Banco de Portugal

EUROSISTEMA

Estudos e Documentos de Trabalho

Working Papers

15 | 2008

WAGE AND PRICE DYNAMICS IN PORTUGAL

Carlos Robalo Marques

September 2008

Please address correspondence to
Carlos Robalo Marques
Economics and Research Department
Banco de Portugal, Av. Almirante Reis no. 71, 1150-012 Lisboa, Portugal;
Tel.: 351 21 312 8330 , Email: cmrmarques@bportugal.pt

BANCO DE PORTUGAL

Economics and Research Department

Av. Almirante Reis, 71-6th floor

1150-012 Lisboa

www.bportugal.pt

Printed and distributed by

Administrative Services Department

Av. Almirante Reis, 71-2nd floor

1150-012 Lisboa

Number of copies printed

170 issues

Legal Deposit no. 3664/83

ISSN 0870-0117

ISBN 978-989-8061-50-8

Wage and price dynamics in Portugal*

Carlos Robalo Marques†

September 8, 2008

Abstract

This paper investigates the persistence of aggregate wages and prices in Portugal assuming a model of a unionized economy with imperfect competition. An impulse response analysis is conducted where the structural shocks are identified by taking into account the long-run properties of the model, as well as the cointegrating and weak-exogeneity properties of the system. Real wages and wage inflation emerge as especially persistent following an import price shock, while price inflation is more persistent following an unemployment shock. At the business cycle horizon variation in the forecast errors of wages is attributable mainly to unemployment shocks (about 80 percent), whereas variation in the forecast errors of prices is attributable mainly to import price shocks (about 60 percent) and to unemployment shocks (around 20 percent). Productivity shocks explain somewhat less than 10 percent of the variation in forecast errors of wages and prices.

JEL classification codes: C32, C51, E31, J30.

Key Words: wages, prices, impulse response function, persistence, structural error-correction model,

---

*This study was developed in the context of the Eurosystem Wage Dynamics Network. The views expressed in this paper are those of the author and do not necessarily reflect those of the Banco de Portugal or the Eurosystem. I would like to thank for helpful discussions and useful suggestions, Daniel Dias, Hervé Lebihan and participants at the Congress of the European Economic Association 2008, held in Milan.

†Banco de Portugal, Research Department. E-mail: cmrmarques@bportugal.pt. Tel.: +351 213128330;

1 Introduction

Labour market rigidity is widely recognised as a crucial issue for macroeconomics and notably for monetary policy. Moreover, the importance of labour market rigidities is especially acute in monetary unions, where labour market flexibility is seen as a substitute for the adjustment of the nominal exchange rate and for independent monetary policy.

Recent literature has re-affirmed the importance of wage rigidities for the evolution of the macro economy in response to shocks. Erceg *et al.* (2000) show that introducing staggered nominal wage setting in addition to staggered price setting in their optimising-agent model changes the conclusions about the optimal monetary policy rules, as opposed to the case when staggered price setting is the sole form of nominal rigidity. Christiano *et al.* (2005) conclude that stickiness in nominal wages is crucial for the performance of their model while stickiness in prices plays a relatively small role. Levin *et al.* (2005) show that the shape of the distribution of wage contracts in staggered wage-setting models matters significantly for monetary policy. In turn, Blanchard and Galí (2007) demonstrate that allowing for real wage rigidities in the standard new Keynesian model the so-called "divine coincidence" disappears and central banks face a trade-off between stabilising inflation and stabilising the welfare relevant output-gap.

In the real world the existence of price and nominal wage rigidities is expected to translate into persistent responses of real wages, as well as of price and wage inflation to shocks hitting the economy. Evaluating the degree of persistence of such responses is thus an issue of paramount importance.

This paper evaluates persistence of wages and prices in the Portuguese economy, within a structural vector error-correction model (SVECM) framework by assuming a model of a unionized economy with imperfect competition, where wages are determined through collective bargaining and prices are set by imperfectly competitive firms. Our econometric approach follows very closely the analysis in King *et al.* (1991) and Jacobson *et al.* (1997) as regards the identification of the shocks, and in contrast to the approaches that use simple bivariate SVAR models (see, for instance, Moore and Pentecost, 2006) it has the advantage of allowing to separate the effects of the responses of wages and prices to real and nominal permanent, as well as transitory shocks.

Following our theoretical model an empirical VAR model involving nominal wages, prices, the unemployment rate, productivity and import prices is estimated and three permanent and two transitory structural shocks are identified. The three permanent shocks, which by definition are allowed to have significant long-run impacts on some or all the variables of the system, are labelled as "import price", "productivity" and "unemployment" shocks and are identified using the properties of the theoretical model, as well as the cointegrating and weak-exogeneity properties of the system. The two transitory shocks, which we label as "wage" and "price" shocks are identified by imposing restrictions on the matrix of the contemporaneous effects and, by definition, they are not allowed to have any long-run impact on the variables of the system.

From the impulse response functions measures of persistence are computed for nominal wages and prices, as well as for real wages, wage and price inflation. As expected, we find that the relative persistence of wages and prices (including real wages and wage and price inflation) varies with the type of shock hitting the economy. In particular, real wages are especially persistent following a permanent import price shock such that only 53 percent of the total disequilibrium dissipates in the first two years after the shock. This compares to 66 percent in the case of a permanent unemployment shock and 69 percent in the case of a permanent productivity shock. Similar conclusions hold for wage inflation. Two years after the shock only 31 percent of the total disequilibrium has dissipated in case of an import price shock, compared to 51 percent in the case of the unemployment shock and to 59 percent in the case of a productivity shock. In contrast, price inflation is more persistent following a permanent unemployment shock, as only 42 percent of the total disequilibrium dissipates in the first two years, compared to 53 percent in the case of a permanent import price shock. These results accord with intuition because an import price shock impacts directly on domestic prices and only indirectly on wages, while an unemployment shock impacts directly on wages and mainly indirectly on prices through lower wages.

From the analysis of the forecast-errors variance decompositions we conclude that at the business cycle horizon (3-5 years) variation in the forecast errors of wages are attributable mainly to unemployment shocks (about 80 percent) whereas variation in the forecast errors of prices are attributable mainly to import price shocks (around 60 percent) and to unemployment shocks (around 20 percent). Productivity shocks explain a relatively small proportion of the forecast errors in wages and prices (somewhat less than 10 percent). By looking at the historical decompositions we conclude that the decline in inflation in the period 1996-2001 is attributable to the permanent import price shock, as well as to the transitory price shock, whereas for the most recent period (after 2002) only the permanent import price shock plays a major role. In turn, the forecast errors in wages are mainly attributable to the permanent unemployment shock for all the sample period (with the transitory wage shock also playing a role in the period 1996-1998).

The rest of the paper is organised as follows. Section 2 presents the theoretical model. Section 3 describes the data set used in the empirical section. Section 4 presents the econometric analysis. Section 5 discusses the identification of the shocks, looks at the impulse response functions including the forecast-errors variance decompositions and computes some measures of persistence for nominal wages and prices, including real wages and wage and price inflation. Section 6 concludes.

2 A theoretical model of wages and prices

This section briefly presents and discusses the so-called wage-bargaining approach to the process of wage determination. In this approach it is assumed that wages are determined through a bargaining process between firms and labour unions in an economy with imperfect competition[1]. The wage-bargaining approach emerges as the natural choice to model the process of wage determination in the Portuguese labour market. In fact, collective wage agreements usually covering a whole industry predominate in the Portuguese economy, such that the wages of 90 percent of the Portuguese private sector workforce in 2005 (97.6 percent in 1995 and 96 percent in 2000) were set through collective wage agreements, thus involving a bargaining process between labour unions and employers organizations[2].

2.1 Wage formation

The wage bargaining formulation can be derived directly from a model with profit maximizing firms and utility maximizing consumers organised in labour unions[3]. This type of models predicts that the bargaining solution will depend on the real producer wage and productivity on the firm side, and on the real consumer wage from the workers side. A simple log-linear form of the wage equation corresponding to the bargaining solution can be written as (with lower case letters denoting logs):

$$w - q = k_1 + \mu(p - q) + \delta h - \theta u + \varepsilon_\omega, \qquad 0 \leq \mu, \delta \leq 1, \theta \geq 0, \tag{1}$$

where w is the target or equilibrium nominal wage rate, q is the producer price level, p is the consumer price level, h is labour productivity and u the unemployment rate. Expressed in nominal wages equation (1) may be rewritten as:

$$w = k_1 + (1 - \mu)q + \mu p + \delta h - \theta u + \varepsilon_\omega, \tag{2}$$

[1] For text book expositions of the model see, for instance, Layard *et al.* (1991), Lindbeck (1993) or Bardsen *et al.* (2005). The presentation in this section follows closely the discussion in Bardsen and Fisher (1999), Pétursson (2002), Bardsen *et al.* (2005) and Bardsen *et al.* (2006).

[2] For a detailed description of the Portuguese collective wage bargaining process, see Cardoso and Portugal (2005).

[3] See, for instance, Nickell and Andrews (1983) and Pétursson and Slok (2001).

where the homogeneity of nominal wages with respect to prices is apparent.

Equation (1) is a general proposition about the bargaining outcome and its determinants and will be used to describe wage formation in the Portuguese economy. According to (1) the real wage faced by firms (real producer wage) is affected by $(p-q)$, h and u. The relative price $(p-q) = (w-q) - (w-p)$ which measures the difference between the producer real wage and the consumer real wage, is usually referred to as the *price wedge*, and plays an important role in theoretical wage bargaining models. The coefficient μ can be interpreted as a measure of "real wage resistance" (see Layard *et al.*, 1991, ch.4.7), which occurs if the unions are able to obtain higher wages to compensate for exogenous changes in workers' living standards (increases in p brought about, for example, by changes in indirect taxes)[4].

The bargaining solution (1) also implies that an increase in labour productivity, h, will increase wages, since higher productivity increases the profitability of firms, so they are more likely to accept higher wage claims from the unions. Note that if $\delta = 1$ the bargaining solution is in terms of unit labour costs, $w - h$, i.e., all gains in labour productivity will be reflected in the wage rate, in the long run.

The unemployment rate u represents the degree of tightness in the labour market which influences the outcome of the bargaining process through the relative bargaining power of the labour unions and employers organizations. The elasticity θ is a key parameter in the wage curve literature as it measures the responsiveness of wages to changes in unemployment and thus is a measure of the flexibility of real wages. The magnitude of θ may be expected to depend on the relative bargaining power of the labour unions

[4] In empirical applications the role of the wedge may depend on the level of aggregation of the analysis. In the traded sector exposed to international competition it may be reasonable to assume that $\mu = 0$, i.e., wages are determined by the ability to pay by firms, such that the price wedge has no long-run effect on wages and the bargaining solution fully reflects the real producer wage, $w-q$. In the non-traded sector however negotiated wages are expected to be linked to domestic price level. Depending on the relative size of the two sectors, the implied weight on the consumer price may become relatively large in an aggregate wage equation. In the limit if $\mu = 1$, the price wedge will have a proportional long run effect on the producer real wage, i.e., the bargaining solution fully reflects the consumer real wage, $w-p$. However, as we shall see later on, in the context of our model the parameter μ is not estimable, as we need to assume $\mu = 1$ in order to get the long-run wage equation identified.

and employers organizations, on the disutility of job loss, the exercise of insider power, as well as on the degree of bargaining coordination. For given levels of measured unemployment the disutility of job loss is lower if unemployment benefit level is high or if benefit entitlements have a long duration, and the insider power is increased for higher employment protection (see, Layard *et al.*,1991, ch.4). In turn, a high degree of coordination, especially on the employer side and centralisation of bargaining may be expected to induce more responsiveness of wages to unemployment than uncoordinated systems (firm or industry-level bargaining) that give little incentives to solidarity in bargaining (see, Layard *et al.*, 1991, ch.2, Blanchard and Wolfers, 2000).

The wage equation sometimes includes additional terms not explicitly considered in equation (1) that may affect the bargaining outcome, namely some institutional features of the labour market. Examples of such terms are changes in the employers and employees tax rates, in the replacement ratio (ratio between unemployment insurance payments and earnings), in the reservation wage (the wage equivalent of being unemployed), in the union power and in the unemployment composition (short-term versus long-term unemployment)[5]. These aspects will not be explicitly modelled or taken into account in the present study mainly due to the absence of data, but also because the empirical evidence for other countries suggests that they do not seem very important in explaining wages in the long run. Moreover, as far as the Portuguese labour market is concerned, some of these variables, such as the replacement ratio or the duration of benefit entitlements, do not seem to have undergone significant changes during the sample period[6]. Nevertheless, as for the effects of this omission on the empirical results reported below, we note that the finding of cointegrating relations within the information set used implies that the

[5] See, among others, Nickell and Andrews (1983), Layard *et al.* (1991), Blanchard and Katz (1999).

[6] The replacement ratio has not changed during our sample period (it was basically equal to 65 percent of the previous wage), but in 1999 some changes were introduced in the entitlement period of unemployment insurance that seem to have had some consequences for the duration of some categories of unemployment spells (see Centeno and Novo, 2007). It is however unclear whether such changes should be expected to have a noticeable impact in the long-run equilibrium level of aggregate unemployment.

omitted factors are not important in the long run, so that their effects may be seen as subsumed in the stationary part of the model.

2.2 Price formation

In an economy with imperfect competition producers target their prices, q, as a mark up, ψ, over marginal costs. If there are constant returns to scale, marginal costs are constant and therefore prices are set as a mark-up over unit labour costs:

$$q = \psi + (w - h). \tag{3}$$

The mark-up is not necessarily constant and in an open-economy it may be a function of the level of international competitiveness (Layard *et al.*, 1991, ch. 8.4). This allows for a pricing-to-market effect with the mark-up inversely related to the elasticity of demand (see, for instance, Krugman, 1987):

$$\psi = k_2 + \lambda(z - q) + \varepsilon_q, \qquad k_2, \lambda \geq 0, \tag{4}$$

where z is the domestic currency price of imperfect substitute tradable goods produced abroad (imports) and λ reflects the exposure of domestic firms to international competition. Thus, the greater the pricing-to-market effect (smaller λ) the less is the pass-through from foreign price or exchange rate shocks to domestic prices. The residual ε_q may include other factors that also affect the mark-up.

Substituting (4) into (3) gives the target producer price level as a mark-up over unit labour costs and import prices:

$$q = \frac{k_2}{1+\lambda} + \frac{1}{1+\lambda}(w - h) + \frac{\lambda}{1+\lambda}z + \frac{1}{1+\lambda}\varepsilon_q. \tag{5}$$

If we further assume that consumer prices are a weighted average of producer and import prices:

$$p = (1 - \rho)q + \rho z, \qquad 0 < \rho < 1, \tag{6}$$

the long-run solution for consumer prices may be written as:

$$p = \frac{(1-\rho)k_2}{1+\lambda} + \frac{1-\rho}{1+\lambda}(w - h) + \frac{\rho+\lambda}{1+\lambda}z + \frac{1-\rho}{1+\lambda}\varepsilon_q, \tag{7}$$

where consumer prices appear as a weighted average of unit labour costs and import prices.

From this equation we see that there are two channels through which foreign price and exchange rate shocks impact on domestic consumer prices. First, there is a direct channel through imported goods given by ρ. Second, a rise in import prices reduces competitiveness of foreign firms allowing domestic producers to increase their mark-up and the price of their products.

Substituting (6) into (2) and using the price equation in (7) we obtain the long-run wage and price equations estimated in this paper (ignoring the constants for simplicity):

$$w = (1 + \alpha)p - \alpha z + \delta h - \theta u + ec(w), \tag{8}$$

$$p = \beta(w - h) + (1 - \beta)z + ec(p), \tag{9}$$

where $\alpha = \rho(1-\mu)/(1-\rho)$ and $\beta = (1-\rho)/(1+\lambda)$[7].

We view the wage and price equations, (8) and (9), as long-run or equilibrium targets that are not necessarily achieved by workers and firms in a specific time period. The

[7] As an alternative or in addition to the level of international competitiveness in (4), one could allow the price mark-up to depend on domestic demand relative to domestic capacity. In this case it would be possible to further replace capacity utilization with the rate of unemployment (using the Okhun's law) and the unemployment rate would appear in equation (4) and logically also in the price equation (9) (See Bardsen *et al.*, 2005, ch. 5, or Layard *et al.*, 1991, ch. 8.). We choose specification (4) because Portugal is a small open economy where international competitiveness may be expected to be important for the price formation process.

residual $ec(w)$ measures the disequilibrium between actual wages and the equilibrium or target wages at each point in time. The wage bargaining solution implies that when actual wages are below the equilibrium target wage, i.e., $ec(w) < 0$, labour unions will bid up the wage rate to restore the long-run equilibrium. In turn $ec(p)$ measures the disequilibrium between actual consumer prices and the equilibrium or target consumer prices. Even though equation (9) is in terms of consumer prices the adjustment mechanism is better understood in terms of producer prices, equations (5) and (6). If the actual producer price is below the target price, firms start raising prices towards the long-run target. This raises consumption prices through (6). The capacity of firms to react to changes in unit labour costs $(w - h)$ and foreign prices, z, is determined by the elasticity of demand for their goods. The less the market power of domestic firms (greater λ) the more are domestic prices affected by international prices. The pass-through of foreign price and exchange rate shocks, $1 - \beta = (\rho + \lambda)/(1 + \lambda)$ is the larger the larger the share of imported goods in the consumption basket (larger ρ) or the smaller the pricing-to-market (larger λ).

Solving equations (8) and (9) for w and p (and ignoring the residuals) we get the steady-state solution that reflects the joint determination of these two variables as a function of the variables z, h and u:

$$w = z + \left(1 - \frac{(1+\lambda)(1-\delta)}{\lambda + \mu\rho}\right) h - \left(\frac{(1+\lambda)\theta}{\lambda + \mu\rho}\right) u, \tag{10}$$

$$p = z - \left(\frac{(1-\rho)(1-\delta)}{\lambda + \mu\rho}\right) h - \left(\frac{(1-\rho)\theta}{\lambda + \mu\rho}\right) u. \tag{11}$$

In this reduced form system it is apparent that prices and wages display long-run homogeneity with respect to import prices. The parameter δ determines how the productivity gain is distributed between firms and employees. If $0 < \delta < 1$ an increase in productivity will lead to a fall in equilibrium prices and an increase in equilibrium wages. Notwithstanding the rise in the real wages will be less than proportional leading to a fall in the labour share. Moreover, in this case equation (11) implies a wedge between domestic and foreign inflation.

However, if $\delta = 1$ wages will completely absorb productivity gains, but prices are not affected so that the wage share in consumer prices will be unaffected. In fact if $\delta = 1$ we get:

$$w - p - h = -\left(\frac{\theta(\lambda + \rho)}{\lambda + \mu\rho}\right) u \tag{12}$$

so that in the long run the labour share in consumer prices depends solely on the unemployment rate. Furthermore, in this case, from equation (11) we obtain the standard open economy result that the steady-state rate of domestic inflation is equal to the rate of inflation abroad[8].

3 The data

To investigate the model above for the Portuguese economy we use quarterly data for the period 1992q2 to 2006q4. Even though our original quarterly data set dates back to 1978, there is a large set of reasons suggesting that the use of data prior to 1992 should be avoided[9]. Even though this choice has the obvious implication of reducing the

[8] In this type of models the equilibrium unemployment rate, which may be obtained by solving (1), (5) and (6) for the unemployment rate, depends among other factors on productivity. It is easy to show that the equilibrium unemployment rate falls when productivity increases if $\delta < 1$ but it is independent of productivity if $\delta = 1$. This is consistent with the absence of a significant long-run downward trend in the unemployment rate, despite a significant long-run trend growth of productivity in most countries (see Layard *et al.*, 1991).

[9] Some of the reasons why we think it is advisable to exclude from the analysis the data prior to 1992q2 are the following: 1) Significant changes in the unemployment insurance benefit system occurred in 1985, and were followed, in 1989, by changes in the eligibility criteria for insurance benefit and in the entitlement duration period (see, Bover *et al.*, 2000, for details); 2) During the second half of the 1980s a new remuneration system for the government employees was introduced, which brought about large wage increases in the government sector and thus, contaminated the data on global wages in a way that cannot be explained in the context of the model used in this paper; 3) In the early nineties a new monetary policy regime was put into practice by the Portuguese central bank aiming at reaching nominal convergence by 1998 and thus meeting the Maastricht criteria for full participation in the future European Monetary Union (EMU); 4) In 1992q2 a new quarterly unemployment survey with important methodological changes (new sampling procedures and redefinition of the key unemployment variable) was introduced and 5) Some changes in the VAT rates with significant contemporaneous impact on the consumer price index occurred in the first and second quarters of 1992. On the top of these country specific events, the emergence of the EMU, with the Maastricht treaty signed in 1992, brought about

degrees of freedom of our estimated model it however has the advantage of also reducing the probability of significant structural breaks occurring during the estimation period and of allowing us to focus on the most recent period of the Portuguese economy.

All the series are seasonally adjusted. To measure wages, w, we use compensation per employee for the whole economy. Productivity, h, is measured by the ratio of real GDP to total employment and import prices, z, are measured by the total imports deflator. Consumer prices, p, are measured by the consumer price index (CPI)[10].

Figure 1 plots the levels of the logs of all five variables including the real wage, the unit labour costs and the labour share and Figure 2 plots the first differences of some of these variables. From Figure 1 we can see that the real wage increased steadily over the nineties but slowed down afterwards. The labour share, $w - p - h$ exhibits a very similar time pattern. It increases until the year 2000 and exhibits a slightly decreasing trend afterwards. An important point to keep in mind is the fact that the labour share does not behave as a stationary variable during the sample period.

In this paper we assume that w, p, h, z and u are all $I(1)$ variables. Such an assumption, is consistent with the results of the unit-root tests reported in Table 1. In fact, from this Table we conclude that according to the ADF statistic the null of a unit root is not rejected for w, p, h, z and u at standard significance levels, while the null of a unit root is rejected for Δw, Δh, Δz at a 5% test and for Δp and Δu at (around) a 10% test.

In addition to the results of the unit roots tests it is important to notice that treating all the variables as $I(1)$ is also the most sensible choice for the properties of the data, given the theoretical features of our model. As we shall see below, h, z and u are weakly-exogenous for the parameters of the wage and price equations which means that they

several changes with far reaching consequences for the way the economy worked. In particular, the coming into force of the Single European Market at the start of 1993 marked a decisive step in the creation of a wider market for goods and services with the full mobility of people, goods and capital.

[10] With the exception of the CPI, all the remaining series may be downloaded from the Banco de Portugal webpage.

are used to define the common trends of our model and thus, may be seen as the source of the nonstationarity of the system. Thus, if they are assumed $I(1)$ (the most plausible choice) this prevents us from treating w, and p as $I(2)$ variables, despite Δw and Δp seeming to display some nonstationarity in Figure 2.

As regards unemployment one alternative would be to treat it as a stationary variable, as there are theoretical grounds to argue that the population unemployment rate should be seen as $I(0)$. However, virtually all the papers in the empirical literature dealing with wage-price models treat the unemployment rate as $I(1)$ (see, for instance, Bardsen *et al.*, 2006, Pétursson and Slok, 2001, Pétursson, 2002, Bardsen and Fisher, 1999, Greenslade *et al.*, 2002, Marcellino and Mizon, 2000, 2001). In doing so, it is sometimes argued (see, for instance, Pétursson, 2002 and Bardsen et al., 2006) that it does not matter whether we regard unemployment as $I(1)$ or $I(0)$ as both can be handled in a cointegrating VAR and thus, the essential issue is rather whether or not the resultant long-run wage equation is a valid cointegration equation. This claim however does not go without problems because assuming that unemployment is $I(0)$ has strong implications for the identification of the long-run wage equation. In this paper we treat unemployment as $I(1)$ not only because such an assumption is not rejected by the data, but also because, as we shall discuss below, it is required for the identification of the wage equation.

4 Econometric Analysis

The theoretical model developed above proposes two behavioural equations one for wages and one for prices, but does not suggest any long-run behavioural equation for unemployment, productivity or import prices. These three variables appear in the model because we think they may affect wages and/or prices but the model does not include the many variables we believe might explain productivity, unemployment or the import prices. In fact, even though in a real world wages may affect unemployment and productivity (efficiency wages theory) and productivity may also affect unemployment, these relations are not likely to imply further cointegrating vectors in our data set, given the absence of other relevant variables. On the other hand, the model does not also suggest that the disequilibrium in the wage and price equations should appear in the equations for unemployment, productivity and import prices. In other words, the model assumes the existence of only two cointegrating or long-run equations, one for wages and one for prices, and that u, h and z may be weakly-exogenous for the parameters of the long-run wage and price equations.

All these, of course, are testable assumptions of the model. In order to see whether the model is data consistent we start by estimating a full-system VAR model in the five variables: w, p, u, h, and z. The first objective of the exercise will be to identify the long-run wage and price equations and test whether or not unemployment, productivity and import prices can be treated as weakly-exogenous for the purpose of the wage-price system, consistently with the theoretical model presented above[11].

4.1 Full-system cointegration analysis

Consider a VAR model with w, p, u, h and z entering with k lags. Once there is no reason to believe that the long-run wage and price equations are stationary around a deterministic trend we do not allow for deterministic trends restricted to the cointegration space. However, since the data are trending the VAR includes an unrestricted constant. In addition four dummy variables (one step and three impulse dummies) are introduced to allow for special events (namely VAT rate changes) occurred during the sample period[12].

[11] Testing for the weak-exogeneity status of the variables u, h, and z also prevents invalid inference from being made in an otherwise misspecified model if false weak-exogeneity assumptions were imposed at the outset.

[12] These are defined as: d1 which equals 1 in 1995q1 and is zero otherwise, d2 which equals 1 in 2005q3 and is zero otherwise, d3 which equals 1 in 2003q1, -1 in 2003q2 and is zero otherwise, and the step dummy d4 which is zero until 1994q4 and equals 1 from 1995q1 onwards. We note that d1, d2, and d4 are related to changes in the VAT rates and d3 aims at capturing a significant change in prices brought about by oil price increases in an environment of Government energy controlled prices.

The lag length of the VAR was set equal to three, as this is the smallest number of lags that ensures that the residuals of the VAR model are normally distributed and do not exhibit significant serial correlation. Thus, our reduced form VAR model reads as:

$$\Delta x_t = \mu_0 + \varphi\gamma' x_{t-1} + \sum_{i=1}^{2} \Gamma_i \Delta x_{t-i} + \pi D_t + \varepsilon_t, \qquad t = 1, 2, ...T, \tag{13}$$

where $x_t = (w,\ p,\ u,\ h,\ z)$, D_t is the vector of the dummy variables, φ and γ are the $(5 \times r)$ matrices of the loading coefficients and cointegrating vectors, respectively, under the assumption of r cointegrating vectors (with $r \leq 5$).

It is well-known that the conventional critical values of the Johansen cointegration tests are not appropriate when the model includes intervention dummies[13]. One way of overcoming this difficulty is to look at the model without the intervention dummies, as in such a case the critical values available in the literature are directly applicable[14]. Table 2 reports the Johansen cointegration trace tests for the unrestricted full system, estimated without the dummy variables. Given that our sample is a small one we stick the analysis to the small sample corrected tests obtained by using the so-called Reinsel-Ahn correction factor (Cheung and Lai, 1993) and the Bartlett correction factors (Johansen, 2002). While the Reinsel-Ahn corrected trace test suggests the existence of three cointegrating vectors at a 5% significance level, the Bartlett corrected trace test suggests the existence of a single cointegrating vector at a 5% significance level and of two cointegrating vectors at a 10% significance level. However, it is known that the Reinsel-Ahn correction factor leads to tests that tend to be oversized, i.e., tend to find too many cointegrating vectors (see Cheung and Lai, 1993 and Greenslade *et al.*, 2002). Thus, based on the empirical evidence in Table 2, as well as on the characteristics of our

[13] See, for instance, Johansen and Nielson (1993), Johansen et al. (2000), Mosconi (1998) or Dennis (2006). Simulating the correct asymptotic critical values using the program DISCO of Johansen and Nielsen (1993) is worth doing when the sample is large, which is not our case.

[14] This of course under the assumption that the residuals of the resulting model are normally distributed and do not exhibit significant autocorrelation, which is the case of our model. In fact, when the model is estimated without the intervention dummies we get $\chi^2(10)$=8.37 (P=0.59) for the vector normality test, and F(100,82)=1.00 (P=0.50) for the vector autocorrelation test of order 1 to 4.

theoretical model discussed above, the hypothesis of two cointegrating vectors emerges as the natural choice that reconciles the empirical evidence with the theoretical features of the model. Therefore, we proceed by discussing the identification of the long-run wage and price equations under the assumption of two cointegrating vectors.

4.2 Identification of the wage and price equations

It is well known that the unrestricted cointegrating vectors are hardly given any economically meaningful interpretation. This is often the case in practice and suggests the importance of using structural information derived from an assumed underlying model to over-identify the cointegrating vectors[15].

The lack of identification of the wage equation has long ago been recognised in the literature (see, Layard et al., 1991, ch. 9) but, to our knowledge, it has not yet been satisfactorily resolved. Here we address the identification issue in the context of the specific theoretical model developed in section 2 and the VECM model defined above.

In such a framework the identification of the long-run wage and price equations depends on the number of cointegrating vectors of the system. In our case, under the assumption of two cointegrating vectors, the order condition for identification of the wage and price equations (8) and (9) requires one restriction in each equation (besides normalization)[16]. If we take into account the theoretical restrictions on the parameters of the model we see that the theoretical cointegrating vectors in equations (8) and (9) do meet the order condition for identification as there is one restriction on the parameters of equation (8) (which involves the coefficients of p and z) and three restrictions on parameters of equation (9) (a zero restriction on the coefficient of the unemployment rate and two restrictions on the coefficients of w, h and z)[17]. However, the wage equation

[15] For a discussion see, for instance, Söderlind and Vredin (1996) or Bardsen and Fisher (1999).

[16] Identification of cointegrating vectors has been discussed in Johansen and Juselius (1994), Johansen (1995) and Pesaran and Shin (2002), among others.

[17] Note that the order condition would be met even if our model included the unemployment rate in the price equation (see, footnote 7).

is not in fact identified because it does not meet the rank condition for identification. In particular, it can be shown that the restriction in the wage equation does not meet the necessary and sufficient condition stated in Theorem 3 of Johansen (1995). The problem persists even if we impose the additional restriction of $\delta = 1$ in equation (8). In such a case, the restrictions of equation (8) are also met by equation (9), making the rank condition to fail.

In order to overcome the problem one possibility is to impose $\alpha = 0$ in equation (8) such that z drops from the wage equation. In that case it is possible to show that the two equations do meet the necessary and sufficient condition for identification as postulated in Johansen (1995), so that both the wage and price equations become identified. This identifying restriction amounts at imposing $\mu = 1$ at the outset, which means that we are not able to estimate the degree of real wage resistance. Imposing $\alpha = 0$ in equation (8) the system becomes over-identified with three over-identifying testable restrictions[18].

Once we estimate the model imposing these three over-identifying restrictions we realise that the coefficient of productivity, δ, becomes close to one. If we further impose

[18]The identification here assumes that all the five variables of the system are I(1). However, as referred above, sometimes it is claimed that unemployment would be better classified as I(0) (see, for instance, Bardsen *et al.* 2005). Assuming that unemployment is $I(0)$ may have strong consequences for the identification of our model, though. If in addition in equation (8) we have $\alpha = 0$ and $\delta = 1$, a result often found the empirical literature (see, for instance, Pétursson, 2002, Bardsen and Fisher, 1998, Bardsen *et al.*, 2006, and also in our case, as we shall see below) then equation (8) implies that the labour share in consumer prices, $s = w - p - h$, must be stationary (alternatively, stationarity of the labour share also follows if $\delta = 1$, and the real exchange rate $(z - p)$ is stationary). However, if the labour share is stationary we have a problem with the second cointegrating vector. We note that the long-run equation (9) may be rewritten as

$$w - p - h = \frac{\beta - 1}{\beta}(z - p)$$

so that if s is $I(0)$ and $(z - p)$ is $I(1)$ we must have $\beta = 1$. This has the undesirable consequence that we are left with a single cointegrating vector (the labour share) and also unable of introducing a long-run effect of import prices on domestic prices, in the model. This of course would represent a major limitation of the analysis in a small open economy as is the case of Portugal, where we believe that international prices are the main exogenous driver of domestic prices. On the other hand, if $(z - p)$ is $I(0)$ from (9) it follows that the labour share must also be stationary (and thus also the unemployment rate, by equation (8)). In such a case we need to account for the possibility of three cointegrating vectors or rather three stationary disequilibria: the labour share, s, the real exchange rate, $(z - p)$, and the unemployment rate, u. Given that in our data set the labour share is not stationary, treating unemployment as $I(1)$, as we do in this paper may be seen as convenience, which is not contradicted by the unit root tests performed.

this restriction we get the following two cointegrating vectors:

$$w = p + h - 0.059u \tag{14}$$

$$p = 0.510(w - h) + 0.490z \tag{15}$$

where it is worth noticing that the wage equation is such that it implies cointegration between unemployment and the wage share (or real unit labour cost), which is a result often found in the empirical literature[19]. Based on the asymptotic χ^2 critical values, the likelihood-ratio test for the 4 over-identifying restrictions on the two cointegrating vectors rejects the null at a 5 percent test but not at 1 percent test (the P-value of the test is 0.0116). However, the bootstrapped simulated p-value for this test is 0.34 suggesting that the four imposed over-identifying restrictions are data consistent[20].

4.3 Testing for weak-exogeneity of $u, h,$ and z.

Having identified the cointegrating vectors we can now proceed by testing for weak-exogeneity of unemployment, productivity and import prices. The outcome of the weak-exogeneity tests for each variable under the assumption of the two cointegrating vectors (with over-identifying restrictions imposed) is shown in Table 3. From the table we conclude that we cannot treat wages and prices as weakly-exogenous, but we may treat each of unemployment, productivity or import price variables as weakly-exogenous for the parameters of the wage and price equations.

Given the results of the partial weak-exogeneity tests, which accord with what one could expect in the context of our theoretical model, we can proceed by testing simul-

[19] See, for instance, Drèze and Bean (1990) where the wage equations for five out of ten countries are error correction models in which the labour shares and unemployment enter the error-correction term.

[20] It is known that the asymptotic χ^2 critical values may be a very poor approximation for such tests in small samples. In fact, Monte Carlo simulations conducted in Greenslade *et al.* (2002) have shown that tests of over-identifying restrictions on the cointegrating vectors conducted in a full VAR model with unrestricted dynamics and (true) weak-exogeneity restrictions not imposed are hugely oversized (the true set of over-identifying restrictions is rejected 96 percent of the cases, in a test with a nominal size of 5 percent).

taneously the full-set of weak-exogeneity restrictions including additionally the weak-exogeneity restriction of prices for the parameters of the wage equation and the weak-exogeneity restriction of wages for the parameters of the price equation. This amounts to test the hypothesis that the wage error-correction term enters the wage equation only, and that the price error-correction term enters the price equation only.

If not rejected, this hypothesis of 8 weak-exogeneity restrictions in the φ matrix (together with the 4 over-identifying restrictions on the two cointegrating vectors of the γ matrix) will ensure full compatibility between our empirical model and the theoretical model postulated in (8) and (9). Such a test may be performed in two different ways. One possibility is to test the full set of eight weak-exogeneity restrictions, conditional on the restrictions of the γ matrix. For such a test we get a likelihood-ratio statistic with eight degrees of freedom equal to 7.35, with a P-value of 0.50. Thus, the full set of eight weak-exogeneity restrictions (conditional on the restricted γ matrix) is easily accepted by the data[21]. The second possibility amounts at testing simultaneously the full set of 12 restrictions (on the φ and γ matrices). For such a test we get a likelihood-ratio statistic with 12 degrees of freedom equal to 20.29, with a P-value of 0.062 (based on the asymptotic χ^2 distribution) so that the null is not rejected at a 5 percent level. We thus may proceed under the assumption that our theoretical model (including all the underlying restrictions) is consistent with the data for the period under analysis.

After imposing the 8 weak-exogeneity restrictions (together with the 4 over-identifying restrictions) the two long-run estimated wage and price equations read as follows (with asymptotic standard errors in parenthesis):

$$w = p + h - \underset{(0.007)}{0.057} u \tag{16}$$

[21] As anticipated above, we note that the weak-exogeneity status of u, h and z implies that the cumulated residuals of the equations for unemployment, productivity and import prices, in the VAR model (13) define the three common stochastic trends that are the source of the nonstationarity of the system.

$$p = \underset{(0.055)}{0.745}(w-h) + \underset{(0.055)}{0.254}z \tag{17}$$

while the matrix of the loading coefficients becomes

$$\varphi' = \begin{bmatrix} \underset{(0.016)}{-0.097} & 0 & 0 & 0 & 0 \\ 0 & \underset{(0.021)}{-0.118} & 0 & 0 & 0 \end{bmatrix} \tag{18}$$

Notice that while the coefficient of the unemployment rate did not change significantly with the introduction of the weak-exogeneity restrictions, the coefficients of the price equation exhibit a significant change from (15) to (17). However the estimates for the coefficients of the price equation seem now more reasonable, given the values of the labour and imports shares on Portuguese GDP. As for the coefficient of the unemployment rate we note that the estimate of -0.057, even though highly significant, appears to be somewhat lower than standard elasticity estimates obtained in the literature for other countries, which usually stand close to -0.10 (see, Blanchflower and Oswald, 1994, Bardsen *et al.*, 2006). As regards the estimates of the loading coefficients they are relatively small suggesting that the disequilibrium in each market fades away very slowly, as one might expect in the presence of wage and price rigidities[22].

5 Structural analysis

Having established the cointegrating and weak-exogeneity properties of the model an impulse response analysis may now be conducted where the identification of the structural shocks takes into account not only the restrictions implied by cointegration but also the weak-exogeneity status of unemployment, productivity and import prices. Besides those restrictions no additional constraints are imposed on the system so that the impulse response analysis conducted below allows for the empirical interdependencies

[22] In terms of economic interpretation we notice that our VECM model is also consistent with wage and price staggering and lack of synchronization among firms' price-setting, which would imply sluggish adjustment to the equilibrium of wages and prices (see Andersen, 1994, ch.7).

among all the variables of the system. We start by discussing the identification of the structural shocks in the context of our VECM model and then look at the impulse response functions of the structural shocks.

5.1 Identification of the structural shocks

Alternative approaches have been suggested in the literature to identify the structural disturbances in a VECM. Here we follow the approach first suggested in King *et al.* (1991) and further expanded in Crowder *et al.* (1999), and Gonzalo and Ng (2001)[23].

In a VAR model with I(1) variables it is known that cointegration imposes restrictions on the matrix of the long-run effects of the shocks to the system, which must be taken into account for the identification of the structural innovations. In particular, in a system with m endogenous variables and r cointegrating vectors the matrix of the long-run effects has reduced rank $m-r$, implying that $m-r$ structural shocks must have permanent effects and r shocks must have transitory effects. Briefly, let us assume that the structural shocks which we denote by the vector v_t have zero mean and identity covariance matrix. For just identification of the shocks we need a total of $m(m-1)/2$ independent restrictions. Given that $r(m-r)$ restrictions can be derived from the cointegration structure of the model this leaves us with $m(m-1)/2 - r(m-r)$ further restrictions for just identifying the structural innovations. More precisely, $r(r-1)/2$ additional restrictions, which must be placed in the matrix of contemporaneous effects, are required to identify the transitory shocks, and $(m-r)(m-r-1)/2$ restrictions that must be imposed on the matrix of the long-run effects are needed to identify the permanent shocks.

[23]For a very simple and nice discussion of the identification issue in cointegrated VAR models, see Lütkephol (2006). For a critical assessment concerning the interpretation of the shocks, see Juselius (2006) and Giannone *et al.* (2008). In particular, Juselius (2006) argues that structural restrictions on the residuals derived from a theoretical model can only be interpretable and meaningful to the extent that the basic hypotheses derived from the theoretical model are in line with the information in the data. In a similar vein, Giannone *et al.* (2008) show that the estimation of the shocks is not consistent in models contaminated by omitted variables problems.

Our system has five variables and two cointegrating vectors so that three structural shocks must have permanent effects and two shocks must have transitory effects. As cointegration *per se* imposes six restrictions, we only need to impose three additional restrictions on the long-run impact matrix to identify the three permanent shocks and one restriction on the matrix of the contemporaneous effects to identify the two transitory shocks.

Assuming that the relation between the reduced-form errors and the structural innovations is given by $\varepsilon_t = Bv_t$, the long-run restrictions must be imposed on the matrix $A = CB$ where B is the matrix of the contemporaneous effects and C is the matrix of the long-run impacts in the reduced form Moving Average representation of the VAR model.

Given the existence of two cointegrating vectors (and three common stochastic trends) we know that the A (5×5) matrix has rank three so that the imposition of the three identifying restrictions must take this condition into consideration. Assuming that the five variables of the system are ordered as w, p, u, h and z, we consider the following A and B matrices (where * indicates any real number):

$$A = \begin{bmatrix} * & * & * & 0 & 0 \\ * & * & * & 0 & 0 \\ 0 & 0 & * & 0 & 0 \\ 0 & * & * & 0 & 0 \\ * & * & * & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} * & * & * & * & 0 \\ * & * & * & * & * \\ * & * & * & 0 & 0 \\ * & * & * & 0 & 0 \\ * & * & * & 0 & 0 \end{bmatrix} \qquad (19)$$

First notice that the two rightmost columns of zeros in the A matrix follow from the restrictions imposed by cointegration, while the lower-right 3×2 matrix of zeros in the B matrix follows from the weak-exogeneity restrictions on u, h and z [24]. Thus, the identifying restrictions of the three permanent shocks are the three null restrictions in

[24] Imposing the weak-exogeneity restrictions during the estimation process has the implication that the transitory shocks do not have a contemporaneous impact on the weakly-exogenous variables (see, Fisher and Huh, 1999).

the first and second columns of A while the identifying restriction of the two temporary shocks is the null restriction in the first line of the B matrix. Given the ordering of the variables, the specific A and B matrices in (19) imply that we may define the following five structural shocks. The first three shocks are the permanent shocks in the sense that they are allowed to have permanent effects on some (but not necessarily all) the variables of the system, and the last two shocks are the transitory shocks that are not allowed to have permanent effects on any of the variables of the system (which is ensured by the fact that the two last columns of A are zero).

The first shock, which we shall denote as v_1, is identified by the condition that it has a zero long-run impact on the real variables, unemployment and productivity (and is allowed to have permanent effects on the nominal variables: wages, consumer prices and import prices). The second shock, denoted as v_2, is identified by the condition that it has a zero long-run effect on unemployment (and is allowed to have non-zero permanent effects on the remaining variables) and the third shock, v_3, is allowed to have permanent effects on all the variables of the system. In its turn, the transitory shock, v_4, is identified from the B matrix as the shock that is allowed to have contemporaneous effects on both wages and prices while shock v_5 is not allowed to have a contemporaneous effect on wages.

We note that the permanent shocks so defined have a natural interpretation in the context of our theoretical model. The permanent shock v_1 can be interpreted as a nominal shock and more specifically as an import price shock, which according to our theoretical model is expected to have long-run equal impact on nominal wages and prices, thus leaving the real wage unchanged in the long run, and having no long-run impact on unemployment and productivity. In the context of our model such a shock may stem from an unexpected change in the prices of imported products or from an unexpected change in the nominal exchange rate.

The second permanent shock v_2 can be interpreted as a productivity shock, which given the fact that $\delta = 1$ in the wage equation, will be completely absorbed by wages, having no long-run direct effect on unemployment (and prices).

The third shock, v_3, can be interpreted as a permanent unemployment shock, which in the context of our theoretical model is expected to have permanent effects on the nominal wages and prices, as well as on real wages. We can think of a permanent unemployment shock as stemming from an unexpected increase in labour supply[25].

Finally, v_4 is defined as a transitory shock to nominal wages (originating, for instance, from a transitory demand shock) and v_5 as a transitory shock to consumer prices (stemming, for instance, from an unexpected monetary policy shock)[26].

Given the identification above we get the estimated matrices of the contemporaneous (B) and the long-run (A) effects reproduced in Tables 4 and 5, with asymptotic standard errors in parenthesis[27].

[25] In the context of our model it is not possible to distinguish between permanent labour supply and permanent labour demand shocks because none of these variables is explicitly modelled. Usually it is assumed that labour demand shocks have only transitory effects in this type of models (see, for instance, Jacobson et al. 1997, Carstensen and Hansen, 2000, and Hansen and Warne, 2001). However, in Brüggemann (2006), both permanent supply and labour demand shocks are considered.

The important point to notice is that in our model a unit root in unemployment means that there must be some shocks which have permanent effects on unemployment. However, we do not take a stand on whether such permanent changes in unemployment are solely the result of supply shocks or may also result from permanent labour demand shocks.

[26] Usually changes in the bargaining power of the unions, in the unemployment benefit ratio and in the duration of benefit entitlements are suggested as potential sources of autonomous wage growth (see, Layard *et al.*, 1991). However, in the context of our theoretical model, with two cointegrating vectors that define the long-run wage and price equations, and where the nonstationarity of the model is driven by three stochastic common trends (which are defined from the cumulated residuals of the equations for u, h, and z) it is not possible to think of a "permanent autonomous change" in wages originating in shocks to the bargaining power of the unions, to the unemployment benefit ratio or to the duration of benefit entitlements. In other words, our model assumes that the institutional features of the labour market are constant or, if not, their changes have solely transitory effects on the variables of the system. See also the discussion in section 2 concerning the wage equation.

[27] The model was estimated using Structural VAR 0.40, developed by Anders Warne.

5.2 Persistence of wages and prices

We now look at the impulse response functions with a especial emphasis on real wages and wage and price inflation. The impulse response functions of the five shocks are depicted in Figures 3-7[28].

In order to quantify the speed of adjustment of such variables to the different shocks we compute some measures of persistence[29]. Given the type of information at hand (the impulse response functions) we have two, basically equivalent, possibilities of computing scalar measures of persistence. We can either compute the number of periods (quarters) required for a certain proportion (10, 50, 90 percent, say) of the total disequilibrium to dissipate (see, for instance, Dias and Marques, 2005) or compute the proportion of the total disequilibrium that dissipates in a given number of periods (1, 4, 8, etc.). These measures appear as particularly suitable to evaluate how fast the impulse response functions approach the new long-run equilibrium level[30]. For simplicity we assume that all the adjustments have taken place by the very last period of the simulations (the 40th period). This in fact seems a reasonable simplifying assumption given the visual inspection of the impulse response functions in Figures 3-7[31].

Table 6 displays the proportion of the total disequilibrium that has dissipated after 1, 4, 8, 12, 16, 20, 24 and 32 quarters. This way we may compare the different speeds of

[28] The impulse response functions for the 5 original variables of the system are depicted together with 80% confidence bands.

[29] For the purpose of the exercise that follows we think of persistence as the speed with which the impulse response function converges to the new equilibrium (long-run level) after a shock. This definition of persistence is fairly standard in the literature. See, for instance, Marques (2004) and the references therein.

[30] Notice that we compute the persistence of the deviations from equilibrium, so that when the new equilibrium of the variable is zero (for instance, real wage, wage inflation and price inflation, in the case of the import price shock) there is no issue of concern. However, for those variables for which the new equilibrium is not zero (for instance, nominal wages and prices, in the case of the import price shock) we compute persistence of the deviations of the impulse response function from the new long-run equilibrium level.

[31] Our measure of persistence may be significantly distorted by this simplifying assumption if an important part of the total adjustment occurs after the assumed 40 periods, but is not affected if all the adjustment occurs in less than the assumed 40 periods (as seems to be case in most of the computed impulse response functions).

adjustment across variables and across shocks in the short run, as well as in the medium to long run.

Figure 3 depicts the impulse responses to a permanent positive import price shock which, as we have seen, is identified by the condition that it has no long-run effects on unemployment and productivity. An unexpected increase in import prices brings about a permanent increase in nominal wages and prices such that in the long run the effect is the same, as one could expect given the property of nominal homogeneity of the model. As a result real wages as well as the labour share are unaffected in the long run.

However, in the short run prices increase faster than nominal wages so that in fact real wages decrease during the first two years or so, before starting to slowly return to the previous equilibrium level. While the largest impact on inflation occurs almost contemporaneously, the largest impact on wage changes only occurs after 10 quarters. The real wages, the labour share and wage inflation all display a very persistent hump-shaped response type to this shock. From Table 6 we can see that after two years (8 quarters) only 53 percent, 31 percent and 53 percent of the total disequilibrium has dissipated for real wages, wage inflation and price inflation, respectively. Moreover it takes about 5 years for 90 percent of the disequilibrium to dissipate in the case of real wages (about 6 years in case of wage and price inflation).

The larger short-term persistence of wages following an import price shock comes hardly as a surprise. On the one hand, the import price shock impacts directly on prices and only indirectly on wages. On the other hand, it is known that in Portugal wages are adjusted once a year on average (see, Cardoso and Portugal, 2005), while prices are known to change more frequently, thus allowing a much faster short-term response of prices to an import price shock[32].

[32] According to Dias *et al.* (2004) the monthly frequency of price changes in Portugal, for the period 1992-2001, is 0.22 (higher than in most European countries) and the median duration of price spells is of 8.5 months. On the other hand, using survey data for Portugal, Martins (2005) finds that prices change on average 1.9 times a year.

Figure 4 depicts the impulse responses to a permanent productivity shock, which is identified by the condition that it has no long-run effect on the unemployment rate. In the context of our model productivity gains are all absorbed by wages in the long run. Thus, in the long run we should expect nominal wages to increase in line with productivity and prices and unemployment to remain constant, which is exactly what we get in Figure 4. Also, as expected, we have a permanent increase in the real wage, but no long-run effect on the labour share.

In the short run an increase in productivity brings about a decrease in the price level (during the first 6-7 quarters) and a rapid increase in nominal wages, so that real wages increase very fast and exhibit some overshooting before starting to converge to the new equilibrium level. This increase in real wages implies a short-run increase in unemployment that lasts for about one year.

A noticeable fact is that the adjustment of real wages to the new equilibrium level is faster than in the case of an import price shock, as the same proportion of the total adjustment occurs one year earlier (see Table 6). In the case of wage inflation the adjustment is even faster as 59 percent of the disequilibrium dissipates in the first two years (as opposed to 31 percent in the case of the import price shock). It takes about three years and a half for 90 percent of the disequilibrium to dissipate in the case of real wages (about five years and a half in case of wage and price inflation).

Figure 5 displays the impulse responses to a permanent positive unemployment shock (or a labour supply shock), which is identified as the shock that may have long-run effects on all the variables of the model. It is seen that such a shock is associated with a permanent decrease in nominal wages, prices and productivity, in the long run. As a result, real wages, as well as the labour share decrease permanently to a lower equilibrium level.

In the short run (first two years), however, prices increase in line with a short-term increase in import prices and in the nominal unit labour costs (stemming from a quicker reaction of productivity than wages to the shock).

The largest decrease in wages is obtained one year after the shock (as expected, given the annual revision of wages) despite the recorded increase in inflation during the first year. After two years 66 percent of the total disequilibrium in real wages has already dissipated meaning that real wages are less persistent in face of an unemployment shock than in face of an import price shock, even though slightly more persistent than in face of a productivity shock. This accords with the idea that in Portugal real wages react very quickly and significantly to negative news coming from the labour market. Thus, if anything, real wages emerge as adjusting very quickly to shocks to unemployment, suggesting that wage flexibility, understood as the reaction of real wages to changes in unemployment, is very high in the Portuguese labour market.

As far as wage and price inflation are concerned, we see from Table 6 that wage inflation is also less persistent than in the case of the import price shock (slightly more than in the case of the productivity shock), but price inflation is somewhat more persistent, as could be expected given that the import price shock impacts directly on domestic inflation whereas unemployment is expected to impact only indirectly through lower wages. As regards the long-run adjustment, it takes about four years for 90 percent of the disequilibrium to dissipate in the case of real wages (about six years in case of wage and price inflation).

We now take a brief look to the two transitory shocks (see Figures 6 and 7). The interpretation of these shocks is not as intuitive as that of the permanent shocks, because their identification is not so well grounded on economic theory.

The effects of the transitory positive wage shock look very much like the expected effects of transitory positive demand shock. In fact, from Figure 6 we see that such a shock brings about a temporary decrease in unemployment that lasts for about six quarters, and gives rise to a temporary nominal (and real) wage increase, being also followed, two periods later, by a temporary increase in prices (and inflation). Overall, this shock may be seen as evidence that transitory demand shocks create a short-run relation between real wages and unemployment that lasts for five so six quarters. On the other hand, the effects of a transitory positive price shock look very much like the expected effects of a monetary policy shock (unexpected increase in the interest rate), with the so-called liquidity effect. In fact, from Figure 7 we see that in the very short run there is an increase in inflation (in the first two quarters) and a decrease afterwards. Such a shock is also accompanied by a temporary decrease in import prices (brought about by a currency appreciation) and a temporary increase in unemployment (due to a decrease in demand) that brings about a temporary decrease in nominal (and real) wages that lasts for about one year.

As expected, persistence of the transitory shocks is lower than that of the permanent shocks. From Table 6 we see that for both shocks about 75 percent of the disequilibrium in the real wage dissipates during the first two years, while in the same period, the proportion of the adjustment of price inflation following a transitory wage shock is about 60 percent and that of the adjustment of wage inflation following a transitory price shock is 56 percent.

5.3 Forecast-errors variance decomposition of the shocks

We now investigate how important are the different shocks in accounting for the observed fluctuations in wages and prices, by looking at the forecast-error variance decompositions for the variables of the model (see Table 7).

As expected, the two transitory wage and price shocks explain the largest amount of the variation in the corresponding variables at the very short horizons of 1 to 4 quarters, but little else.

Shocks to import prices are not important for wage developments but are very important for price developments especially at the business cycle horizons (3-5 years). For those periods, on average around 60 percent of the variation in the forecast errors in prices is attributable to import price shocks.

The permanent productivity shock explains a considerable amount of the variation in productivity but a relatively small proportion of the forecast errors in wages and prices (somewhat less than 10 percent).

Unemployment shocks emerge as the most important shocks that explain not only more than 90 percent of the variation in unemployment itself but also a considerable amount of the variation in wage and productivity developments. This is especially the case at the business cycle horizons in which these are responsible for about 80 percent of the variation in the forecast errors of wages and for about 60 percent of the variation in the forecast errors of productivity. For this horizon this shock is also important for prices even though not as much as import price shocks, being responsible for about 20 percent of the variation in the corresponding forecast errors.

In summary, in the very short run (1 to 4 quarters) variation in the forecast-errors of wages and prices is attributable to the transitory wage and price shocks, respectively. At the business cycle horizon variation in the forecast errors of wages is attributable mainly to unemployment shocks, whereas variation in the forecast errors of prices is attributable mainly to import price shocks and, to a lesser extent, to unemployment shocks. Productivity shocks explain a relatively small proportion of the forecast errors in wages and prices.

5.4 Historical decomposition of forecast errors

Figure 8 illustrates the roles played by the different shocks by plotting the forecast-error at the three-year horizon (12 quarters) and the portion attributable to each shock for wages and prices. It can be seen that the permanent unemployment shock plays a substantial role in explaining the forecast errors in wages and, to a lesser extent, in prices and the permanent import price shock has an important role in explaining the forecast errors in prices (even though at this horizon the temporary price shock also plays a role). Looking at specific episodes in Figure 8 we conclude that in the period 1996-2001 the decline in inflation is attributable to the permanent import price shock, as well as to the transitory price shock, whereas for the most recent period (after 2002) only the permanent import price shock plays a major role. In turn, the forecast errors in wages are mainly attributable to the permanent unemployment shock for all the sample period (with the transitory wage shock also playing a role in the late nineties). Thus, unemployment emerges as the major explanation for the wage acceleration in the period 1996-2000 (in this period unemployment decreased steadily from 6.3 percent in 1996q1 to 3.7 percent in 2000q4), as well as for the wage decceleration in the period 2001-2006 (in this period unemployment increased steadily from 3.9 percent in 2001q1 to 7.9 percent in 2006q4).

5.5 Consequences of the EMU for the impulse response functions

The emergence of the European Monetary Union (EMU) in 1999, with the introduction of a common currency, implied a significant change in the monetary policy regime at the country level, as the possibility of an independent monetary policy was lost. As a consequence the reaction of the nominal exchange rate to some of the shocks that hit the Portuguese economy during the sample period is likely to be different for the periods before and after the emergence of the EMU. In particular, this is the case of idiosyncratic shocks (the ones that hit the Portuguese economy and not the euro area), which are not expected to bring about significant changes in the nominal exchange rate in the period after the emergence of the EMU. On the other hand, however, shocks common to all the EMU countries (e.g., commodity or oil price shocks) may be expected to have significant implications for the nominal exchange rate, just as before the EMU. Thus, as far as the effect of the import price shock is concerned, there are no strong reasons to expect significant changes to have occurred with the emergence of the EMU. There are also no strong reasons to believe that the effects of a productivity shock may have been significantly affected with the emergence of the EMU, as in the estimated model it does not involve a significant change in the exchange rate. However, the dynamics of the remaining shocks (the permanent unemployment shock and the two transitory wage and price shocks) may have undergone significant changes because the estimated impacts involve changes on the import price deflator (brought about by changes in the nominal exchange rate) that cannot reasonably be assumed to hold for the EMU period. A formal test of these hypotheses cannot however be conducted given the small number of observations for the two sub-periods.

6 Conclusions

This paper investigates the persistence of aggregate wages and prices in the Portuguese economy assuming a model of a unionized economy with imperfect competition, where wages are determined through collective bargaining and prices are set by imperfectly competitive firms.

The analysis is conducted within a structural vector error-correction model (SVECM), where two separate cointegrating relationships for wages and prices are identified by imposing the long-run restrictions implied by the theoretical model. The weak-exogeneity status of unemployment, productivity and import prices, implicitly assumed in the derivation of theoretical model, is investigated and comfortably accepted by the data.

Following the cointegrating and weak-exogeneity properties of the system three permanent and two transitory shocks are identified. The permanent shocks, which we label as "import price", "productivity" and "unemployment" shocks, are identified using the economic theory that underlies our theoretical model and, by definition, they are allowed to have significant long-run effects on some (or all) the variables of the system. The two transitory shocks, which we label as "wage" and "price" shocks are identified by imposing one restriction on the matrix of the contemporaneous effects and, by definition, are not allowed to have any long-run impact on the variables of the system.

As expected, we find that the relative persistence of wages and prices (including real wages and wage and price inflation) varies with the type of shock hitting the economy. In particular, real wages are especially persistent following a permanent import price shock, such that only 53 percent of the total disequilibrium dissipates in the first two years after the shock. This compares to 66 percent in the case of a permanent unemployment shock and to 69 percent in the case of permanent productivity shock (around 75 percent in case of the two transitory wage and price shocks). Similar conclusions hold for wage inflation. Two years after the shock only 31 percent of the total disequilibrium has dissipated in case of an import price shock, compared to 51 percent in the case of the unemployment shock and 59 percent in the case of a productivity shock. In contrast, price inflation is more persistent following a permanent unemployment shock (only 42 percent of the total disequilibrium dissipates in the first two years after the shock, compared to 53 percent in the case of a permanent import price shock). These results accord with intuition because an import price shock impacts directly on domestic prices (or domestic inflation) and only indirectly on wages, while an unemployment shock impacts directly on wages and mainly indirectly on prices through lower wages.

From the analysis of the forecast-error variance decomposition we conclude that at the business cycle horizon (3-5 years) variation in the forecast errors of wages are attributable mainly to unemployment shocks (in about 80 percent) whereas variation in the forecast errors of prices are attributable mainly to import price shocks (around 60 percent) and to unemployment shocks (around 20 percent). Productivity shocks explain a relatively small proportion of the forecast errors in wages and prices (less than 10 percent).

Looking at the historical decompositions we conclude that during the period 1996-2001 the decline in inflation is attributable both to the permanent import price shock as well as to the transitory price shock, whereas for the most recent period (2002-2006) only the permanent import price shock plays a major role. In turn, the forecast errors in wages are mainly attributable to the permanent unemployment shock for all the sample period (with the transitory wage shock also playing a role during the late nineties, 1996-1998). Thus, unemployment emerges as the major factor explaining both the wage acceleration in the period 1996-2000, as well as the wage decceleration in the period 2001-2006.

Concerning the implications for the impulse response analysis conducted in this paper, we may expect the emergence of the European Monetary Union in 1999, to have brought about significant changes for some of the shocks. This is especially the case of the permanent unemployment shock (but also of the two transitory wage and price shocks), which may be expected to have undergone significant changes because the estimated impact involves significant changes on the import price deflator (brought about by changes in the nominal exchange rate) that cannot reasonably be assumed to hold after the creation of the European Monetary Union. However, there seems not to be strong reasons to expect that significant changes on the effects of the permanent import prices and productivity shocks have occurred.

References

Andersen, T. M., 1994. *Price rigidity, Causes and Macroeconomic Implications.* Clarendon Press, Oxford.

Bardsen, G., Eitrheim, O., Jansen, E.S., Nymoen, R., 2005. *The econometrics of macroeconomic modelling.* Oxford University Press;

Bardsen, G., Fisher, P. G., 1999. Economic theory and econometric dynamics in modelling wages and prices in the United Kingdom. *Empirical Economics*, 24, 483-507;

Bardsen, G., Hurn, S., McHugh, Z., 2006. Modelling wages and prices in Australia. Mimeo.

Blanchard, O., Galí, J., 2007. Real wage rigidities and the new Keynesian model. *Journal of Money Credit and Banking*, 39, 1, 35-65;

Blanchard, O., Katz, L.,1999. Wage dynamics: Reconciling theory and evidence. *American Economic Review*, 89, 69-74;

Blanchard, O., Wolfers, J., 2000. The role of shocks and institutions in the rise of European unemployment: the aggregate evidence. *The Economic Journal*, 110, C1-C33;

Blanchflower, D. G., Oswald, A. J., 1994. *The wage curve.* The MIT Press, Cambridge, MA.

Bover O., García-Perea P., Portugal, P., 2000. Labour markets outliers: lessons from Portugal and Spain. *Economic Policy*, October, 380-428;

Brüggeman, R., 2006. Sources of German unemployment: a structural error correction analysis. *Empirical Economics*, 31, 409-431;

Cardoso, A.R., Portugal, P., 2005. Contractual wages and the wage cushion under different bargaining settings. *Journal of Labour Economics*, 23, 503-523;

Carstensen, K., Hansen, G., 2000. Cointegration and common trends on the West German labour market. *Empirical Economics*, 25, 475-493;

Centeno, M., Novo, A., 2007. Identifying unemployment insurance income effects with a quasi-natural experiment". *Banco de Portugal, Working Paper No.10/2007*;

Cheung, Y-W., Lai, K.S., 1993. Finite-sample sizes of Johansen's likelihood ratio tests for cointegration. *Journal of Political Economy*, 113, 1, 1-45;

Christiano, L.J., Eichenbaum, M., Evans, C.L., 2005. Nominal rigidities and the dynamic effects of a shock to monetary policy. *Oxford Bulletin of Economics and Statistics*, 55, 3, 313-328;

Crowder, W. J., Hoffman, D. L., Rasche, R. H., 1999. Identification, long-run relations, and fundamental innovations in a simple cointegrated system. *The review of Economics and Statistics*, 81, 109-121;

Dennis, J., G., 2006. *Cats in Rats - Cointegration Analysis of Time Series*. Version 2, Estima, USA;

Dias M., Dias, D., Neves, P.D., 2004. Stylised features of price setting behaviour in Portugal: 1992-2001. *European Central Bank, Working Paper No. 332*;

Dias, D., Marques, C. R., 2005. Using mean reversion as a measure of persistence. *European Central Bank, Working Paper No. 450*;

Drèze, J.H., Bean, C.R., 1990. Europe's unemployment problem: Introduction and synthesis. In *Europe's unemployment problem*, Drèze. J.H., Bean, C.R., (eds), Cambridge, Mass.: MIT Press.

Erceg, C.J, Henderson D.W., Levin, A.T., 2000. Optimal monetary policy with staggered wage and price contracts. *Journal of Monetary Economics*, 46, 281-313;

Fisher, L. A., Huh, H-s., 1999. Weak exogeneity and long-run and contemporaneous identifying restrictions in VEC models. *Economics Letters*, 63, 159-165;

Giannone, D., Lenza, M., Reichlin, L., 2008. Explaining the great moderation. *European Central Bank, Working Paper No. 865*;

Gonzalo, J., Ng, S., 2001. A systematic framework for analyzing the dynamic effects of permanent and transitory shocks. *Journal of Economic Dynamics & Control*, 25, 1527-1546;

Greenslade, J. V., Hall, S. G., Henry, B., S. G., 2002. On the identification of cointegrated systems in small samples: a modelling strategy with an application to UK wages and prices. *Journal of Economic Dynamics and Control*, Vol. 26, 1517-1537;

Hansen, H., Warne, A., 2001. The cause of Danish unemployment: Demand or supply shocks?. *Empirical Economics*, 26, 461-486;;

Jacobson, T., Vredin, A., Warne, A., 1997. Common trends and hysteresis in Scandinavian unemployment. *European Economic Review*, 41, 1781-1816;

Johansen, S., 1995. Identifying restrictions of linear equations with applications to simultaneous equations and cointegration. *Journal of Econometrics*, 69, 111-132;

Johansen, S., 2002. A small sample correction for the test of cointegration rank in the vector autoregressive model. *Econometrica*, 70, 1929-1961;

Johansen, S., Juselius, K., 1994. Identification of the long-run and the short-run structure: An application to the ISLM model. *Journal of Econometrics*, 63, 7-36;

Johansen, S., Mosconi, R., Nielson, B., 2000. Cointegration Analysis in the presence of structural breaks in the deterministic trend. *Econometrics Journal*, 3, 216-249;

Johansen, S., Nilsen, B., 1993. Manual for the simulation program DISCO. *Institute of Mathematical Statistics*, University of Copenhagen;

Juselius, K., 2006. *The Cointegrated VAR model.* Oxford University Press.

King, R.G., Plosser C.I., Watson M.W., 1991. Stochastic trends and economic fluctuations. *The American Economic Review*, 81, 819-840;

Krugman, P., 1987. Pricing to market when the exchange rate changes. In S. Arndt and J. Richardson (eds), *Real-Financial Linkages Among Open Economies*, Cambridge: MIT Press;

Layard, R., Nickell, S., Jackman, R., 1991. *Unemployment*, Oxford University Press;

Levin, A., Onatski, A., Williams, J.C., Williams, N., 2005. Monetary policy under uncertainty in micro-founded macroeconometric models. *NBER, Working Paper 11523*;

Lindbeck, A., 1993. *Unemployment and macroeconomics*, The MIT Press;

Lütkepohl, H., 2006. Structural vector autoregressive analysis for cointegrated variables. *Allgemeines Statistics Archiv*, 90, 75-88;

Marcellino, M., Mizon, G.E., 2000. Modelling shifts in the wage-price and unemployment-inflation relationships in Italy, Poland and the UK. *Economic Modelling*, 17, 387-413;

Marcellino, M., Mizon, G.E., 2001. Small-system modelling of real wages, inflation, unemployment and output per capita in Italy 1970-1994. *Journal of Applied Econometrics*, 16, 359-370;

Marques, C. R., 2004. Inflation persistence: facts or artefacts?. *European Central Bank, Working Paper No. 371*;

Martins, F., 2005. The price setting behaviour of Portuguese firms: evidence from survey data. *European Central Bank, Working Paper No. 562*;

Moore, T., Pentecost, E.J., 2006. An investigation into the sources of fluctuation in real and nominal wage rates in eight EU countries: A structural VAR approach. *Journal of Comparative Economics*, 34, 357-376.

Mosconi, R., 1998. *Malcolm - The theory and practice of cointegration analysis in Rats.* Cafoscarina;

Nickell, S., Andrews, M., 1983. Unions, real wages and employment in Britain 1951-79. *Oxford Economic Papers*, 35, 183-206;

Pesaran, M. H., Shin, Y., 2002. Long-run structural modelling. *Econometric Reviews*, Vol. 21, No.1, 49-87;

Pétursson, T. G., 2002. Wage and price formation in a small open economy: Evidence from Iceland. *Central Bank of Iceland, Working Paper No.16*;

Pétursson, T. G., Slok, T., 2001. Wage formation and employment in a cointegrated VAR model. *Econometrics Journal*, 4, 191-209;

Söderlind, P., Vredin, A., 1996. Applied cointegration analysis in the mirror of macroeconomic theory. Journal of Applied Econometrics, 11, 363-381;

TABLE 1

Augmented Dickey-Fuller (ADF) Tests				
w	p	u	h	z
ADF(5)=-0.03	ADF(2)=-3.11	ADF(3)=-1.94	ADF(2)=-0.80	ADF(3)=-3.77
Δw	Δp	Δu	Δh	Δz
ADF(3)=-3.03	ADF(2)=-2.84	ADF(1)=-2.48	ADF(2)=-11.2	ADF(1)=-5.83

ADF(k) stands for the test with k lags, where k is the smallest number of lags that ensures that the residuals do not display significant autocorrelation. The critical values of the test for w, p, h and z (model with a time trend) are -4.14 (1%) and -3.49 (5%). The critical values of the test for u, Δw, Δp, Δu, Δh and Δz (test with a constant) are -3.57 (1%), -2.92 (5%) and -2.59 (10%).

TABLE 2

Cointegration Trace Tests					
Rank	Corrected trace test(a)	Corrected trace test(b)	90% quantile	95% quantile	99% quantile
0	88.12***	78.26***	64.74	68.68	76.37
1	59.47***	44.96	43.84	47.21	53.91
2	33.44**	21.08	26.70	29.38	34.87
3	14.02	4.19	13.31	15.34	19.69
4	1.90	0.55	2.71	3.84	6.64

Note: *** and ** mark significance at 1% and 5% respectively;
(a) Small sample corrected trace test using the Reinsel-Ahn correction (Cheung and Lai, 1993);
(b) Small sample corrected trace test using the Bartlett correction factors (Johansen, 2002);

TABLE 3

Weak-exogeneity tests (Under the hypothesis of two cointegrating vectors)					
	Equations				
	w	p	u	h	z
Test [Pvalue]	28.20 [0.000]	17.37 [0.000]	4.47 [0.107]	0.12 [0.941]	4.57 [0.102]

TABLE 4

Comtemporaneous (B) matrix of the structural VAR model

Equation	$v1$	$v2$	$v3$	$v4$	$v5$
w	0.000207 (0.000142)	0.000071 (0.000143)	−0.000234 (0.000143)	0.000902 (0.000085)	0
p	0.000112 (0.000267)	−0.000194 (0.000230)	0.000492 (0.000224)	−0.000029 (0.000214)	0.001602 (0.000151)
u	−0.002597 (0.010604)	0.008593 (0.005317)	0.034266 (0.003670)	0	0
h	0.000702 (0.001647)	0.005260 (0.000596)	−0.001548 (0.001152)	0	0
z	0.010461 (0.001070)	−0.000887 (0.003441)	0.001035 (0.003397)	0	0

TABLE 5

Long run (A=C*B) matrix of the structural VAR model

Equation	$v1$	$v2$	$v3$	$v4$	$v5$
w	0.004276 (0.0001345)	0.003619 (0.001825)	−0.011711 (0.007772)	0	0
p	0.004276 (0.0001345)	0.000537 (0.001574)	−0.003583 (0.003679)	0	0
u	0	0	0.068981 (0.035023)	0	0
h	0	0.003081 (0.000550)	−0.004186 (0.002867)	0	0
z	0.004276 (0.0001345)	0.000537 (0.001574)	0.008002 (0.003910)	0	0

TABLE 6

Persistence of wages and prices					
(Proportion of total desiquilibrium that has dissipated after a given number of quarters)					
Permanent import price shock					
Quarters	w	p	$w-p$	Δw	Δp
1	0.145	0.176	0.024	0.067	0.163
4	0.350	0.392	0.191	0.135	0.325
8	0.585	0.599	0.532	0.313	0.532
12	0.745	0.749	0.728	0.572	0.660
16	0.847	0.851	0.829	0.713	0.782
20	0.915	0.916	0.914	0.816	0.861
24	0.956	0.956	0.954	0.893	0.914
32	0.993	0.993	0.994	0.968	0.975
Permanent productivity shock					
1	0.200	0.078	0.349	0.039	0.202
4	0.432	0.268	0.603	0.358	0.389
8	0.573	0.542	0.692	0.592	0.580
12	0.743	0.693	0.859	0.690	0.760
16	0.849	0.816	0.922	0.864	0.786
20	0.908	0.897	0.941	0.892	0.883
24	0.956	0.944	0.981	0.931	0.924
32	0.992	0.991	0.995	0.978	0.979
Permanent unemployment shock					
1	0.171	0.096	0.331	0.082	0.115
4	0.375	0.286	0.557	0.335	0.280
8	0.568	0.522	0.662	0.505	0.421
12	0.729	0.689	0.809	0.599	0.597
16	0.837	0.811	0.889	0.755	0.706
20	0.906	0.893	0.993	0.834	0.816
24	0.952	0.943	0.969	0.897	0.884
32	0.992	0.991	0.995	0.969	0.966
Transitory wage shock					
1	0.170	0.029	0.201	0.039	0.090
4	0.528	0.105	0.574	0.456	0.341
8	0.599	0.473	0.743	0.704	0.590
12	0.725	0.621	0.849	0.841	0.819
16	0.851	0.739	0.926	0.923	0.876
20	0.886	0.851	0.952	0.954	0.934
24	0.940	0.901	0.983	0.970	0.965
32	0.981	0.972	0.994	0.993	0.991
Transitory price shock					
1	0.032	0.317	0.239	0.066	0.414
4	0.197	0.663	0.574	0.240	0.618
8	0.581	0.740	0.767	0.559	0.816
12	0.798	0.840	0.868	0.815	0.890
16	0.832	0.922	0.925	0.889	0.951
20	0.933	0.942	0.970	0.934	0.972
24	0.953	0.972	0.983	0.972	0.982
32	0.990	0.991	0.996	0.995	0.996

TABLE 7

Forecast-error variance decomposition										
Fraction of the forecast-error variance decomposition attributable to each shock, at different horizons										
Permanent import price shock										
Horizon	w	*s.e.*	p	*s.e.*	u	*s.e.*	h	*s.e.*	z	*s.e.*
1	0.047	(0.063)	0.004	(0.021)	0.005	(0.044)	0.016	(0.076)	0.983	(0.084)
4	0.017	(0.057)	0.114	(0.150)	0.029	(0.091)	0.007	(0.025)	0.929	(0.091)
8	0.021	(0.073)	0.260	(0.233)	0.030	(0.088)	0.003	(0.013)	0.860	(0.123)
12	0.047	(0.095)	0.457	(0.230)	0.025	(0.074)	0.002	(0.012)	0.813	(0.181)
16	0.071	(0.109)	0.605	(0.167)	0.022	(0.062)	0.002	(0.011)	0.823	(0.177)
20	0.082	(0.116)	0.678	(0.127)	0.018	(0.053)	0.002	(0.009)	0.824	(0.168)
40	0.101	(0.121)	0.658	(0.296)	0.011	(0.033)	0.001	(0.005)	0.679	(0.256)
Permanent productivity shock										
1	0.006	(0.022)	0.013	(0.031)	0.059	(0.074)	0.905	(0.128)	0.007	(0.055)
4	0.025	(0.037)	0.093	(0.103)	0.008	(0.014)	0.654	(0.175)	0.006	(0.028)
8	0.127	(0.094)	0.135	(0.146)	0.004	(0.007)	0.491	(0.204)	0.031	(0.087)
12	0.111	(0.096)	0.105	(0.135)	0.005	(0.012)	0.433	(0.219)	0.066	(0.126)
16	0.098	(0.095)	0.075	(0.108)	0.005	(0.012)	0.404	(0.228)	0.069	(0.133)
20	0.094	(0.097)	0.052	(0.077)	0.004	(0.011)	0.388	(0.236)	0.070	(0.137)
40	0.083	(0.099)	0.018	(0.018)	0.003	(0.007)	0.365	(0.263)	0.053	(0.115)
Permanent unemployment shock										
1	0.060	(0.070)	0.085	(0.072)	0.936	(0.070)	0.078	(0.114	0.010	(0.063)
4	0.460	(0.137)	0.354	(0.169)	0.955	(0.094)	0.333	(0.175)	0.018	(0.084)
8	0.731	(0.150)	0.391	(0.226)	0.958	(0.102)	0.503	(0.206)	0.037	(0.059)
12	0.778	(0.168)	0.282	(0.210)	0.965	(0.091)	0.562	(0.223)	0.059	(0.124)
16	0.794	(0.182)	0.209	(0.132)	0.971	(0.078)	0.593	(0.233)	0.053	(0.110)
20	0.801	(0.190)	0.192	(0.102)	0.975	(0.068)	0.609	(0.240)	0.055	(0.079)
40	0.810	(0.197)	0.303	(0.313)	0.985	(0.043)	0.634	(0.266)	0.234	(0.249)
Transitory wage shock										
1	0.888	(0.079)	0.000	(0.004)	0	(–)	0	(–)	0	(–)
4	0.469	(0.115)	0.004	(0.009)	0.002	(0.005)	0.002	(0.004)	0.002	(0.002)
8	0.102	(0.044)	0.034	(0.021)	0.001	(0.002)	0.002	(0.002)	0.004	(0.005)
12	0.048	(0.025)	0.033	(0.019)	0.001	(0.001)	0.001	(0.002)	0.011	(0.009)
16	0.028	(0.018)	0.024	(0.013)	0.001	(0.001)	0.001	(0.001)	0.010	(0.009)
20	0.017	(0.011)	0.018	(0.010)	0.001	(0.001)	0.001	(0.001)	0.010	(0.008)
40	0.005	(0.004)	0.005	(0.003)	0.000	(0.001)	0.000	(0.000)	0.007	(0.005)
Transitory price shock										
1	0	(–)	0.898	(0.077)	0	(–)	0	(–)	0	(–)
4	0.030	(0.022)	0.434	(0.124)	0.007	(0.012)	0.004	(0.007)	0.046	(0.034)
8	0.019	(0.016)	0.179	(0.072)	0.006	(0.012)	0.002	(0.004)	0.068	(0.044)
12	0.016	(0.019)	0.122	(0.049)	0.004	(0.007)	0.001	(0.003)	0.051	(0.035)
16	0.009	(0.010)	0.087	(0.035)	0.003	(0.006)	0.001	(0.002)	0.045	(0.033)
20	0.005	(0.007)	0.060	(0.027)	0.002	(0.005)	0.001	(0.002)	0.041	(0.030)
40	0.001	(0.002)	0.016	(0.011)	0.001	(0.003)	0.000	(0.001)	0.027	(0.018)

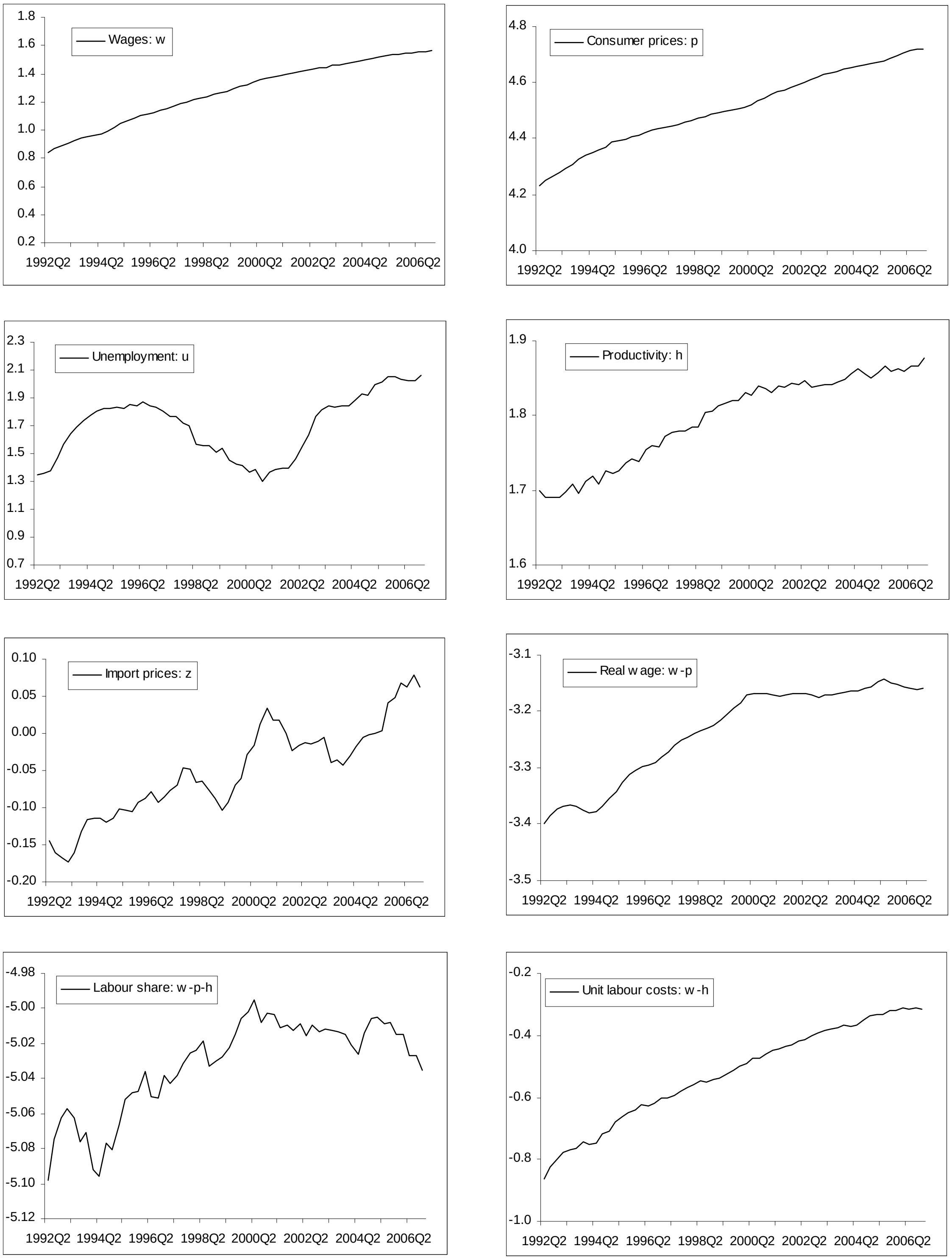

Figure 1: Logaritms of the series: 1992Q2-2006Q4

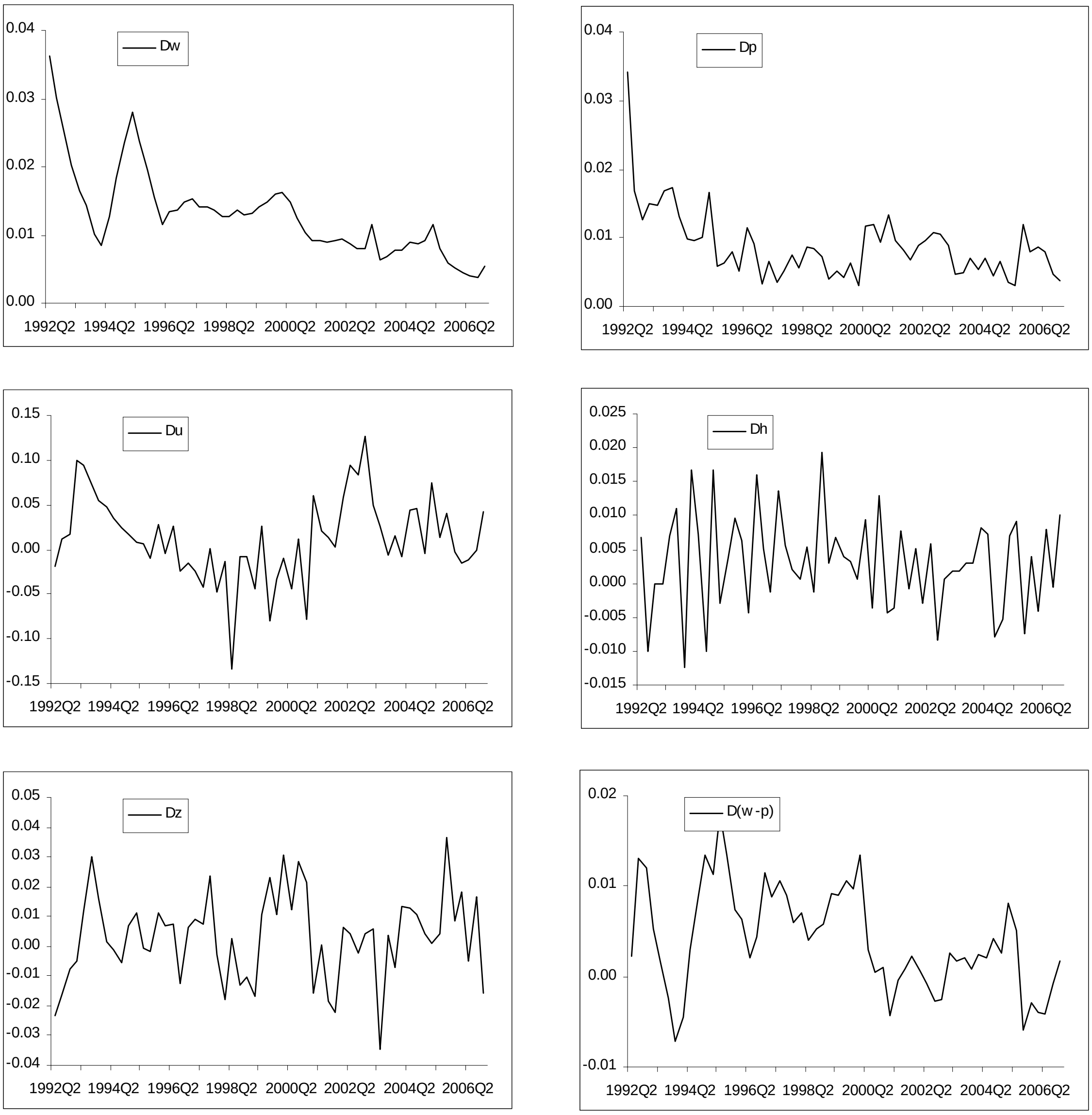

Figure 2: First differences of the logs of the variables

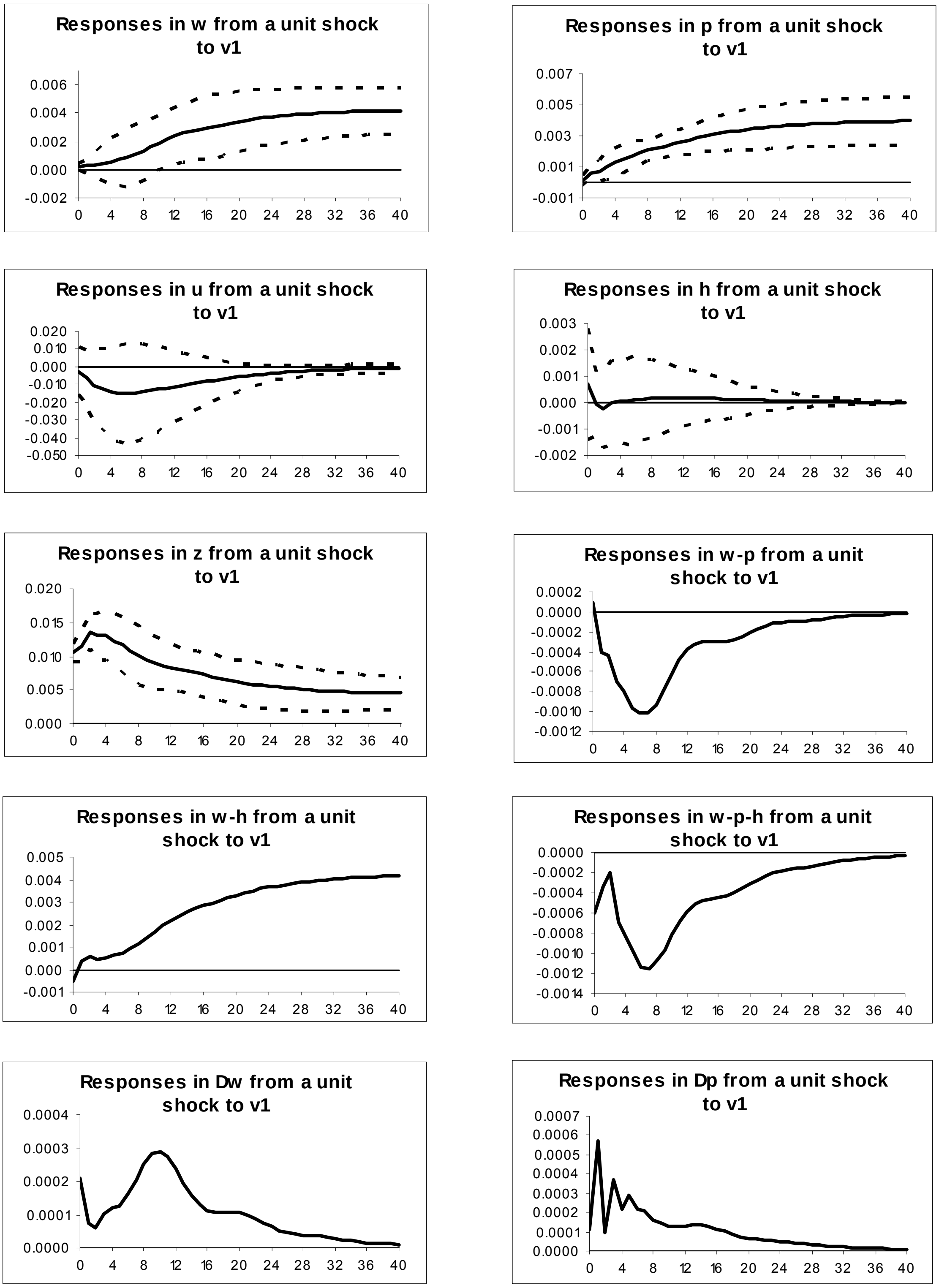

Figure 3: Responses from a unit shock to import prices.

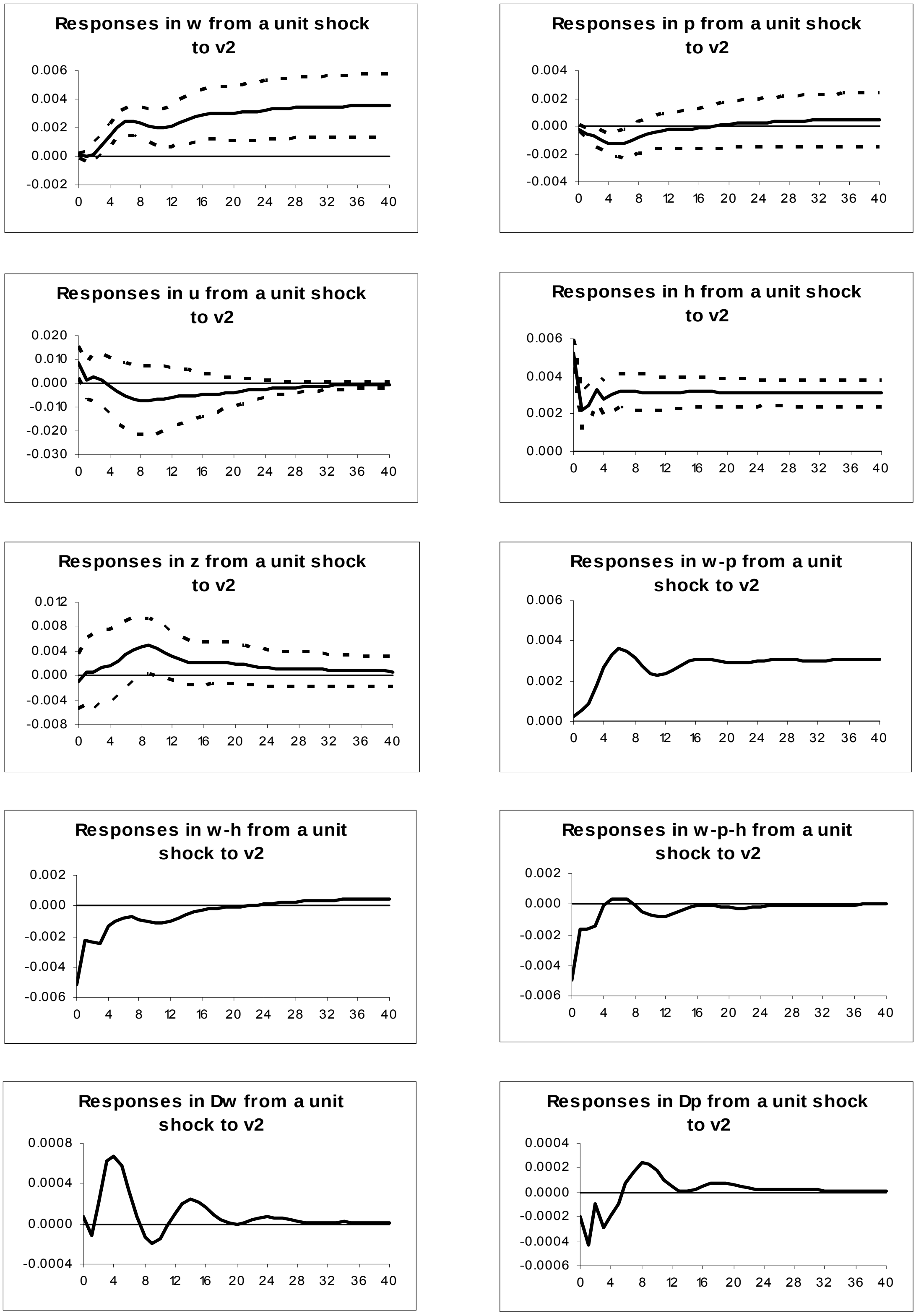

Figure 4: Responses from a unit shock to productivity

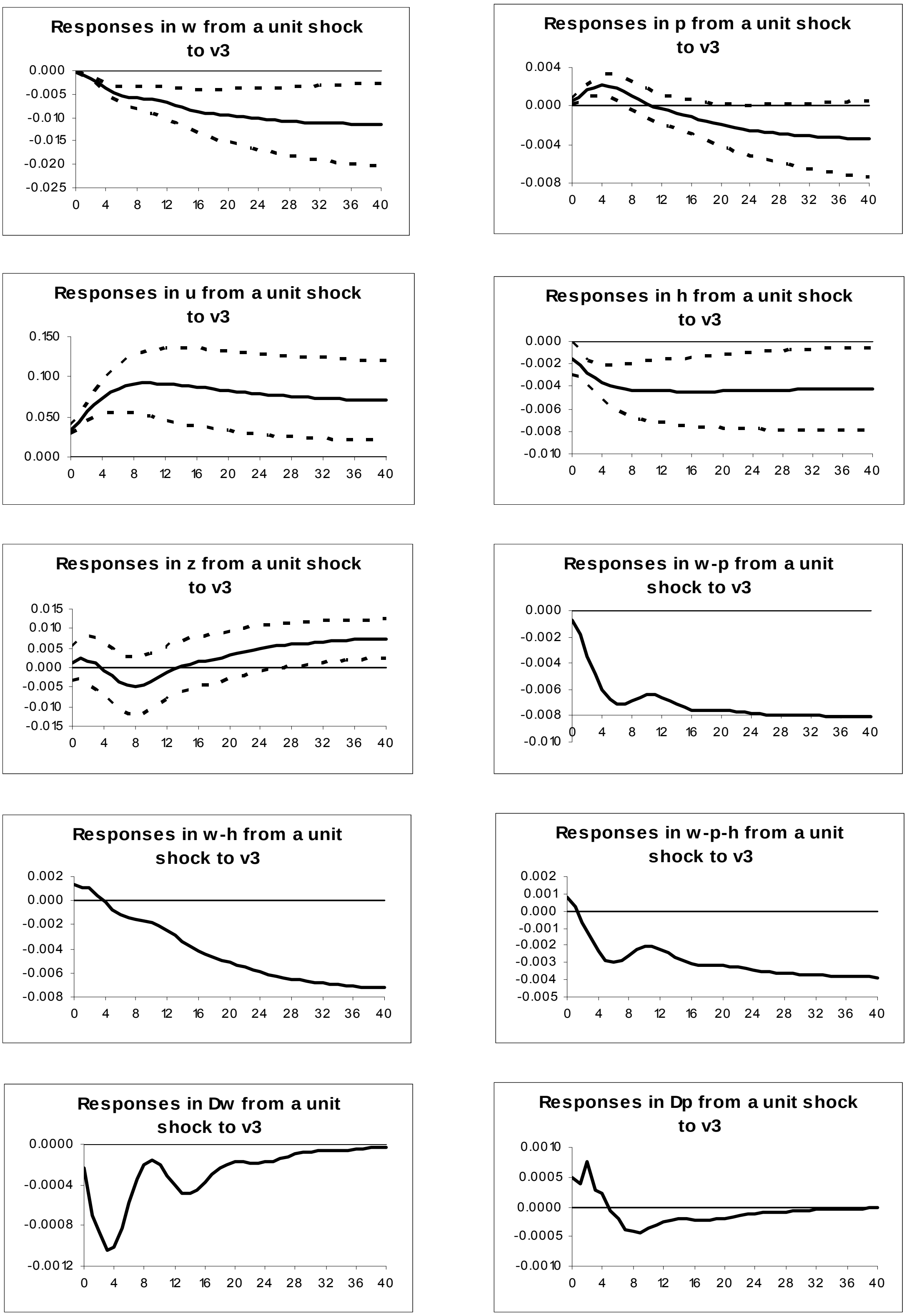

Figure 5: Responses from a unit shock to unemployment

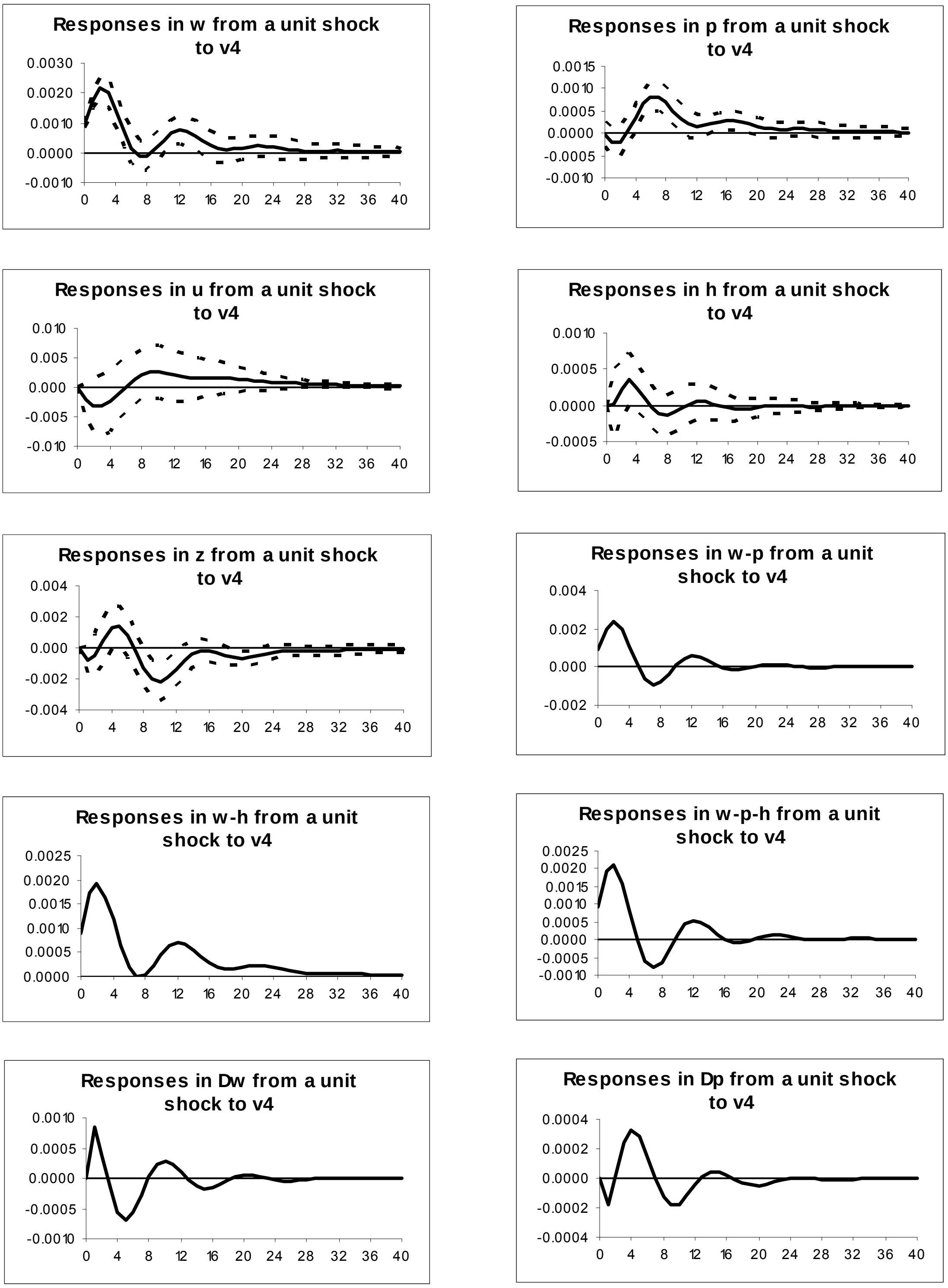

Figure 6: Responses from a unit shock to wages

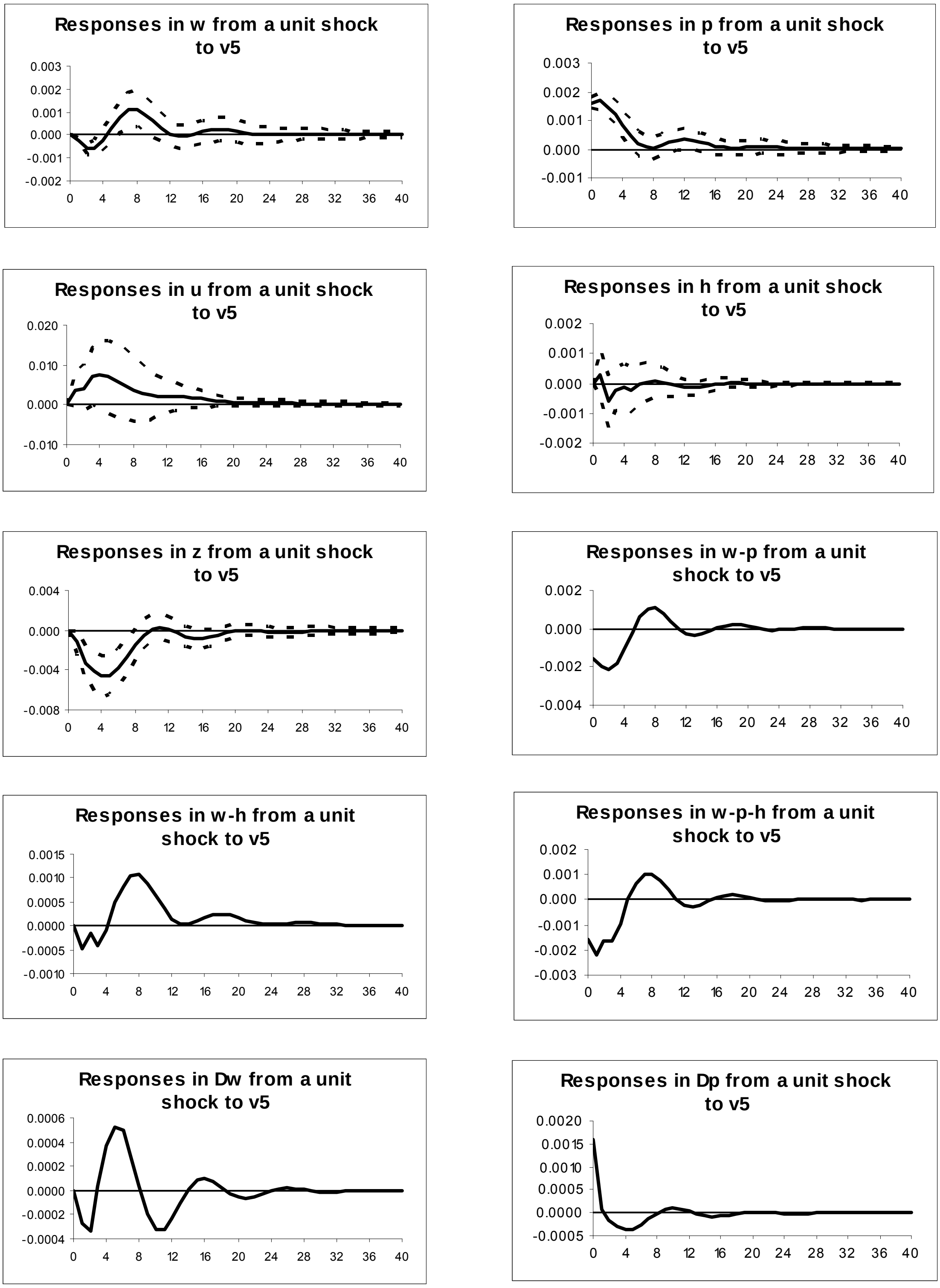

Figure 7: Responses from a unit shock to prices

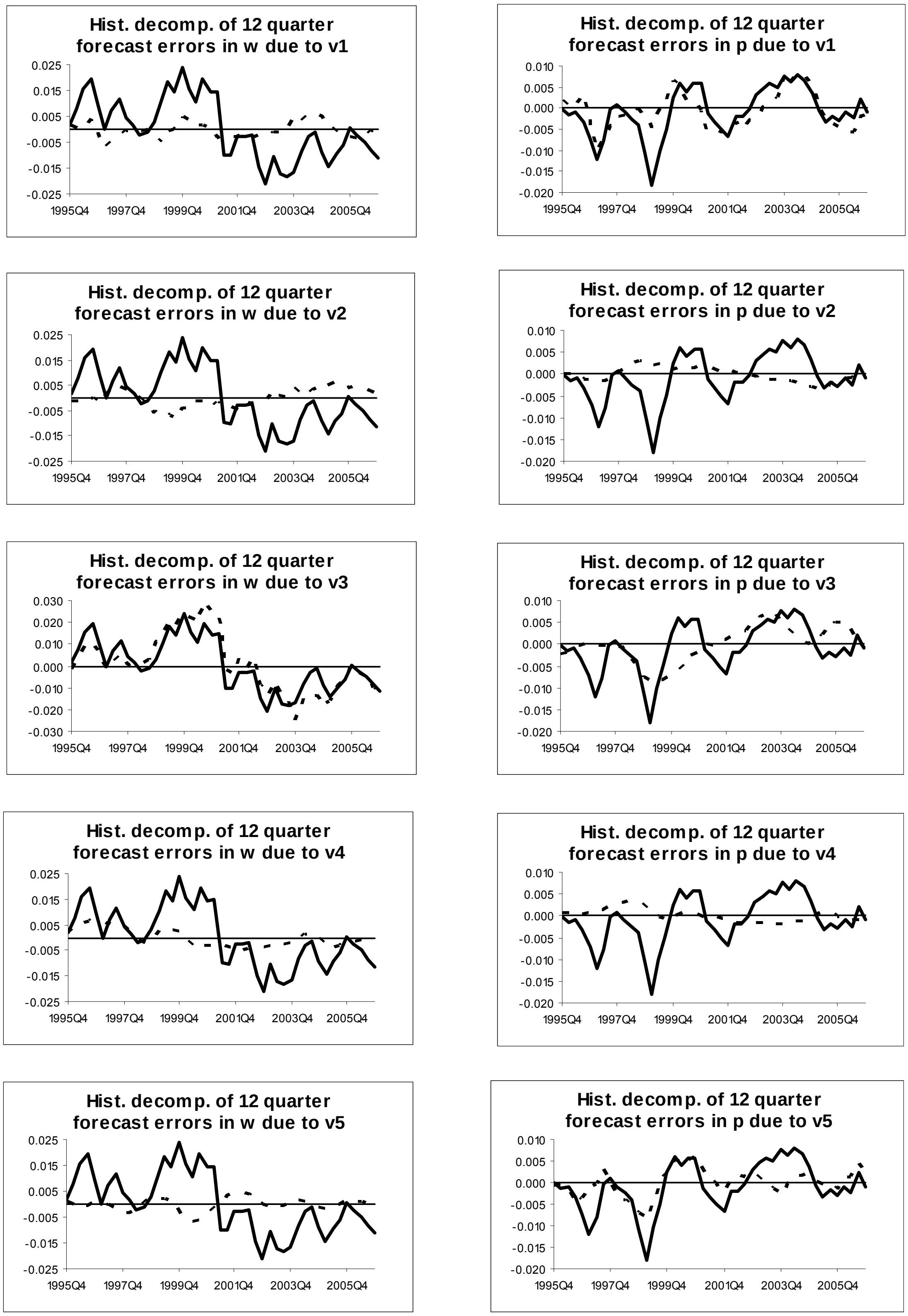

Figure 8: Historical decomposition of 12 quarter forecast errors in w and p

WORKING PAPERS

2000

1/00 UNEMPLOYMENT DURATION: COMPETING AND DEFECTIVE RISKS
— *John T. Addison, Pedro Portugal*

2/00 THE ESTIMATION OF RISK PREMIUM IMPLICIT IN OIL PRICES
— *Jorge Barros Luís*

3/00 EVALUATING CORE INFLATION INDICATORS
— *Carlos Robalo Marques, Pedro Duarte Neves, Luís Morais Sarmento*

4/00 LABOR MARKETS AND KALEIDOSCOPIC COMPARATIVE ADVANTAGE
— *Daniel A. Traça*

5/00 WHY SHOULD CENTRAL BANKS AVOID THE USE OF THE UNDERLYING INFLATION INDICATOR?
— *Carlos Robalo Marques, Pedro Duarte Neves, Afonso Gonçalves da Silva*

6/00 USING THE ASYMMETRIC TRIMMED MEAN AS A CORE INFLATION INDICATOR
— *Carlos Robalo Marques, João Machado Mota*

2001

1/01 THE SURVIVAL OF NEW DOMESTIC AND FOREIGN OWNED FIRMS
— *José Mata, Pedro Portugal*

2/01 GAPS AND TRIANGLES
— *Bernardino Adão, Isabel Correia, Pedro Teles*

3/01 A NEW REPRESENTATION FOR THE FOREIGN CURRENCY RISK PREMIUM
— *Bernardino Adão, Fátima Silva*

4/01 ENTRY MISTAKES WITH STRATEGIC PRICING
— *Bernardino Adão*

5/01 FINANCING IN THE EUROSYSTEM: FIXED VERSUS VARIABLE RATE TENDERS
— *Margarida Catalão-Lopes*

6/01 AGGREGATION, PERSISTENCE AND VOLATILITY IN A MACROMODEL
— *Karim Abadir, Gabriel Talmain*

7/01 SOME FACTS ABOUT THE CYCLICAL CONVERGENCE IN THE EURO ZONE
— *Frederico Belo*

8/01 TENURE, BUSINESS CYCLE AND THE WAGE-SETTING PROCESS
— *Leandro Arozamena, Mário Centeno*

9/01 USING THE FIRST PRINCIPAL COMPONENT AS A CORE INFLATION INDICATOR
— *José Ferreira Machado, Carlos Robalo Marques, Pedro Duarte Neves, Afonso Gonçalves da Silva*

10/01 IDENTIFICATION WITH AVERAGED DATA AND IMPLICATIONS FOR HEDONIC REGRESSION STUDIES
— *José A.F. Machado, João M.C. Santos Silva*

2002

1/02 QUANTILE REGRESSION ANALYSIS OF TRANSITION DATA
— *José A.F. Machado, Pedro Portugal*

2/02 SHOULD WE DISTINGUISH BETWEEN STATIC AND DYNAMIC LONG RUN EQUILIBRIUM IN ERROR CORRECTION MODELS?
— *Susana Botas, Carlos Robalo Marques*

3/02 MODELLING TAYLOR RULE UNCERTAINTY
— *Fernando Martins, José A. F. Machado, Paulo Soares Esteves*

4/02 PATTERNS OF ENTRY, POST-ENTRY GROWTH AND SURVIVAL: A COMPARISON BETWEEN DOMESTIC AND FOREIGN OWNED FIRMS
— *José Mata, Pedro Portugal*

5/02 BUSINESS CYCLES: CYCLICAL COMOVEMENT WITHIN THE EUROPEAN UNION IN THE PERIOD 1960-1999. A FREQUENCY DOMAIN APPROACH
— *João Valle e Azevedo*

6/02 AN “ART”, NOT A “SCIENCE”? CENTRAL BANK MANAGEMENT IN PORTUGAL UNDER THE GOLD STANDARD, 1854 -1891
— *Jaime Reis*

7/02 MERGE OR CONCENTRATE? SOME INSIGHTS FOR ANTITRUST POLICY
— *Margarida Catalão-Lopes*

8/02 DISENTANGLING THE MINIMUM WAGE PUZZLE: ANALYSIS OF WORKER ACCESSIONS AND SEPARATIONS FROM A LONGITUDINAL MATCHED EMPLOYER-EMPLOYEE DATA SET
— *Pedro Portugal, Ana Rute Cardoso*

9/02 THE MATCH QUALITY GAINS FROM UNEMPLOYMENT INSURANCE
— *Mário Centeno*

10/02 HEDONIC PRICES INDEXES FOR NEW PASSENGER CARS IN PORTUGAL (1997-2001)
— *Hugo J. Reis, J.M.C. Santos Silva*

11/02 THE ANALYSIS OF SEASONAL RETURN ANOMALIES IN THE PORTUGUESE STOCK MARKET
— *Miguel Balbina, Nuno C. Martins*

12/02 DOES MONEY GRANGER CAUSE INFLATION IN THE EURO AREA?
— *Carlos Robalo Marques, Joaquim Pina*

13/02 INSTITUTIONS AND ECONOMIC DEVELOPMENT: HOW STRONG IS THE RELATION?
— *Tiago V.de V. Cavalcanti, Álvaro A. Novo*

2003

1/03 FOUNDING CONDITIONS AND THE SURVIVAL OF NEW FIRMS
— *P.A. Geroski, José Mata, Pedro Portugal*

2/03 THE TIMING AND PROBABILITY OF FDI: AN APPLICATION TO THE UNITED STATES MULTINATIONAL ENTERPRISES
— *José Brandão de Brito, Felipa de Mello Sampayo*

3/03 OPTIMAL FISCAL AND MONETARY POLICY: EQUIVALENCE RESULTS
— *Isabel Correia, Juan Pablo Nicolini, Pedro Teles*

4/03 FORECASTING EURO AREA AGGREGATES WITH BAYESIAN VAR AND VECM MODELS
— *Ricardo Mourinho Félix, Luís C. Nunes*

5/03 CONTAGIOUS CURRENCY CRISES: A SPATIAL PROBIT APPROACH
— *Álvaro Novo*

6/03 THE DISTRIBUTION OF LIQUIDITY IN A MONETARY UNION WITH DIFFERENT PORTFOLIO RIGIDITIES
— *Nuno Alves*

7/03 COINCIDENT AND LEADING INDICATORS FOR THE EURO AREA: A FREQUENCY BAND APPROACH
— *António Rua, Luís C. Nunes*

8/03 WHY DO FIRMS USE FIXED-TERM CONTRACTS?
— *José Varejão, Pedro Portugal*

9/03 NONLINEARITIES OVER THE BUSINESS CYCLE: AN APPLICATION OF THE SMOOTH TRANSITION AUTOREGRESSIVE MODEL TO CHARACTERIZE GDP DYNAMICS FOR THE EURO-AREA AND PORTUGAL
— *Francisco Craveiro Dias*

10/03 WAGES AND THE RISK OF DISPLACEMENT
— *Anabela Carneiro, Pedro Portugal*

11/03 SIX WAYS TO LEAVE UNEMPLOYMENT
— *Pedro Portugal, John T. Addison*

12/03 EMPLOYMENT DYNAMICS AND THE STRUCTURE OF LABOR ADJUSTMENT COSTS
— *José Varejão, Pedro Portugal*

13/03 THE MONETARY TRANSMISSION MECHANISM: IS IT RELEVANT FOR POLICY?
— *Bernardino Adão, Isabel Correia, Pedro Teles*

14/03 THE IMPACT OF INTEREST-RATE SUBSIDIES ON LONG-TERM HOUSEHOLD DEBT: EVIDENCE FROM A LARGE PROGRAM
— *Nuno C. Martins, Ernesto Villanueva*

15/03 THE CAREERS OF TOP MANAGERS AND FIRM OPENNESS: INTERNAL VERSUS EXTERNAL LABOUR MARKETS
— *Francisco Lima, Mário Centeno*

16/03 TRACKING GROWTH AND THE BUSINESS CYCLE: A STOCHASTIC COMMON CYCLE MODEL FOR THE EURO AREA
— *João Valle e Azevedo, Siem Jan Koopman, António Rua*

17/03 CORRUPTION, CREDIT MARKET IMPERFECTIONS, AND ECONOMIC DEVELOPMENT
— *António R. Antunes, Tiago V. Cavalcanti*

18/03 BARGAINED WAGES, WAGE DRIFT AND THE DESIGN OF THE WAGE SETTING SYSTEM
— *Ana Rute Cardoso, Pedro Portugal*

19/03 UNCERTAINTY AND RISK ANALYSIS OF MACROECONOMIC FORECASTS: FAN CHARTS REVISITED
— *Álvaro Novo, Maximiano Pinheiro*

2004

1/04 HOW DOES THE UNEMPLOYMENT INSURANCE SYSTEM SHAPE THE TIME PROFILE OF JOBLESS DURATION?
— *John T. Addison, Pedro Portugal*

2/04 REAL EXCHANGE RATE AND HUMAN CAPITAL IN THE EMPIRICS OF ECONOMIC GROWTH
— *Delfim Gomes Neto*

3/04 ON THE USE OF THE FIRST PRINCIPAL COMPONENT AS A CORE INFLATION INDICATOR
— *José Ramos Maria*

4/04 OIL PRICES ASSUMPTIONS IN MACROECONOMIC FORECASTS: SHOULD WE FOLLOW FUTURES MARKET EXPECTATIONS?
— *Carlos Coimbra, Paulo Soares Esteves*

5/04 STYLISED FEATURES OF PRICE SETTING BEHAVIOUR IN PORTUGAL: 1992-2001
— *Mónica Dias, Daniel Dias, Pedro D. Neves*

6/04 A FLEXIBLE VIEW ON PRICES
— *Nuno Alves*

7/04 ON THE FISHER-KONIECZNY INDEX OF PRICE CHANGES SYNCHRONIZATION
— *D.A. Dias, C. Robalo Marques, P.D. Neves, J.M.C. Santos Silva*

8/04 INFLATION PERSISTENCE: FACTS OR ARTEFACTS?
— *Carlos Robalo Marques*

9/04 WORKERS' FLOWS AND REAL WAGE CYCLICALITY
— *Anabela Carneiro, Pedro Portugal*

10/04 MATCHING WORKERS TO JOBS IN THE FAST LANE: THE OPERATION OF FIXED-TERM CONTRACTS
— *José Varejão, Pedro Portugal*

11/04 THE LOCATIONAL DETERMINANTS OF THE U.S. MULTINATIONALS ACTIVITIES
— *José Brandão de Brito, Felipa Mello Sampayo*

12/04 KEY ELASTICITIES IN JOB SEARCH THEORY: INTERNATIONAL EVIDENCE
— *John T. Addison, Mário Centeno, Pedro Portugal*

13/04 RESERVATION WAGES, SEARCH DURATION AND ACCEPTED WAGES IN EUROPE
— *John T. Addison, Mário Centeno, Pedro Portugal*

14/04 THE MONETARY TRANSMISSION N THE US AND THE EURO AREA: COMMON FEATURES AND COMMON FRICTIONS
— *Nuno Alves*

15/04 NOMINAL WAGE INERTIA IN GENERAL EQUILIBRIUM MODELS
— *Nuno Alves*

16/04 MONETARY POLICY IN A CURRENCY UNION WITH NATIONAL PRICE ASYMMETRIES
— *Sandra Gomes*

17/04 NEOCLASSICAL INVESTMENT WITH MORAL HAZARD
— *João Ejarque*

18/04 MONETARY POLICY WITH STATE CONTINGENT INTEREST RATES
— *Bernardino Adão, Isabel Correia, Pedro Teles*

19/04 MONETARY POLICY WITH SINGLE INSTRUMENT FEEDBACK RULES
— *Bernardino Adão, Isabel Correia, Pedro Teles*

20/04 ACOUNTING FOR THE HIDDEN ECONOMY: BARRIERS TO LAGALITY AND LEGAL FAILURES
— *António R. Antunes, Tiago V. Cavalcanti*

2005

1/05 SEAM: A SMALL-SCALE EURO AREA MODEL WITH FORWARD-LOOKING ELEMENTS
— *José Brandão de Brito, Rita Duarte*

2/05 FORECASTING INFLATION THROUGH A BOTTOM-UP APPROACH: THE PORTUGUESE CASE
— *Cláudia Duarte, António Rua*

3/05 USING MEAN REVERSION AS A MEASURE OF PERSISTENCE
— *Daniel Dias, Carlos Robalo Marques*

4/05 HOUSEHOLD WEALTH IN PORTUGAL: 1980-2004
— *Fátima Cardoso, Vanda Geraldes da Cunha*

5/05 ANALYSIS OF DELINQUENT FIRMS USING MULTI-STATE TRANSITIONS
— *António Antunes*

6/05 PRICE SETTING IN THE AREA: SOME STYLIZED FACTS FROM INDIVIDUAL CONSUMER PRICE DATA
— *Emmanuel Dhyne, Luis J. Álvarez, Hervé Le Bihan, Giovanni Veronese, Daniel Dias, Johannes Hoffmann, Nicole Jonker, Patrick Lünnemann, Fabio Rumler, Jouko Vilmunen*

7/05 INTERMEDIATION COSTS, INVESTOR PROTECTION AND ECONOMIC DEVELOPMENT
— *António Antunes, Tiago Cavalcanti, Anne Villamil*

8/05 TIME OR STATE DEPENDENT PRICE SETTING RULES? EVIDENCE FROM PORTUGUESE MICRO DATA
— *Daniel Dias, Carlos Robalo Marques, João Santos Silva*

9/05 BUSINESS CYCLE AT A SECTORAL LEVEL: THE PORTUGUESE CASE
— *Hugo Reis*

10/05 THE PRICING BEHAVIOUR OF FIRMS IN THE EURO AREA: NEW SURVEY EVIDENCE
— *S. Fabiani, M. Druant, I. Hernando, C. Kwapil, B. Landau, C. Loupias, F. Martins, T. Mathä, R. Sabbatini, H. Stahl, A. Stokman*

11/05 CONSUMPTION TAXES AND REDISTRIBUTION
— *Isabel Correia*

12/05 UNIQUE EQUILIBRIUM WITH SINGLE MONETARY INSTRUMENT RULES
— *Bernardino Adão, Isabel Correia, Pedro Teles*

13/05 A MACROECONOMIC STRUCTURAL MODEL FOR THE PORTUGUESE ECONOMY
— *Ricardo Mourinho Félix*

14/05 THE EFFECTS OF A GOVERNMENT EXPENDITURES SHOCK
— *Bernardino Adão, José Brandão de Brito*

15/05 MARKET INTEGRATION IN THE GOLDEN PERIPHERY – THE LISBON/LONDON EXCHANGE, 1854-1891
— *Rui Pedro Esteves, Jaime Reis, Fabiano Ferramosca*

2006

1/06 THE EFFECTS OF A TECHNOLOGY SHOCK IN THE EURO AREA
— *Nuno Alves , José Brandão de Brito , Sandra Gomes, João Sousa*

2/02 THE TRANSMISSION OF MONETARY AND TECHNOLOGY SHOCKS IN THE EURO AREA
— *Nuno Alves, José Brandão de Brito, Sandra Gomes, João Sousa*

3/06 MEASURING THE IMPORTANCE OF THE UNIFORM NONSYNCHRONIZATION HYPOTHESIS
— *Daniel Dias, Carlos Robalo Marques, João Santos Silva*

4/06 THE PRICE SETTING BEHAVIOUR OF PORTUGUESE FIRMS EVIDENCE FROM SURVEY DATA
— *Fernando Martins*

5/06 STICKY PRICES IN THE EURO AREA: A SUMMARY OF NEW MICRO EVIDENCE
— *L. J. Álvarez, E. Dhyne, M. Hoeberichts, C. Kwapil, H. Le Bihan, P. Lünnemann, F. Martins, R. Sabbatini, H. Stahl, P. Vermeulen and J. Vilmunen*

6/06 NOMINAL DEBT AS A BURDEN ON MONETARY POLICY
— *Javier Díaz-Giménez, Giorgia Giovannetti , Ramon Marimon, Pedro Teles*

7/06 A DISAGGREGATED FRAMEWORK FOR THE ANALYSIS OF STRUCTURAL DEVELOPMENTS IN PUBLIC FINANCES
— *Jana Kremer, Cláudia Rodrigues Braz, Teunis Brosens, Geert Langenus, Sandro Momigliano, Mikko Spolander*

8/06 IDENTIFYING ASSET PRICE BOOMS AND BUSTS WITH QUANTILE REGRESSIONS
— *José A. F. Machado, João Sousa*

9/06 EXCESS BURDEN AND THE COST OF INEFFICIENCY IN PUBLIC SERVICES PROVISION
— *António Afonso, Vítor Gaspar*

10/06 MARKET POWER, DISMISSAL THREAT AND RENT SHARING: THE ROLE OF INSIDER AND OUTSIDER FORCES IN WAGE BARGAINING
— *Anabela Carneiro, Pedro Portugal*

11/06 MEASURING EXPORT COMPETITIVENESS: REVISITING THE EFFECTIVE EXCHANGE RATE WEIGHTS FOR THE EURO AREA COUNTRIES
— *Paulo Soares Esteves, Carolina Reis*

12/06 THE IMPACT OF UNEMPLOYMENT INSURANCE GENEROSITY
ON MATCH QUALITY DISTRIBUTION
— *Mário Centeno, Alvaro A. Novo*

13/06 U.S. UNEMPLOYMENT DURATION: HAS LONG BECOME LONGER OR SHORT BECOME SHORTER?
— *José A.F. Machado, Pedro Portugal e Juliana Guimarães*

14/06 EARNINGS LOSSES OF DISPLACED WORKERS: EVIDENCE FROM A MATCHED EMPLOYER-EMPLOYEE DATA SET
— *Anabela Carneiro, Pedro Portugal*

15/06 COMPUTING GENERAL EQUILIBRIUM MODELS WITH OCCUPATIONAL CHOICE AND FINANCIAL FRICTIONS
— *António Antunes, Tiago Cavalcanti, Anne Villamil*

16/06 ON THE RELEVANCE OF EXCHANGE RATE REGIMES FOR STABILIZATION POLICY
— *Bernardino Adao, Isabel Correia, Pedro Teles*

17/06 AN INPUT-OUTPUT ANALYSIS: LINKAGES VS LEAKAGES
— *Hugo Reis, António Rua*

2007

1/07 RELATIVE EXPORT STRUCTURES AND VERTICAL SPECIALIZATION: A SIMPLE CROSS-COUNTRY INDEX
— *João Amador, Sónia Cabral, José Ramos Maria*

2/07 THE FORWARD PREMIUM OF EURO INTEREST RATES
— *Sónia Costa, Ana Beatriz Galvão*

3/07 ADJUSTING TO THE EURO
— *Gabriel Fagan, Vítor Gaspar*

4/07 SPATIAL AND TEMPORAL AGGREGATION IN THE ESTIMATION OF LABOR DEMAND FUNCTIONS
— *José Varejão, Pedro Portugal*

5/07 PRICE SETTING IN THE EURO AREA: SOME STYLISED FACTS FROM INDIVIDUAL PRODUCER PRICE DATA
— *Philip Vermeulen, Daniel Dias, Maarten Dossche, Erwan Gautier, Ignacio Hernando, Roberto Sabbatini, Harald Stahl*

6/07 A STOCHASTIC FRONTIER ANALYSIS OF SECONDARY EDUCATION OUTPUT IN PORTUGAL
— *Manuel Coutinho Pereira, Sara Moreira*

7/07 CREDIT RISK DRIVERS: EVALUATING THE CONTRIBUTION OF FIRM LEVEL INFORMATION AND OF MACROECONOMIC DYNAMICS
— *Diana Bonfim*

8/07 CHARACTERISTICS OF THE PORTUGUESE ECONOMIC GROWTH: WHAT HAS BEEN MISSING?
— *João Amador, Carlos Coimbra*

9/07 TOTAL FACTOR PRODUCTIVITY GROWTH IN THE G7 COUNTRIES: DIFFERENT OR ALIKE?
— *João Amador, Carlos Coimbra*

10/07 IDENTIFYING UNEMPLOYMENT INSURANCE INCOME EFFECTS WITH A QUASI-NATURAL EXPERIMENT
— *Mário Centeno, Alvaro A. Novo*

11/07 HOW DO DIFFERENT ENTITLEMENTS TO UNEMPLOYMENT BENEFITS AFFECT THE TRANSITIONS FROM UNEMPLOYMENT INTO EMPLOYMENT
— *John T. Addison, Pedro Portugal*

12/07 INTERPRETATION OF THE EFFECTS OF FILTERING INTEGRATED TIME SERIES
— *João Valle e Azevedo*

13/07 EXACT LIMIT OF THE EXPECTED PERIODOGRAM IN THE UNIT-ROOT CASE
— *João Valle e Azevedo*

14/07 INTERNATIONAL TRADE PATTERNS OVER THE LAST FOUR DECADES: HOW DOES PORTUGAL COMPARE WITH OTHER COHESION COUNTRIES?
— *João Amador, Sónia Cabral, José Ramos Maria*

15/07 INFLATION (MIS)PERCEPTIONS IN THE EURO AREA
— *Francisco Dias, Cláudia Duarte, António Rua*

16/07 LABOR ADJUSTMENT COSTS IN A PANEL OF ESTABLISHMENTS: A STRUCTURAL APPROACH
— *João Miguel Ejarque, Pedro Portugal*

17/07 A MULTIVARIATE BAND-PASS FILTER
— *João Valle e Azevedo*

18/07 AN OPEN ECONOMY MODEL OF THE EURO AREA AND THE US
— *Nuno Alves, Sandra Gomes, João Sousa*

19/07 IS TIME RIPE FOR PRICE LEVEL PATH STABILITY?
— *Vitor Gaspar, Frank Smets , David Vestin*

20/07 IS THE EURO AREA M3 ABANDONING US?
— *Nuno Alves, Carlos Robalo Marques, João Sousa*

21/07 DO LABOR MARKET POLICIES AFFECT EMPLOYMENT COMPOSITION? LESSONS FROM EUROPEAN COUNTRIES
— *António Antunes, Mário Centeno*

2008

1/08 THE DETERMINANTS OF PORTUGUESE BANKS' CAPITAL BUFFERS
— *Miguel Boucinha*

2/08 DO RESERVATION WAGES REALLY DECLINE? SOME INTERNATIONAL EVIDENCE ON THE DETERMINANTS OF RESERVATION WAGES
— *John T. Addison, Mário Centeno, Pedro Portugal*

3/08 UNEMPLOYMENT BENEFITS AND RESERVATION WAGES: KEY ELASTICITIES FROM A STRIPPED-DOWN JOB SEARCH APPROACH
— *John T. Addison, Mário Centeno, Pedro Portugal*

4/08 THE EFFECTS OF LOW-COST COUNTRIES ON PORTUGUESE MANUFACTURING IMPORT PRICES
— *Fátima Cardoso, Paulo Soares Esteves*

5/08 WHAT IS BEHIND THE RECENT EVOLUTION OF PORTUGUESE TERMS OF TRADE?
— *Fátima Cardoso, Paulo Soares Esteves*

6/08 EVALUATING JOB SEARCH PROGRAMS FOR OLD AND YOUNG INDIVIDUALS: HETEROGENEOUS IMPACT ON UNEMPLOYMENT DURATION
— *Luis Centeno, Mário Centeno, Álvaro A. Novo*

7/08 FORECASTING USING TARGETED DIFFUSION INDEXES
— *Francisco Dias, Maximiano Pinheiro, António Rua*

8/08 STATISTICAL ARBITRAGE WITH DEFAULT AND COLLATERAL
— *José Fajardo, Ana Lacerda*

9/08 DETERMINING THE NUMBER OF FACTORS IN APPROXIMATE FACTOR MODELS WITH GLOBAL AND GROUP-SPECIFIC FACTORS
— *Francisco Dias, Maximiano Pinheiro, António Rua*

10/08 VERTICAL SPECIALIZATION ACROSS THE WORLD: A RELATIVE MEASURE
— *João Amador, Sónia Cabral*

11/08 INTERNATIONAL FRAGMENTATION OF PRODUCTION IN THE PORTUGUESE ECONOMY: WHAT DO DIFFERENT MEASURES TELL US?
— *João Amador, Sónia Cabral*

12/08 IMPACT OF THE RECENT REFORM OF THE PORTUGUESE PUBLIC EMPLOYEES' PENSION SYSTEM
— *Maria Manuel Campos, Manuel Coutinho Pereira*

13/08 EMPIRICAL EVIDENCE ON THE BEHAVIOR AND STABILIZING ROLE OF FISCAL AND MONETARY POLICIES IN THE US
— *Manuel Coutinho Pereira*

14/08 IMPACT ON WELFARE OF COUNTRY HETEROGENEITY IN A CURRENCY UNION
— *Carla Soares*