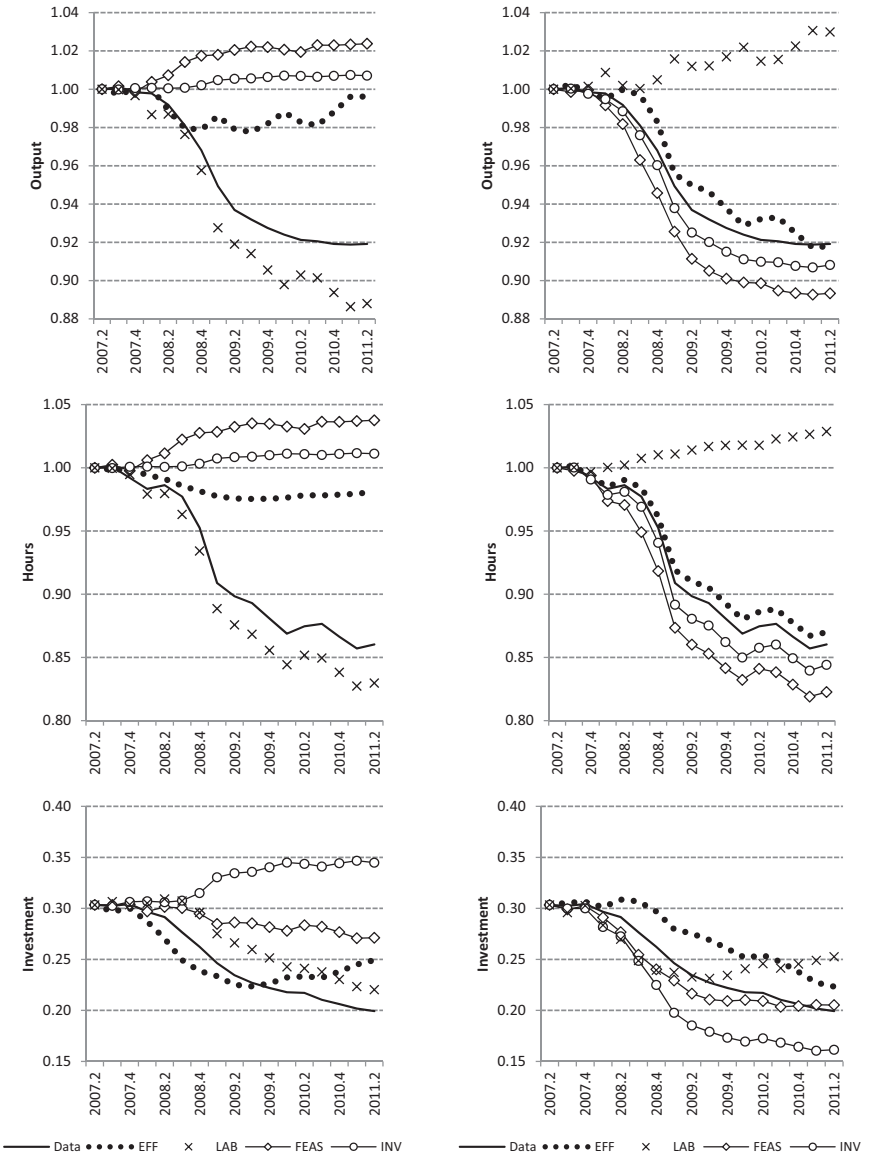


FIGURE 10. Data and model with (left graph) and without (right graph) one wedge, 2007:2–2011:2. Closed economy.

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fall is not of the right magnitude. A model with a feasibility wedge predicts a small increase in hours for all years in the sample.

Finally, the bottom set of graphs shows that no particular wedge plays a definitive role in the evolution of the investment-to-output ratio. When the model is fed with each of the wedges, the prediction in some periods overshoots (and in others underpredicts) the observed values. In looking at the predictions of the model without a feasibility wedge (right column in Figure 9), we can argue, however, that a model that considers the remaining wedges does a fairly good job of capturing the evolution of the series.

During the four decades of dictatorship, the government intervened heavily in the Spanish economy and a variety of firms were state-owned, many of them managed by the *Instituto Nacional de Industria* (INI).[7] The government guaranteed a wide degree of market power for the firms, in the form of either monopoly or monopsony. After 1981, the INI and the rest of the public industrial sector were dismantled through gradual privatization that ended in the second half of the 1990s, known as *la reconversión industrial*. The restructuring operation involved severe reforms to the management of key public industrial firms. Thousands of workers moved to other activities, largely in the service sector. Thus, the expansion predicted by the efficiency wedge in the mid-1980s points to the industrial restructuring. It seems reasonable to assume that the mobility of factors motivated by the restructuring implied efficiency gains that manifested by way of the efficiency wedge but failed to materialize as increases in output or hours worked.[8]

Table 5 summarizes several statistical properties of the accounting exercise for the first data set. Consider first the top panel in the table: the second column displays the standard deviation of the fluctuations in output that can be attributed to each wedge, relative to that of observed output. Fluctuations arising from the efficiency wedge are 69% of observed output and those directly attributable to the labor wedge add up to 98%. The value for the investment and feasibility wedges are considerably lower at 20%. Columns (3)–(7) show that all but the feasibility wedge fluctuations are positively correlated with output contemporaneously and at several (± 2) leads and lags. The prediction of the model with a labor wedge has a contemporaneous correlation of 79% with output (and similarly large values for leads and lags), far larger than the corresponding value for the other wedges.

The bottom panel in the table exhibits a rather general fact: the fluctuations generated by the wedges are negatively correlated between each other. Other than the positive correlation between the labor and the investment wedge, the remaining ones are either negative or close to zero.

4.3. The Great Recession, 2007:2–2011:2

Throughout this section we refer to Figure 10. We find that the labor wedge can account for the observed fluctuations in output, hours, and investment.

The predictions of a model using *only* the labor wedge can capture the direction of output per capita, hours, and investment fairly well. The model implies a deeper

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TABLE 5. Properties of the output components, 1976:3–1994:4

A. Summary statistics

		Cross correlations with y_t^d, $j =$				
Wedge $y(\omega_{a,t-j})$	$\sigma(y(\omega_a))/\sigma(y^d)$	−2	−1	0	1	2
Efficiency	0.69	0.23	0.30	0.27	0.17	0.08
Labor	0.98	0.63	0.73	0.79	0.77	0.67
Investment	0.20	0.33	0.33	0.29	0.30	0.29
Feasibility	0.20	−0.31	−0.35	−0.34	−0.41	−0.46

B. Cross correlations

		Cross correlations $(y(\omega_{a,t}), y(\omega_{b,t-j}))$, $j =$				
Variables $y(\omega_{a,t})$	$y(\omega_{b,t-j})$	−2	−1	0	1	2
Efficiency	Labor	0.02	−0.15	−0.35	−0.27	−0.13
Efficiency	Investment	−0.02	0.02	0.04	−0.01	−0.16
Efficiency	Feasibility	−0.26	−0.29	−0.27	−0.18	0.01
Labor	Investment	0.33	0.30	0.25	0.29	0.37
Labor	Feasibility	−0.31	−0.24	−0.18	−0.21	−0.28
Investment	Feasibility	−0.50	−0.75	−0.87	−0.81	−0.64

recession for output and hours, but a more moderate decline in investment. The labor wedge predicts no change in the investment ratio up to the end of 2008, when the model starts predicting a decline.

When only the efficiency wedge is considered, the model predicts a mild and rather brief recession: output and hours go only 2% below trend. For the investment rate, a model using only the efficiency wedge predicts a decline during the first stretch of the recession and an upward correction after 2009:3.

Figure 10 shows that a model with a feasibility wedge predicts output at 2% above trend rather than a recession, as well as a 4% boom for hours. As can be seen in the set of graphs on the right-hand side, a model with all wedges except the feasibility wedge can account for the observed movements with reasonable accuracy. Right after the great recession started, the Spanish government responded by using fiscal stimulus, whereas structural reforms or supply policies were postponed. The loss of monetary sovereignty has made fiscal policy the government's unique way of countering the recession: the public deficit exceeded 11% of GDP as of December 2009.

Finally, the investment wedge produces counterfactual predictions in the three variables.

Table 6 replicates Table 5 but does so for the second data set. The second column in the table's top panel shows that fluctuations attributable to labor are considerably more volatile (at 124%) than output itself, whereas those coming from the investment wedge represent a fairly small fraction of output variance. As was the case in Table 5, fluctuations generated by the labor wedge are highly

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TABLE 6. Properties of the output components, 1995:1–2011:2

A. Summary statistics

		Cross correlations with y_t^d, $j =$				
Wedge $y(\omega_{a,t-j})$	$\sigma(y(\omega_a))/\sigma(y^d)$	−2	−1	0	1	2
Efficiency	0.59	0.41	0.40	0.35	0.22	0.07
Labor	1.26	0.77	0.86	0.87	0.77	0.61
Investment	0.08	−0.67	−0.83	−0.90	−0.84	−0.70
Feasibility	0.30	−0.86	−0.83	−0.70	−0.50	−0.29

B. Cross correlations

		Cross correlations $(y(\omega_{a,t}), y(\omega_{b,t-j}))$, $j =$				
Variables $y(\omega_{a,t})$	$y(\omega_{b,t-j})$	−2	−1	0	1	2
Efficiency	Labor	0.27	0.11	−0.06	−0.04	0.00
Efficiency	Investment	−0.38	−0.19	0.00	−0.04	−0.08
Efficiency	Feasibility	−0.12	−0.26	−0.30	−0.17	0.01
Labor	Investment	−0.72	−0.88	−0.94	−0.77	−0.53
Labor	Feasibility	−0.46	−0.60	−0.76	−0.87	−0.91
Investment	Feasibility	0.29	0.43	0.57	0.77	0.88

correlated with output, both contemporaneously and through leads and lags. The same values when the efficiency wedge is considered are positive but smaller, whereas the values for the investment and feasibility wedges are negative and large. The bottom panel presents a picture similar to that in Table 5. Most of the cross correlations are negative except for the investment and feasibility wedge pair. Note that the efficiency and labor wedge pair is virtually orthogonal both contemporaneously and through leads and lags.

5. SIMULATIONS

In this section we adopt a more traditional approach, using previous findings. We simulate the model by taking the wedges that emerged as relevant in the BCA exercise, as though they were affected by exogenous fundamental stochastic processes. Section 2 showed that the standard RBC model fails to reproduce some key Spanish business cycle facts, namely, the negative correlations between wages and productivity and between output and productivity. The labor wedge was found to be the key factor in producing Spanish economic cycles.

For the U.S. economy, models governed by productivity shocks have been successful in accounting for a broad set of business cycle facts. In particular, the cyclical volatility of hours and output and the majority of the movements in hours worked can be associated to such shocks. This is not the case for Spain. A model that only considers an efficiency wedge predicts an upward trend in output during the first recession, 1977 to 1985, although it may have had some role in accounting for the output drop in the first quarters of the great recession. The

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TABLE 7. Autoregressions AR(1)

	Estimate	Std. error	95% conf. band
ρ_z	0.717***	0.0598	[0.599,0.836]
σ_z	0.0044***	3.47×10^{-5}	
ρ_ℓ	0.952***	0.0082	[0.935,0.968]
σ_ℓ	0.0164***	7.95×10^{-4}	

Note: Estimates are maximum likelihood.
*** Statistical significance at the 1% level.

remaining wedges (investment and feasibility) were not found to be quantitatively significant in accounting for the Spanish fluctuations.

The simulation exercise allows us to (i) gauge whether the prototype model can do a better job in reproducing the empirical regularities for Spain and (ii) compute how much of the simulated variances can accounted by the orthogonal shocks hitting the wedges.

Let us assume that the efficiency wedge and the labor wedge are governed by a stationary AR(1) process:

$$\begin{aligned} \omega_{jt} &= \rho_j \omega_{j,t-1} + \sigma_j \eta_{jt}, \\ \eta_{jt} &\sim \mathcal{N}(0,1), \end{aligned} \tag{16}$$

with $j = z, l$ and (importantly) $E(\eta_{zt}\, \eta_{lt}) = 0$. The two fundamental shocks (η_{zt}, η_{lt}) now have a structural interpretation. The AR framework renders wedges with mean values that are nil in the steady state, as we focus on fluctuations. For the efficiency wedge, we take the cyclical component of the Spanish TFP, using an HP filter. As long as the filter produces a nonlinear trend, we avoid the structural break that occurs in the productivity series in the mid-1990s (Figure 1). To calculate the labor wedge values, we use the static first-order condition (11) together with the utility function in (13). Both wedges have been demeaned before the estimation of (16).

The parameters involved in (16) have been estimated using OLS and are presented in Table 7. Both the persistency parameter and the variability are higher for the labor wedge, as compared to the efficiency wedge. The standard deviation of the shock to the labor wedge is four times larger than that of the efficiency wedge.

Additionally, the prototype model needs five more parameters that can be determined from the calibration of the Spanish economy: $\beta = 0.961$, $\psi = 117.3$, $\nu = 1/3$, $\delta = 0.042$, and $\theta = 0.364$. Section B in the Online Technical Appendix details the logic behind the calibration exercise. Using these parameters and the estimates in Table 7, we simulate the prototype model. The relevant simulated moments (standard deviations and correlations) are shown in Table 8, whereas Table 9 presents the decomposition of the simulated variances.

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TABLE 8. Simulated and observed correlations

	Simulated			
	Two shocks (η_z, η_ℓ)	One shock η_z	One shock η_ℓ	Observed
corr(Output, Consumption)	0.80	0.57	0.89	0.86
corr(Output, Investment)	0.91	0.96	0.90	0.89
corr(Output, Hours)	0.83	0.86	0.94	0.88
corr(Output, Wage)	0.88	0.99	0.98	0.02
corr(Output, Productivity)	0.29	0.99	−0.29	−0.54
corr(Output, TFP)	0.55	0.98	–	−0.11
corr(Productivity, Hours)	−0.28	0.79	−0.59	−0.87
corr(Productivity, Wage)	−0.17	1.00	−0.45	−0.19
corr(Productivity, TFP)	0.76	0.95	–	0.83

Note: We use a log-linearization of the prototype model given in Section 2, using the estimates of Table 7, and the values calibrated for the Spanish economy given in Online Technical Appendix B. The length of the simulation is 50,000. These correlations are based on logged series.

TABLE 9. Simulated and observed standard deviations and decomposition of simulated variances

	Simulated			
	Two shocks (η_z, η_ℓ)	One shock η_z	One shock η_ℓ	Observed
Output, Y	0.0141	0.0078	0.0117	0.0106
		(31.0%)	(69.0%)	
Consumption, C	0.0116	0.0040	0.0109	0.0131
		(11.6%)	(88.4%)	
Investment, X	0.0422	0.0302	0.0295	0.0462
		(51.2%)	(48.8%)	
Hours, H	0.0140	0.0016	0.0139	0.0185
		(1.3%)	(98.7%)	
Wage, W	0.0503	0.0065	0.0499	0.0078
		(1.7%)	(98.3%)	
Productivity, Y/H	0.0081	0.0065	0.0048	0.0104
		(64.7%)	(35.3%)	
Total factor productivity, A	0.0063	0.0063	—	0.0062
		(100.0%)	(00.0%)	
Labor wedge, ω_ℓ	0.0520	—	0.0520	0.0520
		(00.0%)	(100.0%)	

Note: Upper figures represent the simulated and observed standard deviations, and figures in parentheses represent the percentage of the simulated variance accounted by the shock.

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The first column in Table 8 shows the simulated moments when both shocks $(\eta_{z,t}, \eta_{\ell,t})$ are considered. The following two columns report the moments when the model is simulated with only one shock. In the last column we report the moments observed in Tables 3 and 4. The simulation with two shocks produces a good approximation for the variances of output and investment.

When we allow only the TFP shock to operate, the simulation results are consistent with those found in standard RBC models, namely smoother consumption and positive correlations between output and productivity and between productivity and the real wage. In absolute terms, the standard deviations are well below those reported in Tables 3 and 4.

When the labor wedge shock is the only one in operation, the correlation of productivity with the rest of the variables becomes negative. Movements in wages and hours are now caused by movements along the labor demand curve, which results in a high negative correlation between these two variables.

Table 9 shows that shocks to the labor wedge can help understand a sizable fraction of the simulated fluctuations. More than two-thirds of the output variance can be accounted for by shocks to the labor wedge, whereas the two shocks seem to have equal importance in explaining the investment variance. The simulated variances of hours worked and the real wage are almost fully accounted for by shocks to the labor wedge. Finally, the variance in productivity is still dominated by shocks to the TFP: the dynamic of productivity in Spain closely follows that of TFP (see Figure 1 and Table 4).

As expected, the model fails to reproduce the relative consumption volatility noted in Table 3, although it can produce a negative correlation between productivity and the real wage.

6. LABOR WEDGE AND INSTITUTIONS

In this section we explore whether the labor wedge can be linked to Spanish institutions. For this purpose we regress the change in the labor wedge on a variety of indicators that proxy institutional changes occurring in Spain since 1976. We include the following indicators in our analysis: temporary rate, employment protection, unemployment benefits, unionization and collective bargaining, tax rates, financial frictions, and a set of other unmeasured factors.[9]

The labor wedge LW_t is regressed on a set of indicators reported earlier, namely Allard's (2005a) employment protection index, the temporary rate; the OECD's collective bargaining centralization and coordination indexes; the labor union coverage rate; unemployment benefits; a measure of the tax wedge; and the financial reforms index of Abiad et al. (2008). For the unemployment benefits, we use alternatively those of OECD and Allard (2005b). All variables have been first-differenced. As long as the union coverage evolves alongside a quasi-linear trend, we include it in the regression alternatively with a constant, in order to avoid multicolinearity. Allard's (2005a) index of employment protection and the Abiad et al. (2008) index of financial reforms are log-transformed.

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The regression study is reported in Table 10. In the first three regressions [columns (i) to (iii)], we start by including the OECD's benefit replacement rates as a proxy for unemployment benefits. In column (i), we exclude the change in union coverage and include a constant, and in column (ii) we instead include the change in union coverage, but none of the coefficients seem to be altered significantly. We remove from the regression those variables with a p-value below 0.20, and reach the results in column (iii). We find that employment protection, unemployment benefits (OECD), and the tax wedge appear to be positively correlated with the labor wedge. The temporary rate is negatively correlated, although it is not very statistically significant.

In columns (iv) through (vii), we substitute Allard's (2005b) estimate of unemployment benefits for the OECD measure. Columns (iv) and (v) differ in the inclusion of a constant versus the change in union coverage, but the results do not hinge on it. The variables that appear significantly correlated to the wedge are: centralization of collective bargaining, unemployment benefits, and the tax wedge. These two last are highly significant. The temporary rate is weakly significant and negatively correlated with the labor wedge. We do not find employment protection as significant, as in the case of columns (i)–(iii), when the OECD estimate for unemployment benefits was used instead of that of Allard (2005b). Getting rid of the variables with a p-value below 0.20, we confirm that the tax wedge and unemployment benefits are highly correlated with the labor wedge, and to a lesser extent the centralization of collective bargaining.

The financial reforms index is negatively correlated with the labor wedge, although the coefficient is statistically nonsignificant. As the regressions are limited to 1976–2003, the regression analysis excludes the recent events occurring in the Spanish banking industry, characterized by intense credit expansion until 2007 and tight credit restrictions thereafter. The Abiad et al. (2008) index of financial reforms is likely an imperfect estimator of credit restrictions. In a recent paper, Bentolila et al. (2013) estimated the extent to which the 2008 credit collapse could have generated pronounced employment adjustments in Spain.

In summary, we find that the labor wedge seems to respond to the evolution of taxation and unemployment subsidies. To a lesser extent, the structure of collective bargaining and the employment protection of workers under permanent contracts are some factors that help explain the evolution of this wedge in Spain. The timing of events can be traced as follows: from 1976 to 1986 the increase in the tax wedge can be attributed to changes in labor income taxation, remaining relatively constant afterward. This argument is proposed by Conesa and Kehoe (2005) to explain the fall in hours worked for the period following the advent of democracy. The regression finds that the labor wedge is specially sensitive to tax increases. The VAT was increased in January 2010 and September 2012.

Second, unemployment benefits increased from 1976 to 1986, and in view of our indices, they stabilized afterward. Unemployment benefits, which usually produce a longer period of unemployment, have been found to be positively correlated with the labor wedge [see Tatsiramos (2009) and Carrasco and García (2012)].

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TABLE 10. The labor wedge increase ΔLW and institutions, 1976–2003

		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
Constant	Coefficient	0.005	—	—	0.005	—	—	—
	p-value	0.661	—	—	0.695	—	—	—
Δ employment protection [Allard (2005a)]	Coefficient	0.291	0.293	0.289*	0.015	0.019	—	—
	p-value	0.124	0.120	0.095	0.930	0.911	—	—
Δ temporary rate (INE and own calculations)	Coefficient	−1.265*	−1.284*	−0.645	−1.107	−1.128	−0.525	—
	p-value	0.104	0.100	0.176	0.169	0.162	0.308	—
Δ centralization of collective bargaining [Ochel (2000)]	Coefficient	0.121	0.121	—	0.244	0.242	0.178	0.214*
	p-value	0.373	0.372	—	0.132	0.133	0.168	0.088
Δ coordination of collective bargaining [Ochel (2000)]	Coefficient	−0.276	−0.271	—	−0.252	−0.247	—	—
	p-value	0.262	0.270	—	0.329	0.339	—	—
Δ labor union coverage [Ochel (2001)]	Coefficient	—	0.754	—	—	0.738	—	—
	p-value	—	0.596	—	—	0.623	—	—
Δ unemployment benefits (OECD)	Coefficient	2.048***	2.034***	1.880***	—	—	—	—
	p-value	0.006	0.006	0.005	—	—	—	—
Δ unemployment benefits [Allard (2005b)]	Coefficient	—	—	—	2.068**	2.051**	1.915**	1.844**
	p-value	—	—	—	0.016	0.017	0.013	0.015
Δ tax wedge [Boscá et al. (2008)]	Coefficient	1.763	1.722	2.557***	2.809**	2.757**	3.535***	3.578***
	p-value	0.136	0.146	0.001	0.027	0.030	0.000	0.000
Δ financial reform index [Abiad et al. (2008)]	Coefficient	−0.002	−0.003	—	−0.036	−0.037		—
	p-value	0.985	0.982	—	0.780	0.778		—
No. obs.		27	27	27	27	27	27	27
Prob > *F*		0.0151	0.0073	0.0004	0.0336	0.0163	0.0008	0.0004
R^2		0.5588	0.6203	0.5757	0.5106	0.5788	0.5464	0.5249

Note: All variables are first differenced. The unemployment protection index of Allard (2005a), and the financial reform index of Abiad et al. (2008) have been log-transformed. *F* is the *F*-Snedecor statistic of joint significance.
*, **, and *** Statistical significance at the 10%, 5%, and 1% levels, respectively.

Third, after the Moncloa Pacts in 1978, several policies were gradually introduced in order to strengthen employment protection, at the cost of creating a duality in the Spanish labor market. The labor reforms of 1984 and 1994 overprotected tenured contracts workers, whereas temporary workers ended up underprotected. As a result, the temporary rate is highly procyclical whereas the wage becomes countercyclical after 1995 (see Table 4). The negative correlation of the temporary rate with the labor wedge helps understand the labor wedge increases during the Great Recession.

Finally, in the mid-1980s, and parallel to the enhanced openness of the Spanish economy and labor reforms, the collective bargaining system was reduced from a highly centralized level to a sector level [Ochel (2000) and Flanagan (1999)]. Given the positive correlation between centralization and the labor wedge, this helped to reduce the labor wedge.

7. CONCLUSIONS

In this paper, we have characterized two Spanish recessions that have occurred since the inception of democracy, using the methodology proposed by Chari et al. (2007). In the logic of this methodology, we conclude that any model that tries to understand the causes of recessions occurring in the last three decades should focus on the labor wedge. The feasibility wedge (labeled as the government wedge in Chari et al.'s original work) has a minimal impact on output and hours per capita, as is the case with the investment wedge. The evolution of the efficiency wedge cannot only be regarded as a cyclical problem but must also be regarded as an issue dealing with the permanent component of productivity. These results are robust when we use an open economy version of the BCA methodology. Hence, the actual downturn in output and the large increase in the Spanish unemployment rate should be related to the domestic factors behind the labor wedge.

The prototype model has been calibrated for the Spanish economy and simulated under a shock to the TFP, in the vein of the RBC tradition, and a shock to the labor wedge, reflecting our previous findings from the BCA exercise. We find that the inclusion of a shock to the labor wedge helps to explain the observed negative correlations between wages and productivity, and between output and productivity. Standard RBC models cannot reproduce these cyclical regularities for Spain [Boldrin et al. (2010)].

Taxation, labor market rigidities, and credit constraints are natural candidates to account for movements in the labor wedge. When confronting our estimate of the labor wedge against a variety of indicators in a regression analysis, we find a high sensitivity with respect to taxes and unemployment benefits and, to a lesser degree, employment protection, and the degree of centralization in collective bargaining. All these institutions have been created and developed in Spain's recent history.

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NOTES

1. The BCA methodology has been successfully applied to other countries. See, for example, the papers by Ahearne et al. (2006) for Ireland, Kobayashi and Inaba (2006) for Japan, and Lama (2011) for a subset of South American countries.

2. The working paper version of this article contains a Technical Appendix with complementary information, available at http://ideas.repec.org/p/pab/wpaper/14.05.html. In Section C of that document we also perform a second robustness check: we extend the BCA methodology to consider an open economy specification following Lama (2011).

3. In this respect we follow Kehoe and Prescott (2007). A recent application of the growth accounting methodology to Spain (using annual-frequency observations) can be found in Boldrin et al. (2010).

4. The 1994 productivity downturn has been documented by several authors: See Mas and Quesada (2006) and Jimeno et al. (2007). In Section A of the Online Technical Appendix we incorporate our own analysis of structural breaks into the series of productivity using the tests of Andrews (1993) and Andrews and Ploberger (1994). We find support for three breaks: 1985:2, 1994:4, and 2006:3.

5. The fact that consumption is more volatile than GDP contradicts the life-cycle hypothesis; this feature of the Spanish consumption series was noted by Dolado et al. (1993) and Licandro and Puch (1997), and can be blamed on the fact that the measure of consumption combines nondurable goods and services with durable goods.

6. For example, the immigrant population in Spain increased from nearly 600 thousand in 1998 to 5.7 million in 2011, accounting for 1.5% and 12.2% of total population in these years.

7. Some examples are SEAT and ENASA (automobiles), Iberia (airlines), AESA and Bazán (civil and military shipyards), ENSIDESA (metallurgy), Santa Bárbara (weapons and explosives), and HUNOSA (coal mining). Other public non-INI firms were RTVE (broadcasting), CAMPSA (oil refinery and fuel distribution), RENFE (railroad transport), Tabacalera (tobacco), and Telefónica (telecommunications).

8. The firms affected by the industrial restructuring were severely hit by the oil price shocks of the 1970s and the privatization of public firms started during this period. In the oil refinery, broadcasting, and telecommunications sectors, liberalization preceded privatization. When considered together, all of these factors positively affected the levels of efficiency [see Nicoletti and Scarpetta (2003)].

9. See Section E of the Online Technical Appendix for a description of these indicators and their sources.

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