Vol. 3, 2009-4 | March 3, 2009 | http://www.economics-ejournal.org/economics/journalarticles/2009-4

Balassa-Samuelson and Wage, Price and Unemployment Dynamics in the Spanish Transition to EMU Membership

Katarina Juselius
University of Copenhagen, Denmark
Javier Ordóñez
Jaume I University, Spain

Abstract
This paper provides an empirical investigation of the wage, price and unemployment dynamics that have taken place in Spain during the last two decades. The aim of this paper is to shed light on the impact of the European economic integration on Spanish labour market and the convergence to a European level of prosperity. We found that the Balassa-Samuelson effect, product market competition, and capital liberalization have been the main driving forces in this period. The adjustment dynamics show that Spanish inflation has adjusted in the long run to the European purchasing power parity level (as measured by the German price level) corrected for the Balassa-Samuelson effect. In the medium run this long-run convergence was achieved by two types of Phillips curve mechanisms; one where the inflation/unemployment trade-off was triggered off for different levels of the interest rate and real wage costs, another one where the trade-off was a function of the real exchange rate and the interest rate. Excess wages and/or increasing cost levels in the tradable sector led to higher unemployment rather than higher prices. Thus, much of the burden of adjustment was carried by unemployment in this period.

Special issue "Using Econometrics for Assessing Economic Models"

JEL: C32, E24

Keywords: Balassa-Samuelson effect; nominal and real convergence; unemployment dynamics; purchasing power parity; cointegrated VAR

Correspondence
Katarina Juselius, e-mail: Katarina.Juselius@econ.ku.dk
Javier Ordóñez, e-mail: jmonfort@eco.uji.es

The authors gratefully acknowledge the financial help from the Instituto Valenciano de Investigaciones Económicas (IVIE) and the CICYT project SEJ2005-01163.

1 Introduction

Spain, being the largest of the "peripheral" countries that joined the European Union, has been successful in curbing inflation and promoting economic growth and employment. At the beginning of the sample period the Spanish standard of living was low compared to the EC countries, at the end it was more or less in line with the same countries. The question is whether there are useful lessons to be learnt from studying the historical changes in the macroeconomic mechanisms during this convergence period. Such knowledge may be used to better understand (and hopefully avoid) future problems for new member states.

Our sample begins in 1983:1, a few years after the EMS regime became effective with 11 member states adopting the ERM exchange rate arrangement. Spain did not become a member in the first round: the Spanish inflation rate was too high and the economy suffered from various structural imbalances. When our sample starts, the Spanish purchasing power parity (PPP) was at a much lower level than most of the more prosperous EC member states. When our sample ends in 2007:3, Spain has achieved a PPP level similar to the other European member states. Several interrelated factors can potentially explain this development.

First, the *Balassa-Samuelson effect* (Balassa, 1964, Samuelson, 1964) explains the empirical fact that the real exchange rates of less wealthy economies generally deviate substantially from the ones of the more wealthy economies. In short it says that a country's general price level is positively related to its level of per capita income. The rational for this is that productivity in the tradable sector tends to be higher in richer than in poorer countries, whereas productivity in the nontradable sector is more similar. The related *Baumol-Bowen effect* (Baumol and Bowen, 1966) predicts that the price wedge between non-tradables and tradables should be positively co-moving with productivity. We find that both effects have been significant in this period.

Second, in a globalized and competitive world, real wage increases in excess of productivity are likely to jeopardize *competitiveness* in exposed industries. When Spain joined the EU in 1989 most of her previous restrictions on trade with goods and capital were lifted and Spain became increasingly exposed to global competition. In such a competitive regime, pricing-to-market rather than mark-up-pricing is likely to characterize pricing behavior. Excessive real wage claims are likely to be compensated by improvements in labor productivity rather than by increases in product prices. We find strong empirical evidence for this hypothesis: labor productivity has been improved by producing the same output with less labor. The consequence has typically been an intermittently increasing unemployment.

Third, while the Balassa-Samuelson effect is likely to explain the tendency for the peseta to appreciate in the transition period, the *long swings in the Spanish real exchange rate* characterizing this period (see Figure 1 in Section 4) needs a different explanation. Frydman and Goldberg (2007) has shown that such persistent movements away from historical benchmark values are likely to be the outcome of speculative behavior in the foreign exchange market when expectations are based on *imperfect knowledge* (not knowing the right model, nor the most relevant explanatory variables). Furthermore, such persistent movements in the real exchange rate are likely to coincide with similar movements in the real long-term interest rate differential (Johansen *et al.*, 2008). We find that the persistent movements in the real exchange rates and the long-term real interest rate have had a significant effect on the Spanish wage and price setting.

To empirically study these issues, we have performed a detailed cointegrated VAR analysis of consumer and producer prices, wages, productivity, unemployment, interest rates and exchange rates. This allowed us to identify long-run tendencies in the data by means of cointegration and common stochastic trends, and to estimate the adjustment dynamics in the system. The challenge was to identify mechanisms in the wage and price setting process associated with the Balassa-Samuelson, Baumol-Bowen effects, the increased product market competition, and the effect of imperfect knowledge in the foreign exchange market and how wages and prices have adjusted to secure the path towards a European purchasing parity level.

The remainder of the paper is organized as follows: Section 2 discusses the more data-driven methodological approach of this paper and contrasts it with a more traditional 'theory comes first' approach, Section 3 provides the institutional background for this period, Section 4 provides an ocular analysis of the data and Section 5 introduces a number of hypothetical relations to be tested. Section 6 discusses the VAR approach and reports some econometric tests on the model's pulling and pushing (endogenous and exogenous) forces. Section 7 identifies long-run regularities in the data by means of a cointegration and common trends analysis and Section 8 discusses the short-run adjustment dynamics of wages, prices and unemployment that brought Spain to a European purchasing power parity level. Section 9 concludes.

2 "Theory First" versus "Data First": Two Approaches to Empirical Economics

One can broadly distinguish between two different approaches to empirical economics which, somewhat loosely, could be called 'theory comes first' versus 'data comes first'. The latter approach (used here) is basing its scientific foundation on strict statistical/econometric principles, choosing the data based on broad economic relationships (demand and supply functions, etc.), without constraining them in a pre-specified direction. The advantage of not imposing prior restrictions from the outset is that it allows us to *test* competing theory models against data rather than *assuming* that the chosen one is the true one. The 'theory comes first' approach is based on the assumption that the basic economic mechanisms can be pre-specified, i.e. that we know the exogenous variables, how interventions have affected the system, etc. Econometrics in this case plays the subordinate role of getting estimates of the economic parameters assumed to be empirically relevant from the outset.[1] Such an approach, however, runs the risk of producing empirically irrelevant and misleading results as demonstrated by Juselius and Franchi (2007), and many of the papers in this special issue, see for example Bjørnstad and Nymoen (2008), Juselius, M. (2008), Fanelli (2008).

[1] See also the discussions in Colander (2009) and Spanos (2009) in this issue.

Even though the 'theory comes first' approach is the preferred way of doing research in economics, there is a mounting evidence that it frequently fails to explain the empirical variation of our macro data. There seems to be a growing awareness that today's most pressing economic problems cannot be adequately addressed by further elaborating the economists' standard tool kit including representative agents and model based rational expectations (Colander *et al.* 2009, Kirman, 2009). The present financial crises is just one compelling example (Bouchaud, 2008, Lux and Westerhoff, 2009). The effect of globalization on domestic economic policy, how to organize international governance and regulation, the effect of capital deregulation on domestic economies, how to guide and assist under-developed countries, etc. are other examples where the 'theory-comes-first' approach does not seem able to provide us with useful advice (Stiglitz, 2003). This has evoked a new interest within the profession to start looking for new ways of understanding the empirical reality (Colander, 2006). Our suggestion in this context is simply to start by learning from the data in a systematic and structured way.

Many economists would argue that the quality of economic data is too low for a 'data-come-first' approach. We agree that economic time series data seldom correspond very closely to the theoretical concepts of a theory model (for example, prices, income, money, etc. in a theory model versus the multitude of different measurements CPI, PPI, PY, GDP, GNE, DI, M1 M2, M3, etc. that can be chosen in an empirical analysis). But even though macro data are contaminated with measurement errors, the latter may not be of great concern unless they are systematic and cumulate to nonstationarity. Another point is that the theoretically correct measurements are not observable and, hence, cannot be used by politicians and policy makers to react on. The forecasts, plans and expectations that agents base their decisions on are the observed data, however imperfect they are. Hence, in our view, we need to understand the mechanisms that have generated these data.

If one accepts this view and take macroeconomic data seriously, it often comes as a surprise how informative they are. The biggest hurdle in learning from these data is the (almost irresistible) urge to impose too many economic priors on the statistical model, in spite of them being against the information in the data. To start from the idea that we know what the empirical model should tell us and then insist that the reality behaves accordingly is a receipt for deep frustration, which too often have led researchers to 'torture' the data until they confess.

To argue that it would be possible to pre-specify how the Balassa-Samuelson mechanism and Spain's economic integration within EU should have affected the Spanish wage and price setting (knowing what is important and what is not, which variables are exogenous, which are endogenous) would no doubt be a little heroic. Therefore, instead of assuming that we can pre-specify *the* correct economic model based on which economic actors make decision, we might accept the obvious fact that they do not know the right model, nor the right variables to use for predicting future outcomes, that they may change their view on which model to use as they learn more.[2] In such a world, the best one can hope for is to characterize the data in

[2]Furthermore, if we add that agents, in view of their imperfect knowledge, are risk averse and myopic, then we will end up with a theoretical framework that has shown to be empirically relevant (even astonishingly so see Frydman and Goldberg, 2007, Johansen, Juselius, Frydman and

terms of interpretable empirical regularities on the ground of broadly defined theory models, using a methodology based on strict statistical principles.

When data are in the form of economic time-series the VectorAutoRegressive (VAR) approach seems an obvious platform from which to start searching for empirical regularities. This is because the unrestricted VAR is essentially a convenient reformulation of the information in the data (Hendry and Mizon, 1993, Juselius, 2006, Chapter 3). It provides a simple linear system that can characterize the probability distribution of a set of variables, hence allowing for likelihood-based inference. Of course the VAR is not *the* underlying data-generating process, but it often works as a good approximative description of a particular problem.

As most economic time-series are non-stationary, accounting for (near) unit roots in the model provides a powerful tool to robustify statistical and economic inference.[3] It should, however, be emphasized that the order of integration, in this view, is a useful empirical approximation (not a structural parameter) measuring the degree of persistent behavior in a variable or relation. Classifying data according to their persistency, allows us to combine stationary differences and cointegration between variables (see Juselius, 2008, for a detailed discussion) and, therefore, to analyze economic data as short-run variations around moving longer-run equilibria. Longer-run forces are themselves divided into the forces that move the equilibria (pushing forces, which give rise to stochastic trends) and forces that correct deviations from equilibrium (pulling forces, which give rise to cointegrating relations). For a detailed discussion, see Møller (2008). Structuring the data in this way offers a way of nesting a multivariate, path-dependent data-generating process and relevant dynamic macroeconomic theories. Unlike approaches in which the data are silenced by prior restrictions, this way of structuring the data offers a rich context in which the data can speak freely on empirically relevant mechanisms. In this sense, the Cointegrated VAR (CVAR) approach can be thought of as providing confidence bands (broadly defined) within which an empirically relevant theory model should fall. See Hoover *et al.* (2008) for a detailed discussion and Juselius (2006) for a practical applied macroeconometric methodology.

Thus, we believe the CVAR approach can provide both a critical framework and constructive insights. To some extent, the CVAR approach switches the role of theory and statistical analysis in the sense of rejecting the privileging of *a priori* economic theory over empirical evidence (Hoover *et al.* 2008). It is in this sense it is the 'data-come-first' methodology.

3 Four Stages in the Transition towards the EMU

Spain's commitment to move towards the European monetary union in 1986 initiated an adjustment process towards the European productivity level and, gradually, towards a European purchasing power parity level. Over this period, we were able

Goldberg, 2008, Juselius, M. 2008).

[3]For example, tests based on χ^2, F and $t-$distributions and the assumption of stationarity will go badly wrong when the data-generating process has a near unit root, unless we have a very long sample of, say, more than 5000 observations (Johansen, 2006).

to broadly identify four regimes[4] describing various aspects of the convergence towards the European level. As will be shown below, some of the regimes were very successful in terms of growth and prosperity, others less so. First, we shall briefly discuss the basic characteristics of the four regimes.

The first subperiod, 1983 - 1986, describes the last years of a long period of serious structural imbalances, characterized by slowdown in productivity growth, high unemployment rates, real wage growth in excess of productivity growth, and high inflation rates. The roots of these problems can be traced back to the oil crisis in the seventies which hit the Spanish economy very severely[5]. This shock increased product prices and decreased labour demand. Downward wage rigidities prevented the necessary real wage adjustment that could have restored the demand for labor. Strong bargaining power by labor unions resulted in wage claims which substantially exceeded productivity growth. The result was stagflation: high rates of inflation and unemployment[6] and modest real GDP growth rates were pervasive until the decision to join the EMS in 1986.

The second subperiod, 1987-1993, describes the early EMS period ending with the crisis in 1992. Intra-European trade was enhanced by the removal of trade barriers, by financial deregulation and by gradually fixing the exchange rates. In most of this period Spain experienced high real growth rates, declining unemployment rates, but also raising real wages and consumer prices, very much in accordance with the Balassa-Samuelson effect. In the first years, Spain adopted the broad bands of the Exchange Rate Mechanism (±6%) and from 1989 the narrow bands (±2.25%). Even though productivity continued to increase, there were signs of a slowdown at the end of the period, indicating that productivity had begun to catch up with the EU level. With high real interest rates, Spain experienced large inflows of foreign capital, and the consequent appreciation of the Spanish peseta eroded competitiveness in the export sector. At the same time, a steady increase of real wages in excess of productivity resulted in a serious loss of competitiveness. Because the membership in the ERM prevented competitive devaluations, the economy got stuck in external and internal imbalances that gradually became unsustainable. This was spotted by the financial market which launched a speculative attack on the Spanish peseta in September 1992 forcing Spain to leave the narrow bands of the ERM and to devalue the peseta.[7]

The third subperiod, 1993-1998, describes a restructuring and consolidation regime starting from the speculative attack in September 1992 and ending with the launch of the Euro in 1999. During the first years, the floating peseta brought the real exchange rate back to its pre-1987 level. The market labour reforms of 1994 and 1997 contributed to reduce labor union bargaining power. Excessive wage claims were avoided and competitiveness was restored. From 1996 onwards, almost

[4]These regimes have been defined based on strict statistical testing as explained in Section 5.1.

[5]In 1977 approximately 66% of the consumed energy was imported.

[6]From 1977 to 1985 Spain experienced a huge employment reduction (about two million jobs) which raised the unemployment rate to 21% of the labour force.

[7]The Spanish currency was first devaluated by 5% in September 1992 and further 6% and 8% in November 1992 and May 1993 respectively. The last devaluation took place in March 1995 by a 7%.

ten years after the EU membership, unemployment rates started to decline more permanently. In 1999, Spain finally joined EMU as a full member.

The fourth subperiod, 1999-2007, describes the more recent period of full EMU membership during which the Spanish economy seems to have done well: productivity has increased, inflation has remained at the EU level, real interest rates have came down and economic activity and employment have improved. However, after the sample ends, Spanish inflation has increased more than the one in the EU and Spanish unemployment rate has shown a tendency to start rising.

4 Historical Movements in the Data: Empirical Facts to be Explained

According to the Balassa-Samuelson effect, wage levels in the tradable sector influence wages in the nontradable sector, so nontradables tend to be more expensive in rich countries. When domestic wages increase as a result of productivity growth, foreign competition is likely to prevent price increases in the tradable sector, whereas not necessarily in the nontradable sector. This will generally make consumer prices increase more than producer prices. Therefore, positive co-movements between labor productivity and the price wedge (the difference between consumer and producer prices) is likely to reflect product market competition (Boeri *et al.,* 2001). This is illustrated in Figure 1, upper panel, where the price wedge and the productivity both have grown up to 2004 after which the price wedge is declining. Thus, the Balassa-Samuelson catching-up period might have ended around 2004. Figure 1, middle panel, shows that the Spanish peseta appreciated from approximately 1983 until the speculative attack in 1992, after which it gradually depreciated until, in 1995, it had returned to its 1983 level. Since 1995, Spain experienced her second period of appreciation which continued after the adoption of the euro in 1999. Thus, Spain might have lost some of its competitiveness to the Euro area in the recent period. Finally, Figure 1, lower panel, shows that the wage share $(w - p_y - q)$ increased steadily up to the speculative attack in 1993, and then stayed almost constant until 1999, after which it has started to decline illustrating the push for real wage restraints in the more recent period.

Figure 2, upper panel, shows that inflation rate has been steadily declining in this period. The lower part of the figure shows that the inflation rate has exhibited some moderate cyclical swings around a steadily declining trend. The long-term government bond rate, in the lower panel, has also been declining over this period, but compared to the inflation rate, less strongly so. Only after the decision to join the EMU, the interest rate came down to its present low European level.

Unemployment rate, in the middle panel, has exhibited long and persistent cycles. Standard theory models for wage and price setting with flexible prices and market clearing do not in general allow for involuntary unemployment in the long run. Allowing for search costs, imperfect knowledge, different kinds of menu costs, etc. unemployment can deviate in the short run from a constant rate, the natural rate of unemployment. Allowing the natural rate to deviate in the long run from a constant rate introduces the concept of structural unemployment, i.e. the long-run

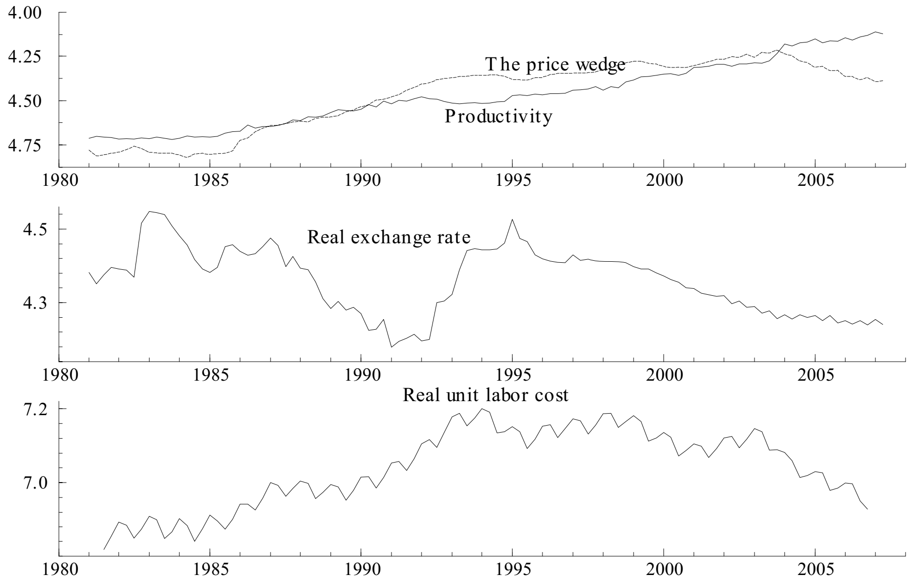

Figure 1: The development of the price wedge and the productivity (upper panel), the real exchange rate (middle panel), and unit labor cost (lower panel)

level of unemployment that is compatible with non-accelerating wages and prices. As the graph in Figure 2 illustrates, the pronounced persistence of the Spanish unemployment rate suggests (near)unit root non-stationarity rather than stationarity, so the constant natural rate hypothesis does not seem empirically tenable in this period. It is interesting to note that the Phillips curve seems empirically relevant in the period 1981-1986 showing low unemployment rates coinciding with high inflation rates and vice versa. However, after Spain decided to join the EU in 1986, the Phillips curve pattern becomes more diffuse. In 1986-1992 unemployment declined, real unit labor cost increased, the peseta appreciated. The resulting loss of competitiveness forced Spain to devalue its currency. In spite of the large devaluations in 1992, unemployment rose dramatically until 1994. The subsequent results suggest that this increase in unemployment was due to improvements of labor productivity in the Spanish industry (producing the same output with less labor) and that evidence of Phillips curve effects can only be found when allowing for a nonconstant natural rate.

5 Testable Hypotheses on Wage and Price Setting

In the subsequent empirical part, the idea is to identify long-run tendencies in the Spanish wage and price setting behavior by means of cointegration techniques. To be able to associate them with the Balassa-Samuelson effect, the increased product market competition, and the effect of imperfect knowledge expectations in the foreign exchange market, this section will discuss a number of hypothetical relationships that seem likely to be associated with these effects. Similar relationships have

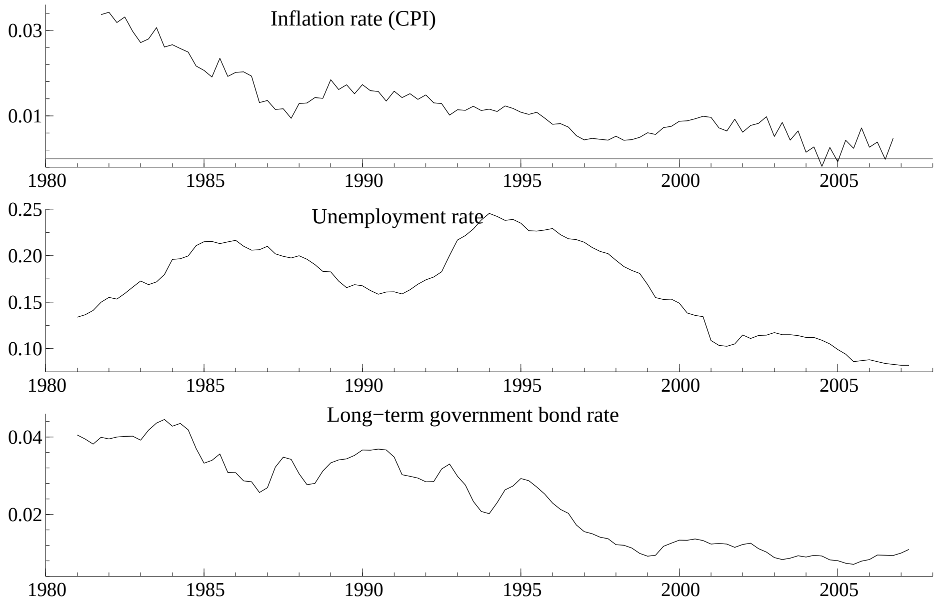

Figure 2: The graphs of quarterly inflation (upper panel), unemployment rate (middle panel), and government bond rate (lower panel)

been empirically significant for a number of other European countries (Juselius, 2006 Chapter 20-21).

5.1 Centralized Wage Bargaining and an Aggregate Wage Relation

In most of the investigated period Spanish wages have been set by centralized wage bargaining with the bargaining power of the unions strongly affected by the unemployment rate. A proposed pay rise by the labor union reflects generally a trade-off between a higher consumption wage against a lower employment as a result of an increase in the real product wage (Moene *et. al.*, 1993). Whether the pay rise is accepted or not by the employers' organizations can be seen as a trade-off between future profits and firm competitiveness against the increased risk of a union strike. In this vein, wage formation can be seen as a struggle over the mark-ups, where expectations of future outcomes of key variables play a significant role. Under this assumption, unions strive to maximize their share of the productivity increase with productivity defined as output per employment, $c_t = y_t - l_t$.[8] The employers' unions attempt to maximize the mark-up on unit labor costs, defined here as $-(w_t - p_{y,t} - c_t)$, accounting for the expected effect of the real product wage increase on its competitiveness. Hypothetically, the mark-up is assumed to be a function of the expected real exchange rate, $q_t^e = (s - p^f - p_y)_t^e$, where s is the nominal exchange rate, p^f is

[8] In this section all variables, except interest rates, are expressed in logarithms.

the foreign price level, of expected inflation, Δp_t^e, and expected real interests, $R_t^{r^e}$, i.e:

$$(w_t - p_{y,t} - c_t) = f(q_t^e, R_t^{r^e}, \Delta p_t^e) + v_{1,t} \tag{1}$$

where $f_{q^e} > 0$ implies a lower mark-up as a result of a real appreciation (see Phelps, 1994), $f_{R^{r^e}} > 0$ implies a lower mark-up as a result of a rise in the expected real interest rate, and $f_{\Delta p^e} > 0$ indicates a negative effect on the markup from expected inflation (see Banerjee and Russel, 2005).

The labor unions attempt to maximize the purchasing power for their members by increasing the real consumer wage, $(w_t - p_{c,t})$ conditional on the level of productivity, c_t, and accounting for the expected effect on the unemployment rate, U_t^e, and expected inflation rate, i.e.:

$$(w_t - p_{c,t} - c_t) = g(U_t^e, \Delta p_t^e,) + v_{2,t} \tag{2}$$

where $g_{U^e} < 0$, and $g_{\Delta p^e} > 0$. If expectations do not deviate from actual observations, as for example under rational expectations, $X_t^e - X_t$ would be a stationary error and the cointegration properties would be invariant to actual rather than the (unobservable) expected values.

5.2 The Price Wedge, Productivity and Unemployment

The price wedge $(p_{c,t} - p_{y,t})$ has often been found highly relevant in empirical wage relations and deserves some discussion. First, subtracting (1) from (2) gives an expression for the relationship between the price wedge and the main determinants of the negotiated wage:

$$p_{c,t} - p_{y,t} = a_1 + a_2 \Delta p_{ct} + a_3 U_t + a_4 R_t^r + a_5 q_t + v_{3,t} \tag{3}$$

However, the price wedge is also likely to be affected by different bargaining structures. This is because they imply different terms of trade between a rise in the real consumption wage and the real product wage (Moene *et al.*, 1993). For example, if wages increase in one employment sector, but not in the others, then *under constant mark-up pricing* output price will increase but the impact on the consumer price will be smaller. Second, the extent of *product market competition* is likely to be even more important for the price wedge. If an industry is exposed to a high degree of foreign competition, product prices cannot be raised by much even though the domestic wages rise. In this case we would expect *pricing-to-market* to characterize pricing behavior. Since prices on non-tradables are more likely to increase after a wage rise, the price wedge is, however, likely to increase. Third, because the consumption basket also contain imported goods and services, the prices of these will also influence the consumer prices so that a nationwide wage rise can increase real consumption wage more than the real product wage if import prices remain unchanged or decrease (Boeri *et al.*, 2001).

The above shows that the price wedge can be associated with a variety of different economic mechanisms. From an econometric point of view, the stationarity of $v_{3,t}$ implies several possible cointegration specifications. For example, (3) might consist of two irreducible cointegrating relations, one between $(p_{y,t} - p_{c,t})$, R_t^r and q_t and the other between U_t and Δp_t. In this case, the five variables would share three common stochastic trends. If there are fewer common stochastic trends then there would be correspondingly more cointegration. Of particular interest here is whether U_t and $\Delta p_{c,t}$ are cointegrated as a Phillips curve relation with a constant NAIRU[9]:

$$\Delta p_{ct} = a_6 + a_7 U_t + v_{4,t} \tag{4}$$

where $a_7 \leq 0$ and $v_{4,t} \sim I(0)$. If, on the other hand $v_{4,t} \sim I(1)$ in (4) we need to combine it with some of the other variables in (3), for example the interest rate as suggested in Phelps (1994):

$$\Delta p_{ct} = a_8 + a_9 U_t + a_{10} R_t + v_{5,t} \tag{5}$$

where $a_9 \leq 0$, $a_{10} \geq 0$ and $v_{5,t} \sim I(0)$. In this case the NAIRU would be a function of the firm's cost of capital.

5.3 Labor Productivity and Unemployment

With the deregulation of capital movements and the adoption of the narrow bands of the EMS in 1989, Spain became more integrated in the EU market, which implied a strong pressure on the Spanish industry to be competitive. In particular, the high real wage increases in the period 1986-1992 aggravated competition for enterprises, the output prices of which often were on (or above) the competitive foreign trade level. Thus, the industry had the possibility to (1) reduce employment until the marginal cost equalled the competitive price, (2) increase labor productivity, or (3) close down the industry (Boeri *et al.* 2001). The subsequent empirical analysis suggests that the first two options were highly relevant in this period.

In view of option (2), we need to distinguish between a rise in labor productivity due to technological progress and to elimination of previous slack in the work process. The latter includes measures such as increasing the work pace, eliminating coffee breaks, and generally making employees run faster. Such an increase in productivity implies that the same output can be produced with less labour and, therefore, could be accompanied by layoffs and/or no new hires.

To distinguish between the two possibilities, we will approximate the long-term technology growth with a linear trend, and the productivity increase due to elimination of slack with trend-adjusted productivity. Recalling that $c_t = y_t - l_t$, we note that productivity can increase both as a result of an increase in aggregate output

[9] While the Phillips curve is defined here to be a relation between nonstationary variables, it should not necessarily be interpreted as a long-run Phillips curve in the economic sense.

with constant employment and a decrease in employment with constant GDP. If $(c_t - b_1 t)$ is empirically $I(1)$ and cointegrates with unemployment (similarly as in Juselius, 2006, Chapter 20) it will be interpreted as evidence that improvements in labor productivity have been achieved by layoffs and/or reduced hires. In this case, output prices are not likely to increase as much as wages, so real consumer wages will increase more than real product wages corrected for productivity and $(p_{c,t} - p_{y,t})$ will increase.

The above ideas can be formulated as the hypothesis that unemployment is co-moving with trend-adjusted productivity and the consumer-output price wedge, i.e.:

$$U_t = a_{11} + a_{12}(c_t - b_1 t) + a_{13}(p_{c,t} - p_{y,t}) + v_{6,t}, \quad (6)$$

where $a_{12} \geq 0$, $a_{13} \geq 0$ and $v_{6,t} \sim I(0)$.

Thus, if the above hypotheses are correct we would expect labor productivity, rather than the real product wage, to be adjusting to (6). Naturally, this kind of improvement in productivity seems only possible up to the point where there is no slack left to eliminate and where increased work pressure becomes counterproductive. In such a situation we would expect outsourcing, rather than labor productivity improvement, to be the consequence of a wage increase in excess of productivity.

5.4 Structural Inflation Adjustment

Most economic theories assume long-run price homogeneity. When nominal variables are approximately I(1) this would generally imply that relative prices and inflation rates are I(0). When inflation rates are empirically $I(1)$ (as in our case), prices are $I(2)$. Under long-run price homogeneity, relative prices are generally I(1) and we would expect cointegration between the latter and the inflation rate (Juselius, 2006, Chapters 16-18). This follows directly from the logic of the econometric model but can also be given an economic interpretation. If relative prices exhibit I(1) behavior it points to some structural imbalance in that sector. For example, if domestic prices deviate persistently from foreign prices (in the same currency), one would expect a disproportional change in either of the two inflation rates to restore balance. A proportional change would not be sufficient as this would be an I(0) process and hence could not offset the imbalance in the price differential, being I(1). Therefore, when inflation rate is I(1), one can use cointegration techniques to find out where in the system the adjustment primarily takes place. See for example Juselius (1994), Ericsson *et al.* (2001), Pesaran *et al.* (2002).

In the present application, inflation rate could potentially be cointegrated with the domestic price wedge, the foreign price wedge and/or real wages in excess of productivity.

$$\Delta p_{ct} = a_{14} + a_{15}(p_c - p_y)_{t-1} + a_{16}(p_c - p^f - s)_{t-1} + a_{17}(w - p_c - c)_{t-1} + v_{7,t} \quad (7)$$

where $(p_c - p^f - s) = -q_t$, $v_{7,t} \sim I(0)$ and $a_{15} \leq 0$, $a_{16} \leq 0$, $a_{17} \geq 0$ implies equilibrium correction of inflation rate. The magnitude and significance of the coefficients signals which part of the system has been most important for the long-run inflation path.

However, in the Spanish case, inflation is likely to be strongly influenced by the Balassa-Samuelson effect predicting that the internal price wedge will be increasing at the same time as the real exchange rate is decreasing (appreciating). Thus, in the transition period we would expect equilibrium correction to take place when $(p_c - p_y)$ increases more than $(p_c - p^f - s)$, or the other way around. The hypothesis of a Balassa-Samuelson corrected relative price can be expressed as $a_{15} = -a_{16}$.

6 Empirical Model Analysis[10]

The purpose of the empirical analysis is to extract as much information as possible from the data at the background of the broadly defined theoretical relations discussed in the previous section. In accordance with the chosen econometric methodology, we will interpret the results in terms of the dynamics of the pulling and pushing forces and how these are related to the institutional changes over this period.

6.1 Defining the Baseline Models

The quarterly data used in this analysis are defined by:

$$x_t' = [\omega_t^r, c_t, u_t, \Delta p_t, pp_t, q_t, R_t^l] \quad \text{t = 1983:3 to 2007:3}$$

where ω_t^r is the log of real wage measured as the hourly wage in manufacturing deflated by the consumer price index; c_t is the log of labour productivity, calculated as real GDP per total employment; u_t is the unemployment rate; Δp_t is the first difference of the log of the consumer price index and measures inflation; pp_t is the price wedge and corresponds to the difference between consumer price index and producer price index, both expressed in logs; q_t stands for the log of the real exchange rate of the Spanish peseta relative to the German mark and is expressed in units of the national currency per foreign currency; finally, R_t^l is the ten year government bond yield. The long-term interest rate is divided by 400 to make the estimated coefficients comparable with logarithmic quarterly changes.

The baseline VAR is specified with two lags, a linear trend restricted to the cointegration relations and a number of dummies to be explained below:

$$\Delta x_t = \Gamma \Delta x_{t-1} + \alpha\beta' x_{t-1} + \alpha\beta_1 t + \alpha\delta_0 Ds_t + \Phi_1 Dp_t + \Phi_2 Dq_t + \Phi_{21} Dq02_t + \mu_0 + \varepsilon_t \quad (8)$$

where α is $p \times r$ adjustment coefficients, $\beta' x_t$ is r cointegration relations, β_1 is an $r \times 1$ vector of trend coefficients, $\mu_0 = \alpha\beta_0 + \alpha_\perp \gamma_0$ is a $p \times 1$ vector of constant terms, with β_0 an intercept in the cointegration relations. γ_0 measures the slope of linear trends

[10] All calculations in the cointegrated VAR model have been performed with the software program CATS in RATS (Dennis *et al.*, 2005).

in the data, and δ_0 the mean shifts in $\beta' x_t$[11] given by $Ds_t = [DS861_t,\ DS923_t,\ DS991_t]$, where $DSxxy_t = 1$ for $t \geq 19xx$:y, otherwise 0. In addition, there are five permanent impulse dummies $Dp_t = [Dp861_t, Dp923_t, Dp991_t, Dp951_t, Dp011_t]$, where $DPxxy$ is 1 in $199xx$:y, 0 otherwise, Dq_t contains seasonal dummies and $Dq02_t$ is a set of seasonal dummies starting from 2002:1. The latter is needed because of a redefinition of CPI prices in 2002:1.[12]

Based on a first VAR model, the following dates 1986:1, 1992:3, 1995:1, 1999:1, 2001:1 were classified as outliers based on the criteria $|\varepsilon_t/\sigma_e| > 3.5$. They correspond to the following events: 1986:1, Spain made the decision to join the EU; 1992:3, the speculative attack on the peseta forced Spain to devalue its currency; 1995:1, the Spanish central bank changed its policy from from monetary to inflation targeting; 1999:1, the beginning of the EMU; 2001:1, a reduction of the official unemployment by around 2.5% due to change in the employment survey.

The dummy specification in the cointegrated CVAR is complicated by the fact that an impulse shock in Δx_t corresponds to a level shift in x_t. This means that a large shock in the mean of the equations, $E(\Delta x_t) = \phi_p D_{p,xxy}$, generally corresponds to a mean shift in the equilibrium relations, $E(\beta' x_t) = \phi_s D_{s,xxy}$, unless the level shift has canceled by cointegration (Juselius (2006, Chapter 6). Whether the latter is the case or not is a testable hypothesis. Of the five outliers, only the 1986:1, 1992:3, and 1999:1 outliers were found to have significantly caused a mean shift in the equilibrium relations. They enter the VAR model as step dummies restricted to be in the cointegration relations and as impulse dummies in the equations together with the 1995:1 and 2001:1 impulse dummies.

The common trends representation of (8) is given by:

$$x_t = C \sum_{i=1}^{t} (\varepsilon_i + \mu_0 + \Phi_1 Dp_i) + C^*(L)(\varepsilon_t + \mu_0 + \mu_1 t) + \tilde{X}_0 \tag{9}$$

where

$$C = \beta_\perp (\alpha'_\perp \Gamma \beta_\perp)^{-1} \alpha'_\perp = \tilde{\beta}_\perp \alpha'_\perp \tag{10}$$

and $\alpha_\perp, \beta_\perp$ are the $p \times p - r$ orthogonal complements of α, β, describing the common stochastic trends, $\alpha'_\perp \sum_{i=1}^{t} \varepsilon_i$, and their loadings, $\tilde{\beta}_\perp$.

The baseline models have been carefully checked for signs of mis-specification using a variety of diagnostic tests and seem to describe the data reasonably well. No serious deviations from the basic assumptions of residual independence, heteroscedasticity, and normality were detected. Nonetheless, complete parameter constancy is

[11] See Juselius 2006, Chapter 6, for a discussion of deterministic components in the cointegrated VAR model.

[12] Note that, contrary to the static regression model, the dummies do not eliminate the corresponding observation. They only account for the unanticipated shock at the time it occurred, essentially saying that an event outside the chosen information set had caused the shock. Next period it is no longer unanticipated and the dynamics of the model should be able explain its lagged effect on the system.

hard to guarantee in a period of such significant changes in the macroeconomy. In this sense, the estimates should be interpreted as average effects over the period in question.

6.2 Determining Cointegration Rank

A VAR analysis based on seven variables is quite demanding and the idea here is to expand the information set gradually (see for example Juselius and MacDonald, 2007, and Juselius, 2006, Chapter 19). We begin with Model 1, containing the most important domestic variables, $w-p_c, c, U, \Delta p, p_c-p_y$, and then add the real exchange rate, Model 2, and the long-term interest rate, Model 3. This makes it possible to investigate the impact of Balassa-Samuelson and capital deregulation on the pulling and pushing forces of the Spanish wage and price setting behavior. We illustrate the idea below.

Assume (as we subsequently find) that the cointegration rank is three in Model 1, and hence, the number of common trends is two. Adding the real exchange rate implies two possibilities for Model 2:

1. $r = 4$, $p - r = 2$. There is one new cointegration relation and the number of common stochastic trends is unchanged. Thus, the impact of a real exchange rate shock has been fully transmitted to the domestic variables.

2. $r = 3$, $p - r = 3$. There is no new cointegration relation. The real exchange rate contains a stochastic trend not shared by the domestic variables, so the new variable is long-run excludable in Model 2.

Adding both the real exchange rate and the bond rate to the domestic variables in Model 1 implies the following three possibilities for Model 3:

1. $r = 5$, $p - r = 2$. There are two new cointegration relations and no additional common stochastic trend. For example, one of the new cointegration relations could be between the two new variables, another one between any of the new variables and the domestic variables.

2. $r = 4$, $p - r = 3$. There is one new cointegration relation and one new common stochastic trend. The new cointegration relation could either be a relation between real exchange rate and the long-term rate, or a relation between the two new variables and some of the five domestic variables. There is the possibility that one of the new variables are long-run excludable in Model 3.

3. $r = 3$, $p - r = 4$. The rank is unchanged and the number of autonomous stochastic trends have increased with two. This would imply that the two new variables are neither cointegrated between themselves nor with the five domestic variables. Hence, the two new variables would be long-run excludable as they would not not add any significant long-run information compared to Model 1.

Table 1: Determination of rank in the three models

$p-r$	7	6	5	4	3	**2**	1	0
Eigenvalues λ_i								
M1			0.55	0.46	0.33	**0.22**	**0.05**	
M2		0.59	0.48	0.38	0.25	**0.22**	**0.04**	
M3	0.67	0.48	0.42	0.33	0.28	**0.18**	**0.06**	
The largest unrestricted characteristic root $\rho_{\max} \mid p-r$								
M1			0.62	0.65	0.81	**0.80**	0.84	0.94
M2		0.62	0.63	0.82	0.83	**0.83**	0.84	0.95
M3	0.63	0.65	0.68	0.82	0.81	**0.81**	0.83	0.95
The largest absolute $t-$value, $t_{\max}$, of α_r								
M1				6.7	6.3	**4.9**	3.0	2.0
M2			7.9	7.8	5.0	**3.9**	3.8	1.2
M3		8.8	7.5	6.2	5.4	**2.9**	3.8	2.2

Thus, the determination of cointegration rank in the gradually extended systems contains useful information about the common stochastic trends that have generated the new variables and how the former are associated with the previously found stochastic trends.

Table 1 reports the results for the three models. The choice of rank is based on three different criteria: the eigenvalues of the trace test, λ_i, $i = 1, ..., p$, the largest unrestricted characteristic root for $r = 0, 1, ..., p$, and the largest t value of α_i, $i = 1, ..., p$.[13] The estimated eigenvalues, λ_i, in the upper part of the table (measuring the squared canonical correlations between the stationary part of the process and $\beta_i' x_t$) show that in all models the smallest λ is very close to zero and that the next one is around 0.20, whereas the remaining ones are relatively large. This corresponds closely to the information in the middle part showing that in all models the largest unrestricted characteristic root for $p - r = 0$ is around 0.95, i.e. very close to the unit circle, whereas the next one is approximately 0.84. We interpret this to mean that we have one stochastic trend which is very close to a unit root trend, and another which is highly persistent but probably not a 'true' unit root process. This could, for example, describe the long and persistent cyclical movements typical of real exchange rates. (See Johansen *et al.* 2008).

For the choice of $p - r = 2$, the largest unrestricted root is 0.81. The last part of the table shows that for $p - r = 2$, there would be at least one significant α coefficient of the last cointegrating relation, insuring against including a completely irrelevant cointegration relation in our model. Based on this, we consider the choice of two common stochastic trends to be an appropriate choice for all three models. The interpretation is that the five domestic variables and the two new variables are fully integrated with each other, so that we can expect the domestic variables to be cointegrated with the two new variables.

[13] The statistics in Table 1 are organized according to the hypothetical number of unit roots in the model as these are invariant to the dimension of the system, whereas the cointegration rank is not. For example, two common stochastic trends in the system corresponds to $r = 3$ in Model 1, $r = 4$ in Model 2 and $r = 5$ in Model 3.

6.3 Classifying Variables as Pulling and Pushing

Rather than assuming from the outset which variables are endogenous and which are exogenous, we use two tests formulated as hypotheses on α, to find out whether such assumptions are empirically firmly grounded. While all variables are modeled in the VAR, some may be purely adjusting (the pulling variables) and would potentially correspond to economically endogenous variables. Others may be weakly exogenous (the pushing variables) and would potentially correspond to economically exogenous variables. The long-run weak exogeneity of a variable is formulated as *a zero row in* α, whereas endogeneity of a variable (pure adjustment) is formulated as *a unit vector in* α. See for example Juselius, 2006, Chapter 11. Testing these hypotheses are of particular interest as neither of them are invariant to changes in the information set. For example, we may ask whether the new variable is weakly exogenous or purely adjusting. Has the previous classification into endogenous and weakly exogenous variables changed by adding the new varables variables?

To answer these questions Table 2 report the outcome of the two tests when gradually expanding the VAR system. An additional advantage in this context is that the robustness of the conclusions from the domestic model regarding the theoretical '*ceteris paribus*' clause can be empirically assessed in a systematic way. As the tests depend crucially on a correct choice of rank, the test statistics in Table 2 are based on $r = 3$ in Model 1, $r = 4$ in Model 2, and $r = 5$ in Model 3, all of them consistent with two common stochastic trends.

According to Table 2, none of the variables can be considered weakly exogenous, but some of the variables are borderline so. Productivity is borderline exogenous in all models: the test statistic for productivity does not change when adding the two new varables. The internal price wedge is almost weakly exogenous in Model 1, but not in Model 2 in which it is replaced with the real exchange rate and in Model 3 where the long-term interest rate has replaced the real exchange rate as an 'almost' weakly exogenous variable.

Thus, cumulated shocks to productivity seem to be one of the common driving forces in this period. Cumulated shocks to the internal price wedge is the other driving force in the small model, but is replaced by the real exchange rate in Model 2, and finally by the long-term interest in Model 3. The interpretation is that the permanent shocks to the price wedge are similar to the real exchange rates shocks and that both have originated from shocks to the long-term interest rate.

The second part of Table 2 shows that real consumer wages and inflation have been purely adjusting in all three models. The price wedge can be borderline accepted as purely adjusting in Model 2 and Model 3, suggesting that it has essentially adjusted to the real exchange rate and the long-term interest rate[14]. The finding that productivity remained weakly exogenous and that real wages and inflation remained purely adjusting when adding the new variables is useful as it tells us that the exogeneity/endogeneity status of these variables are robust to the *ceteris paribus* clause.

[14] The result that q and R^l also seem to be almost purely adjusting may seem more puzzling. As explained in Juselius (2006, p.202), such a result can easily arise in a situation when the variable in question only adjusts to one β relation, and not very significantly so.

Table 2: Testing a zero row and a unit root in α

	$w - p_c$	c	U	Δp	$p_c - p_y$	q	R_b
Testing a zero row in α (weak exogeneity)							
M1 ($r = 3, p - r = 2$)							
$\chi^2(3)$	23.33	**9.24**	38.98	41.88	**8.92**	–	–
[*pval*]	[0.00]	[0.03]	[0.00]	[0.00]	[0.03]		
M2 ($r = 4, p - r = 2$)							
$\chi^2(4)$	24.77	**9.25**	39.34	41.25	18.37	**9.92**	–
[*pval*]	[0.00]	[0.06]	[0.00]	[0.00]	[0.00]	[0.04]	
M3 ($r = 5, p - r = 2$)							
$\chi^2(5)$	39.14	**10.60**	52.70	54.57	26.16	17.58	**11.40**
[*pval*]	[0.00]	[0.06]	[0.00]	[0.00]	[0.00]	[0.00]	[0.04]
Testing a unit vector in α (pure adjustment)							
M1 ($r = 3, p - r = 2$)							
$\chi^2(2)$	**4.46**	26.39	10.35	**5.83**	14.85	–	–
[*pval*]	[0.11]	[0.00]	[0.01]	[0.05]	[0.00]		
M2 ($r = 4, p - r = 2$)							
$\chi^2(2)$	**1.37**	17.29	**3.30**	**3.35**	5.24	**3.68**	–
[*pval*]	[0.50]	[0.00]	[0.19]	[0.19]	[0.07]	[0.16]	
M3 ($r = 5, p - r = 2$)							
$\chi^2(2)$	**1.16**	21.81	5.74	**3.70**	4.66	**2.78**	5.18
[*pval*]	[0.56]	[0.00]	[0.06]	[0.16]	[0.10]	[0.25]	[0.07]

Finally, the joint test of a unit vector in α in Model 3 of real wages, inflation rate, the price wedge and the real exchange rate was accepted based on $\chi^2(8) = 9.66[0.29]$. This finding will be used in the next section to identify the common stochastic trends.

7 Identifying Long-Run Regularities in the Spanish Transition Period

In this section we identify the main driving forces in this transition period and study the long-run impact of shocks on the system. Furthermore, we report an overidentified structure of long-run relations and discuss its plausibilty recognizing that it is not unique given that many structures can replicate the same long-run information given by the Π matrix.

7.1 The Pushing Forces

According to the tests in Table 2, productivity and the long-term bond rate were almost weakly exogenous, whereas real wages, inflation, the price wedge, and real exchange rate were purely adjusting ("endogenous" in this system). Consequently, the two common stochastic trends are linear combinations of cumulated shocks to productivity, unemployment, and the interest rate. The results reported in Table 3 are derived under the "joint unit vector in α" restriction of real wages, inflation rate, the price wedge and the real exchange rate, explaining the zero columns of the shocks to these variables in the C matrix.

Table 3: The estimated driving forces

	$\hat{\varepsilon}_{w^r}$	$\hat{\varepsilon}_c$	$\hat{\varepsilon}_u$	$\hat{\varepsilon}_{\Delta p}$	$\hat{\varepsilon}_{pp}$	$\hat{\varepsilon}_q$	$\hat{\varepsilon}_{R_b}$	*trend*
$\hat{\alpha}'_{\perp.1}$	0.00	−0.07	0.06	0.00	0.00	0.00	**1.00**	
$\hat{\alpha}'_{\perp.2}$	0.00	**0.93**	**1.00**	0.00	0.00	0.00	0.00	
The long-run impact matrix C								
w^r	0.0	0.10 [0.65]	−0.17 [−0.89]	0.0	0.0	0.0	**−1.95** [−4.14]	0.004
c	0.0	**0.34** [2.10]	0.31 [1.52]	0.0	0.0	0.0	−0.41 [−0.80]	0.007
u	0.0	−0.29 [−1.11]	0.11 [0.33]	0.0	0.0	0.0	**3.01** [3.65]	−0.002
Δp	0.0	−0.02 [−1.20]	0.00 [0.20]	0.0	0.0	0.0	**0.21** [3.51]	−0.000
pp	0.0	**−2.27** [−2.17]	**−2.49** [−1.89]	0.0	0.0	0.0	−0.31 [−0.09]	0.007
q	0.0	0.76 [1.07]	−0.33 [−0.37]	0.0	0.0	0.0	**−8.34** [−3.69]	−0.007
R_b	0.0	0.04 [0.47]	**0.21** [1.96]	0.0	0.0	0.0	**1.20** [4.44]	−0.000

The first common stochastic trend, $\hat{\alpha}'_{\perp.1}\sum\varepsilon_i$, is approximately measured by the cumulated shocks to the long-term bond rate. Its long-run impact on the variables of the system appears from the last column of the C matrix. A positive shock to the long-term interest rate has a negative long-run impact on real wage and real exchange rate (an appreciation) and a positive impact on unemployment and inflation. It has no significant long-run impact on productivity and the price wedge. The second stochastic trend, $\hat{\alpha}'_{\perp.12}\sum\varepsilon_i$, roughly measured by the cumulated empirical shocks to productivity and unemployment, has exhibited a significant long-run impact on productivity (positive) and on the internal price wedge (negative). In general, the productivity and unemployment shocks have had a similar long-run impact on the system variables, except for the latter which also has had a positive long-run impact on the government bond rate. This is likely to reflect the government need to finance the raising unemployment by issuing bonds, hence raising its price.

The last column of Table 3 reports the estimated slope coefficients of the linear deterministic trend in the data. It is notable that the trend in productivity is identical to the trend in the price wedge and in the real exchange rate (with opposite signs). This is exactly what the Balassa-Samuelson theory would predict and is a confirmation of its significance in this period.

Thus, three driving forces were identified:

1. A long-run Baumol-Bowen, Balassa-Samuelson effect measured by the linear trend effect in productivity and the internal and external price wedge.

2. Product market competition measured by the stochastic trend associated with shocks to trend-adjusted productivity and unemployment.

3. Capital liberalization and speculative behavior in the foreign exchange market measured by the stochastic trend associated with shocks to the long-term interest rate.

Table 4: An identified long-run structure

Test of overidentifying restrictions: $\chi^2(13) = 17.7$ (0.17)

	w^r	c	U	Δp	pp	q	R^l	$Ds_{86.1}$	$Ds_{92.3}$	$Ds_{99.1}$	t
$\hat{\beta}_1^c$	−0.09 [−12.71]	0.09 [12.71]	0.13 [9.70]	**1.00** [NA]	–	–	−0.66 [−18.07]	–	−0.004 [−3.96]		–
$\hat{\alpha}_1$	*	*	−1.54 [−6.38]	−1.10 [−3.12]	−1.64 [−3.88]	*	*				
$\hat{\beta}_2^c$	**1.00** [NA]	–	0.25 [2.74]	–	–	–	–	−0.04 [−5.24]	–	0.04 [4.79]	−0.003 [−20.25]
$\hat{\alpha}_2$	−0.77 [−5.53]	*	−0.08 [−3.23]	*	−0.16 [−3.73]	*	*				
$\hat{\beta}_3^c$	–	**1.00** [NA]	–	–	–	–	–	−0.04 [−3.61]	0.13 [10.68]	–	−0.008 [−23.38]
$\hat{\alpha}_3$	*	−0.21 [−3.17]	0.14 [7.65]	*	*	0.33 [2.96]	*				
$\hat{\beta}_4^c$	–	–	–	**1.00** [NA]	0.04 [5.26]	0.04 [5.26]	–	–	−0.01 [−3.25]	–	0.0002 [4.08]
$\hat{\alpha}_4$	−1.11 [−1.59]	*	0.90 [7.43]	*	0.49 [2.30]	−1.61 [−2.20]	*				
$\hat{\beta}_5^c$	–	–	0.11 [5.08]	**1.00** [NA]	−0.02 [−4.16]	−0.05 [−9.00]	**−1.00** [NA]	–	–	–	–
$\hat{\alpha}_5$	*	*	0.82 [4.28]	*	1.01 [3.00]	3.42 [2.95]	*				

7.2 The Pulling Forces

The long-run structure of cointegration relations reported in Table 4 contains 13 over-identifying restrictions which were accepted based on a p-value of 0.17[15]. The structure is generically and empirically identified as defined in Johansen and Juselius (1994) and further elaborated in Juselius (2006, Chapter 12). Whether the estimated relations are also economically identified in the sense of having interpretable coefficients will be discussed at the background of Sections 3-5.

The *first relation* describes that demand for labor is low when real wages corrected for productivity are high, is positively related to the level of inflation rate and negatively to the long-term interest rate. It can be interpreted as an affordable real wage relation or, alternatively as a Phillips curve with a time-varying NAIRU, the latter being a function of the long-term interest rate and the real wage corrected for productivity. The estimated α coefficients show that the adjustment takes place foremost in the inflation rate, consistent with the original idea in Phillips (1958). Because of this, we choose to normalize on inflation rate to obtain:

$$\Delta p_t = -\underset{[-9.7]}{0.13} u_t + \underset{[12.7]}{0.09}(w_t^r - c_t) + \underset{[18.1]}{0.66} R^l \underset{[-4.0]}{-0.004}\, Ds_{92.3,t}\,. \tag{11}$$

The interpretation of (11) is that the Phillips curve mechanism is triggered off for different levels of interest rate and real wage costs. As discussed in Section 2, Spain has in this period experienced different inflation/unemployment regimes (similarly as most of Europe), starting with a period of high real wage costs, inflation and unemployment rates, followed by the more recent period of lower rates. As these regimes have been long lasting, labor market behavior seems to have adjusted in each regime to what could be called the normal level of unemployment. The estimated

[15] When the sample was extended to 2008:2, the same structure was accepted with a higher p-value (0.40).

step dummy $Ds_{92.3,t}$ suggests that, in spite of the large devaluation of the peseta, the inflation rate decreased significantly after the speculative attack in 1992:3.

The *second relation*, interpretable as an acceptable wage relation, essentially describes that real wage pressure, measured as trend-adjusted real wage, tends to decrease when unemployment increases. The estimated α coefficients show that it is real wages, unemployment and the price wedge that are adjusting.

$$w_t^r = \underset{[-2.7]}{-0.25}\, u_t + \underset{[5.2]}{0.04}\, Ds_{86.1,t} - \underset{[-4.8]}{0.04} Ds_{99.1,t} + \underset{[8.1]}{0.0034} trend \tag{12}$$

The negative and significant coefficient to unemployment rate indicates that it was the rising levels of unemployment rates from the beginning of the nineties until 1995 that finally stopped real wage claims (in excess of a average annual wage growth rate of approximately 1.4%). The step dummies show that real wages increased with 4% from 1986:1 to 1999:1, then went back to their previous level (corrected for the unemployment effect and the 1.4% annual real wage increase). Altogether, the results suggest a strong trade-off between unemployment and real wages.

The *third relation* tells us that trend-adjusted productivity has roughly been stationary when allowing for a positive mean shift in 1986:1 and a negative in 1992:3.

$$c_t = \underset{[3.6]}{0.04} Ds_{86.1,t} \underset{[10.7]}{-0.13}\, Ds_{92.3,t} + \underset{[8.7]}{0.008} trend \tag{13}$$

The α coefficients show that productivity is equilibrium correcting and, more interestingly, that unemployment increases when labor productivity is above its long-run trend. This is just another way of verifying empirically the hypothetical relationship (6) between unemployment and trend-adjusted productivity.

The *forth relation* describes the structural adjustment of Spanish inflation to the internal price wedge corrected for the Balassa-Samuelson real exchange rate effect[16] as hypothetized in (7):

$$\Delta p_t = \underset{[3.91]}{-0.04}(pp+q)_t + \underset{[-3.2]}{0.01} Ds_{92.3,t} - \underset{[4.1]}{0.0002} trend \tag{14}$$

The interpretation is that the Spanish inflation rate has been on a sustainable level as long as it has followed the path given by the internal price wedge corrected for the external one. The linear trend with a negative annual slope coefficient of 0.08%, suggests that the German Balassa-Samuelson effect is not sufficient to explain the steady decline in the Spanish inflation rate over this period (strongly visible in Figure 2).[17] The large devaluation of the peseta after the speculative attack in 1992:3 seems to have increased the level of quarterly inflation with 1%. This, however, is counter-

[16] Note that after 1999:1 q_t measures relative prices between Germany and Spain in a fixed exchange rate.

[17] The time trend is of course only a proxy for other relevant omitted variables, possibly a Balassa-Samuelson effect with respect to other low price countries, such as China.

acted by the negative effect of the large real depreciation of the peseta at the same time.

The *fifth relation* shows a strong positive association between unemployment rate, the real interest rate, the internal price wedge and the real exchange rate and can be given an interpretation in terms of (3). Normalizing on inflation rate gives a modified Phillips curve relation:

$$\Delta p_t = \underset{[-5.08]}{-0.11} u_t + R_{b,t} \underset{[4.16]}{+0.02} (pp_t + q_t) \underset{[6.0]}{+0.03}\, q_t \tag{15}$$

where the unemployment/inflation trade-off is a function of the long-term bond rate, the real exchange rate, and the Balassa-Samuelson effect. However, (15) could equally well be interpreted as a relation for unemployment being positively related to the real interest rate, the real exchange rate and the Balassa-Samuelson effect.

7.3 Is the Long-Run Structure Plausible?

Imposing identifying restrictions on the long-run relations, $\beta' x_t$, can potentially be done in many ways allowing for the possibility that the chosen data may tell different stories.[18] The unrestricted reduced rank estimates of $\Pi = \alpha\beta'$ reported in Table 5, can be thought of as the reduced form that any identified structure has to replicate in order to pass the test of overidentifying restrictions. Thus, the Π can be thought of as a benchmark against which the reader can check his/her doubts/suggestions regarding the chosen identification scheme.

For example, based on the estimated Π matrix it is possible to discuss whether the suggestion by the referees to treat the exchange rate and the long-term interest rate as exogenous from the outset would have been econometrically acceptable. This would have been the case if the coefficients in the last two rows of Π (and the last two rows of Γ_1) were all insignificant. We note that the Δq row exhibits evidence of the Baumol-Bowen and the Balassa-Samuelson effects: productivity and the price wedge are positively co-moving, whereas real exchange rates and the price wedge are negatively co-moving. The estimates in the ΔR^l row gives some evidence of a 'Fisher parity' effect and a real exchange effect on the long-term interest rate. While we agree that the real exchange rate and the long-term interest rate are only partially determined in this model, we nevertheless think that some relevant feed-back information would have been suppressed by treating the two variables as exogenous.

The estimated Π can also be used to assess the *ceteris paribus* effect of adding the real exchange rate and the long-term interest rate to the domestic system. The extent to which the conclusions from the domestic model analysis are robust to the *ceteris paribus* assumption "q and R^l constant", can be checked by studying the significance of these two variables in the q and R^l columns of Table 5. The estimates show that the real exchange rate is insignificant in the first four equations, but enters significantly in the price wedge equation consistent with the Balassa-Samuelson effect. This can explain why the price wedge was found to be weakly

[18]This is similar in economic modelling where several structural models can have the same reduced form.

Table 5: The estimates of $\Pi = \alpha\beta'$ for $r = 5$

	w^r	c	u	Δp	pp	q	R^l	$D_{s,86.1}$	$D_{s,92.3}$	$D_{s,99.1}$	t
Δw^r	**−0.93** [−7.82]	**0.32** [2.83]	−0.05 [−0.51]	0.51 [0.98]	**−0.05** [−2.69]	−0.05 [−1.40]	**−1.81** [−3.49]	**0.02** [3.30]	**0.03** [2.15]	**−0.04** [−6.75]	0.00 [1.33]
Δc	0.00 [0.04]	**−0.13** [−1.80]	0.07 [1.04]	−0.15 [−0.44]	**−0.02** [−1.83]	0.02 [0.66]	0.07 [0.21]	0.01 [1.30]	**−0.03** [−2.68]	0.00 [0.35]	**0.00** [2.85]
Δu	**0.06** [2.93]	0.01 [0.46]	**−0.11** [−6.32]	0.15 [1.70]	**0.02** [7.00]	−0.01 [−0.96]	**0.21** [2.31]	−0.00 [−1.59]	**0.02** [5.79]	−0.00 [−1.23]	**−0.00** [−5.32]
$\Delta^2 p$	**0.14** [4.70]	**−0.12** [−4.37]	**−0.09** [−3.27]	**−0.81** [−6.22]	**0.01** [2.33]	−0.01 [−1.30]	**0.57** [4.42]	−0.00 [−1.45]	0.00 [0.43]	**0.01** [3.63]	−0.00 [−0.16]
Δpp	0.01 [0.22]	**−0.19** [−5.50]	**−0.16** [−4.99]	−0.06 [−0.37]	−0.01 [−1.46]	**−0.03** [−2.23]	0.06 [0.36]	**0.01** [5.32]	−0.00 [−0.11]	**−0.01** [−3.80]	**0.00** [3.90]
Δq	0.06 [0.49]	**0.24** [1.96]	0.10 [0.91]	−0.58 [−1.04]	**−0.05** [−2.82]	**−0.19** [−4.51]	**−2.19** [−3.93]	−0.01 [−1.18]	**0.07** [4.04]	0.01 [1.05]	**−0.00** [−4.49]
ΔR^l	−0.01 [−0.58]	−0.01 [−0.62]	0.00 [0.19]	**0.12** [2.43]	**−0.01** [−3.86]	**−0.01** [−2.52]	**−0.18** [−3.80]	**0.00** [2.82]	0.00 [0.57]	**−0.00** [−1.96]	0.00 [0.38]

Coefficients with t-values ≥ 1.8 in bold face.

exogenous in Model 1 but not in Model 2. The long-term interest rate is, however, significant in the rows of Δw^r, Δu, and $\Delta^2 p$, demonstrating its importance for the Spanish wage, price, and unemployment dynamics in this period.

Altogether, we find that the conclusions from Model 1 (the domestic system) are reasonably robust to the ceteris paribus 'holding the real exchange rate constant' whereas not to the government bond rate. However, most of the Balassa-Samuelson and globalization effects can be understood by the association between the long-term interest rate and real exchange rates on one hand and domestic inflation, real wages, and unemployment rate on the other. Thus, analyzing the Spanish wage, price and unemployment dynamics in a theoretical model with the implicit *ceteris paribus* assumption 'long-term interest rate and real exchange rate constant', is likely to produce unreliable conclusions.

8 Wage, Price, and Unemployment Dynamics in the Spanish Transition Period[19]

In this section, we shall investigate the mechanisms that have pulled the system back to steady-state after the system has been pushed away from equilibrium by the exogenous shocks. Table 6 reports a parsimonious representation of the short-run adjustment structure for the full seven-dimensional model. The lagged values of the system variables were generally not very important. In particular, this was the case with the lagged real exchange rate, which was removed from the system prior to imposing cross equation restrictions. The latter were accepted based on $\chi^2(68) = 78.3[0.18]$). Table 6 reports the estimated coefficients.[20] The five equilibrium errors, $ecm1 - ecm5$, account for most of the explanatory power of the model, and the subsequent discussion will focus on these effects.

[19] The estimates in this section has been calculated with the software package, PcGive in OxMetrics. See http://www.timberlake.co.uk/Oxmetrics/

[20] The estimated effects of the five impulse dummies are not very important for the purpose of the paper and therefore not reported. Similarly, the current residual correlations are not reported as they were altogether modest (the largest was 0.33). All results can be found from the paper's website.

Table 6: The estimated short-run dynamics

	Δw_t^r	Δc_t	Δu_t	$\Delta^2 p_t$	Δpp_t	Δq_t	ΔR_t^l
$ecm1_{t-1}$ [PC 1]	4.54 (4.0)	–	−1.47 (−7.1)	−0.17 (−2.8)	−2.02 (−8.6)	−3.95 (−3.6)	–
$ecm2_{t-1}$ [$Wage$ $rel.$]	−1.51 (−12.9)	–	−0.10 (−5.4)	–	−0.21 (−9.4)	−0.37 (−3.6)	–
$ecm3_{t-1}$ [$prod.$]	0.51 (3.1)	−0.19 (−4.8)	0.14 (7.2)	–	–	0.42 (4.2)	–
$ecm4_{t-1}$ [inf .$adj.$]	−3.13 (−2.9)	–	0.74 (7.0)	−0.46 (−4.2)	0.47 (3.3)	−1.01 (−2.0)	–
$ecm5_{t-1}$ [PC 2]	–	–	0.91 (5.3)	−0.37 (−3.4)	1.37 (7.1)	4.94 (5.6)	0.09 (2.2)
Δw_{t-1}^r	0.90 (18.4)	–	–	–	0.02 (3.2)	–	–
Δc_{t-1}	−0.90 (−2.9)	–	–	–	0.11 (2.7)	–	–
$\Delta^2 p_{t-1}$	–	0.31 (2.6)	−0.13 (−2.4)	–	–	–	–
Δu_{t-1}	–	–	0.17 (2.8)	–	–	–	–
Δpp_{t-1}	–	–	–	–	–	–	–
ΔR_{t-1}^l	–	–	−0.40 (−2.1)	–	−0.55 (1.8)	–	0.51 (5.6)

$ecm1 = \Delta p + 0.13u_t - 0.09(w_t^r - c_t) - 0.66R_t^l + 0.004Ds_{92.3,t}$
$ecm2 = w_t^r + 0.25\,u_t - 0.04\,Ds_{86.1,t} + 0.04Ds_{99.1,t} - 0.0034trend$
$ecm3 = c_t - 0.04Ds_{86.1,t} + 0.13Ds_{92.3,t} - 0.008trend$
$ecm4 = \Delta p_t + 0.04(pp + q)_t - 0.01Ds_{92.3,t} + 0.0002trend$
$ecm5 = \Delta p_t + 0.11u_t - R_{b,t} - 0.02pp_t - 0.05q_t$

To facilitate the interpretation of the dynamic adjustment underlying Spain's transition from a relatively poor EU outsider to today's prosperous insider, the discussion will be organized around the three driving forces discussed above and how these have affected wage and price adjustment in labor market.

8.1 Deregulation and the Cost of Long-Term Capital

One of the driving forces in this period was the cost of capital measured by cumulated shocks to the bond rate. Its importance is evidenced by the significant long-run impact on many of the key domestic variables (see the last column of Table 3). That the bond rate can be considered exogenously given is supported by the result in Table 6 showing that the bond rate has not been affected by any of the determinants of this system except for $ecm5$ and the lagged price wedge with tiny and barely significant coefficients. Thus, for practical purposes, the long-term bond rate seems to have been both weakly and strongly exogenous in this model. A similar conclusion was also reached in a CVAR analysis of monetary transmission mechanisms in Spain (Juselius and Toro, 2005).

The effect of the bond rate on the rest of the system is through its lagged values but foremost through $ecm1$ and $ecm5$. The negative coefficient of $ecm1$ and the positive coefficient of $ecm5$ in the real exchange rate equation show that an increase in the long-term bond rate has been associated with a real exchange rate appreciation. This is confirmed by the real exchange estimate in the last row of Table 5 suggesting that the deregulation of capital movements in 1989 and the subsequent real appreciation with raising interest rates[21], put a strong competitive pressure on the Spanish industry. The result in Table 3 that the final impact of an interest rate shock was increasing unemployment and decreasing real wages seems to suggest that the Spanish industry reacted by improving labor productivity according to hypothesis (6) in Section 5.3.

Thus, the results suggest that much of the burden on adjustment was carried by the Spanish (un)employment. Increasing unemployment as a result of improving productivity in the medium run seem to have resulted in increases in the long-term government bond rate, high interest rates caused the peseta to appreciate, further aggravating competitiveness in the Spanish industry. The latter led to further increases in unemployment and finally to lower real wage claims. Thus, the strong interrelatedness between the cost of capital and unemployment evidenced in Table 3 by the positive long-run impact of an interest rate shock on the unemployment rate and vice versa seem to have triggered off a vicious unemployment circle.

8.2 Product Market Competition: Price and Quantity Adjustment in the Labor Market

The second common stochastic trend, measured by cumulated shocks to trend-adjusted productivity and unemployment, seems associated with the strong product market competition in this period. The estimates of equation Δc_t in Table 6 show that productivity is essentially exogenous, as it only reacts on its own lagged values, $ecm3$, and on the lagged inflation rate (though not very significantly so). An interesting result is that $ecm3$ has a positive and highly significant effect on the unemployment rate. As already mentioned, this gives indirect support to hypothesis (6) in Section 3.3 suggesting that an (exposed) enterprise, facing an unsustainable cost level, is prone to improve productivity by laying off (the least productive) part of the labor force. The finding that unemployment has increased, but not prices, when $ecm3 > 0$ supports this hypothesis.

However, under the hypothesis (6), unemployment would first increase and productivity would then improve. The fact that the second trend was measured by combined productivity and unemployment shocks suggests that such a causal link is not empirically identifiable. That productivity and unemployment shocks had a similar long-run impact on the system is further evidence that such a causal chain is difficult to identify in quarterly aggregates. Nonetheless, the finding in Table 3 that a positive shock to unemployment has increased labor productivity, lowered the price wedge, and increased the long-term bond rate seems to support the empirical relevance of hypothesis (6).

The estimated adjustment dynamics in the real wage equation provide evidence of how Balassa-Samuelson and product market competition have affected wages in this

[21] In most of the transition period, the shocks to the bond rate were positive. The co-movements of the long-term interest with the inverse of the real exchange rate is consistent with the two-country monetary model with imperfect knowledge (Frydman and Goldberg, 2007).

period. The first two equilibrium errors, $ecm1$ and $ecm2$, were interpreted in terms of an affordable and acceptable real wage relation; the former describing how real wages in excess of productivity have been co-moving with higher unemployment, inflation and interest rates; the latter how increasing unemployment has been associated with lower real wages. The adjustment coefficients show that real wages have been equilibrium correcting to both relations. Thus, $ecm1$ and $ecm2$ seems to describe a standard wage-price-unemployment spiral, whereas $ecm3$ is associated with product market competition.

8.3 Inflation Convergence

Finally we need to address the question by which means the *inflation rate was brought down* to the European level. The last two equilibrium errors, $ecm4$ and $ecm5$, seem strongly associated with the inflation transition mechanisms. As discussed in Section 7.2, the former describes the Balassa-Samuelson effect on inflation and the latter the inflation-unemployment Phillips curve type of relationship as a function of the long-term interest rate and the real exchange rate. The estimated adjustment dynamics show that real wages have increased and unemployment decreased when $ecm4 < 0$, i.e when inflation rate has been below its long-run path.

Inflation rate is equilibrium error correcting to $ecm5$, supporting the interpretation of a Phillips curve relationship according to (3). The fact that unemployment rate is error increasing in $ecm5$ seems to provide further evidence of the hypothesis (6) in Section 3.3. When cost increases have threatened competitiveness in the Spanish tradable market, employment, rather than product prices, has carried the burden of adjustment.

The overall conclusion seems to be that inflation has adjusted in the long run to the Balassa-Samuelson corrected European purchasing power parity level measured by the German price level. However, the small negative inflation trend in $ecm4$ suggests that the long-run convergence of the Spanish prices has not just been determined by the German level, but probably also by competition with other low price countries such as China, India, and the new member states in Eastern Europe. In the medium run, inflation rate adjustment seems to have taken place through the two Phillips curve mechanisms, $ecm1$ and $ecm5$, suggesting that the convergence to the present low inflation level was achieved through high and increasing unemployment rates. The long swings of the real exchange rates in the transition period due to the appreciation of the peseta is likely to have aggravated the unemployment problem and prolonged the necessary long-run convergence.

9 Conclusions

Based on a cointegrated VAR analysis, this paper has discussed some complicated interactions between productivity improvements, real wage growth, inflation and unemployment in Spain during the period 1983:3 to 2007:3. The aim was to identify the effect of the Baumol-Bowen, Balassa-Samuelson mechanism, the increased product market competition, and the deregulation of capital movements on the Spanish labor market, and how the former have influenced the Spanish convergence towards a European level of purchasing power parity with low inflation, unemployment and interest rates.

We were able to identify the following main driving forces:

1. A long-run deterministic trend in productivity and the internal and external price wedge associated with the Baumol-Bowen, Balassa-Samuelson effect.

2. A stochastic trend associated with product market competition, measured by cumulated shocks to trend-adjusted productivity and unemployment.

3. A stochastic trend associated with capital liberalization and speculative behavior in the foreign exchange market, measured by cumulated shocks to the long-term interest rate.

As these driving forces have pushed prices, wages, employment, productivity, interest rate and the exchange rate out of long-run equilibrium, the adjustment forces have brought them back again. In Sections 7 and 8 we have discussed these mechanisms in much detail. The following story emerges about the Spanish convergence from an relatively poor outsider to a prosperous EU insider:

The Spanish inflation rate has adjusted over the *long run* to the European purchasing power parity level (measured by the German price level) corrected for the Balassa-Samuelson effect. In the *medium run*, this long-run convergence was achieved by two types of Phillips curve mechanisms; one where the inflation/ unemployment trade-off was triggered off for different levels of the interest rate and real wage costs, another one where the trade-off was a function of the real exchange rate and the real interest rate.

Strong product market competition forced Spanish enterprises to improve productivity in the *medium run* by laying off labor. Increasing unemployment as a result of improvement in productivity resulted in increasing long-term government bond rates, high real interest rates caused the peseta to appreciate, further aggravating competitiveness in the Spanish industry, hence increasing unemployment and finally lowering real wage pressure. Thus, the convergence to the European inflation level was essentially achieved at the price of high unemployment.

However, at the end of the period, the unemployment rates have come down as a result of real wage restraints: the annual long-run growth in real wages was 1.6% compared to the 2.8% productivity growth. Since the level of Spanish interest rates is now tied to the (low) European level, the previously strong interrelatedness between unemployment and the cost of capital may no longer be of major concern. However, over the most recent period Spanish prices have grown more than her European competitors, the external deficit and the private sector indebtedness have kept increasing as have house prices and the Spanish government bond rate. All this is likely to exert renewed pressure on the Spanish unemployment rates.

We think the results contain important lessons to be learnt for new EU/EMU member states. First, there is no short-cut to a European level of standard of living: the path to sustainable prosperity seems to follow the path of productivity improvement. The increase in consumption wages and consumer prices as a result of the Balassa-Samuelson effect should not be allowed to exceed the improvement in productivity. Second, the convergence to a sustainable European purchasing power parity level is likely to be a prolonged process and the fixing the exchange rate before this level is likely to be costly. Third, excessive real wage claims seem to lead to increasing unemployment rather than to increasing inflation rates; higher unemployment rates to higher interest rates, higher interest rates to a real appreciation and loss of competitiveness. The access to the European market and the possibility of increased export demand is likely to speed up the convergence process but only as long as competitiveness is not eroded by excess wage increases.

References

Balassa, B. (1964). The Purchasing-Power Parity Doctrine: A Reappraisal. *Journal of Political Economy*, vol. 72, no. 6, pp. 584-596.

Baumol, W., and Bowen, W. (1966). Performing Arts: The Economic Dilemma. New York, Twentieth Century Fund.

Banerjee, A. and B. Russell (2005). Inflation and Measures of the Markup. *Journal of Macroeconomics*, 27, pp. 289-306.

Bjørnstad, R. and R. Nymoen (2008). The New Keynesian Phillips Curve Tested on OECD Panel Data. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 2, 2008-23. http://www.economics-ejournal.org/economics/journalarticles/2008-23.

Boeri, T., A. Brugiavini and L. Calmfors (2001). The Role of Unions in the Twenty-First Century, Oxford University Press, Oxford.

Bouchaud, J-P. (2008). Economics Needs a Scientific Revolution. *Nature*, 455, 1181-1181.

Colander, D. (ed.) (2006). Post Walrasian Macroeconomics: Beyond the Dynamic Stochastic General Equilibrium Model. Cambridge: Cambridge University Press.

Colander, D. (2008). The Economy as an Evolving Complex System III: Current Perspectives and Future Directions. *Economica*, vol. 75, pp. 191-202.

Colander, D. (2009). Economists, Incentives, and Empirical Work in Macroeconomics, Forthcoming *Economics: The Open-Access, Open-Assessment E-Journal.*

Colander, D., H. Föllmer, H. Haas, M. Goldberg, K. Juselius, A. Kirman, T. Lux, B. Sloth (2009). The Financial Crisis and the Systemic Failure of Academic Economics. Discussion Paper, Department of Economics, University of Copenhagen.

Dennis, J., Johansen, S. and K. Juselius (2005). CATS for RATS: Manual to Cointegration Analysis of Time Series. Estima, Illinois.

Dolado, J. (2008). Does Immigration Affect the Phillips curve? Some Evidence for Spain. *European Economic Review*. 52(8), 1398-1423.

Ericsson, N.R., J.S. Irons, and R.W. Tryon (2001). Output and Inflation in the Long Run. *Journal of Applied Econometrics*. 16(3), 241-253.

Fanelli, F. (2008). Evaluating the New Keynesian Phillips Curve under VAR-based Learning. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 2, 2008-33. http://www.economics-ejournal.org/economics/journalarticles/2008-33.

Frydman, R. and M.D. Goldberg (2007). The Dollar-Euro Exchange Rate and the Limits of Knowledge. Center on Capitalism and Society Working Paper, No. 22, Columbia University.

Hendry, D.'F. and Mizon, G.E. (1993). Evaluating Econometric Models by Encompassing the VAR, in Phillips, P.C (ed.): *Models, Methods and Applications of Econometrics,* Blackwell, Basil.

Hoover, K., S. Johansen and K. Juselius (2008). Allowing the Data to Speak Freely: The Macroeconometrics of the Cointegrated Vector Autoregression. *American Economic Review* 98, pp. 251-55.

Johansen, S. (2006). Confronting the Economic Model with the Data, in Colander (2006), pp. 287-300.

Johansen, S. and K. Juselius (1994). Identification of the Long-Run and the Short-Run Structure: an Application to the ISLM Model. *Journal of Econometrics*, vol. 63, pp. 7-36.

Johansen, S., K. Juselius, R. Frydman and M.D. Goldberg (2008). Testing Hypotheses in an 1(2) Model with Applications to the Persistent Long Swings in the Dmk/USD Rate. Submitted to the *Journal of Econometrics*, Discussion Papers, University of Copenhagen. Department of Economics, http://web.econ.ku.dk/okokj/papers/I2PPPUIP.pdf.

Juselius, K. (1994). Domestic and Foreign Effects on Prices in an Open Economy. The Case of Denmark. *Journal of Economic Policy Modelling*, 14, 401-428. Reprinted in N. Ericsson and J.S. Irons (eds.): *Testing Exogeneity. Advanced texts in Econometrics*, Oxford University Press.

Juselius, K. (2006). The Cointegrated VAR Model. Methodology and Applications, Oxford University Press, Oxford.

Juselius, K. (2009). The Long Swings Puzzle: What the Data Tell When Allowed to Speak Freely. Chapter 8 in K. Patterson and T. C. Mills (eds.): *Handbook of Empirical Econometrics*, Macmillan, 367-384.

Juselius, K. and M. Franchi (2007). Taking a DSGE Model to the Data Meaningfully. *Economics–The Open-Access, Open-Assessment E-Journal*, No. 4. http://www.economics-ejournal.org/economics/journalarticles/2007-4.

Juselius, K. and J. Toro (2005). Monetary Transmission Mechanisms in Spain: The Effect of Monetization, Financial Deregulation, and the EMS. *Journal of International Money and Finance*, 24, 509-531.

Juselius, K. and R. McDonald (2007). International Parity Conditions: A Joint Modelling Approach, in A. M.-Zumaros (ed.): *International Macro-economics: Recent Developments*, Nova Science Publishers.

Juselius, M. (2008). Testing the New Keynesian Model on US and Euro Area Data. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 2, 2008-24. http://www.economics-ejournal.org/economics/journalarticles/2008-24.

Kirman, A. (2009). Understanding the Madness of Crowds: Individual and Collective Rationality. Paper written for the Dahlem conference 'Is there a Mathematics of Social Entities?'.

Lux, T. and F. Westerhoff (2009). Economics Crises. *Nature Physics,* 5, 2 3, http://www.nature.com/nphys/journal/v5/n1/pdf/nphys1163.pdf.

Møller, N.F. (2008). Bridging Economic Theory Models and the Cointegrated Vector Autoregressive Model. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 2, 2008-36. http://www.economics-ejournal.org/economics/journalarticles/2008-36.

Moene, K. O., M. Wallerstein and M. Hod (1993). Bargaining Structures and Economic Performance, in R.J. Flanagan, K.O. Moene and M. Wallerstein (eds.): *Trade Union Behaviour, Pay Bargaining and Economic Performance.* FIEF and Oxford University Press.

Pesaran, M.P., R.J. Smith, and Y.Shin (2002). Structural Analaysis of Vector Error Correction Models with Exogenous I(1) Variables, *Journal of Econometrics*, 97, 293-343.

Phelps, E. S. (1994). Structural Slumps: The Modern Equilibrium Theory of Unemployment, Interest, and Assets. Harvard University Press.

Phi11ips, A. (1958). The Relation Between Unemployment and the Rate of Change on Money in the United Kingdom, 1861-1957. *Economica*, 25, 283-299.

Samuelson, P. (1964). Theoretical Notes on Trade Problems. *Review of Economics and Statistics*, 46, 2, 145-154.

Spanos, A. (2009). The 'Pre-Eminence of Theory' vs. the 'General-to-Specific' in Macro-Econometric Modeling. Forthcoming *Economics: The Open-Access, Open-Assessment E-Journal.*

Stiglitz, J. (2003). Globalization and Its Discontent. Norton paperbacks. New York.