# UPDATE AND RE-ESTIMATION OF THE QUARTERLY MODEL OF BANCO DE ESPAÑA (MTBE)

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2014

Documentos Ocasionales
N.º 1403

BANCO DE **ESPAÑA**

Eurosistema

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**Abstract**

The Quarterly Model of Banco de España (MTBE, *Modelo Trimestral del Banco de España)* is a large-scale macro-econometric model used for medium term macroeconomic forecasting of the Spanish economy, as well as for evaluating the staff projections and performing scenario simulations. The model is specified as a large set of error correction mechanism equations, and, especially in the short run, is mostly demand driven. This paper presents an update of the model, estimated with data from 1995-2012.

In this new version, private productive investment and employment react more to output, capturing the higher sensitivity of these variables observed during the crisis, and prices and wages react less both to each other and to the evolution of real variables. Credit is now an endogenous variable in the model and it also helps explain the behaviour of the main demand components. As a result of all these changes, simulations now generally display a somewhat stronger demand channel and show nominal effects that are both smaller and with less inertia. The updated model describes an economy that is more reactive to financial shocks other than changes in interest rates, where wage moderation can generate growth and employment if it is followed by price moderation and where fiscal consolidation reduces public deficit and has negative but moderate effects on GDP.

**Resumen**

El Modelo Trimestral del Banco de España (MTBE) es un modelo macroeconométrico de gran escala, utilizado para realizar previsiones macroeconómicas a medio plazo de la economía española, así como para evaluar las proyecciones realizadas por los expertos del Banco de España y simular escenarios alternativos. El modelo está especificado como un conjunto amplio de ecuaciones con mecanismo de corrección del error y, especialmente a corto plazo, está determinado principalmente por la demanda. Este documento presenta una actualización del modelo, estimada con datos de 1995-2012.

En esta nueva versión, la inversión productiva privada y el empleo reaccionan más al *output,* capturando la mayor sensibilidad de estas variables observada durante la crisis, y los precios y salarios reaccionan menos tanto entre ellos como a la evolución de variables reales. El crédito es ahora una variable endógena del modelo y, además, ayuda a explicar el comportamiento de los principales componentes de la demanda. Como resultado de todo esto, las simulaciones del modelo ahora presentan, en términos generales, un canal de demanda más potente y unos efectos nominales menores y menos inerciales. El modelo actualizado describe una economía más reactiva ante perturbaciones financieras distintas de los tipos de interés, en la que la moderación salarial puede generar crecimiento y empleo si viene acompañada de moderación de precios, y en la que la consolidación fiscal reduce el déficit y tiene efectos negativos pero moderados sobre el PIB.

**Palabras clave:** economía Española, modelo macroeconométrico.

**Códigos JEL:** E10, E17, E20, E60.

# 1 Introduction

The Quarterly Model of Banco de España (MTBE, for its name in Spanish: Modelo Trimestral del Banco de España) is a large-scale macro-econometric model used for medium term macroeconomic forecasting of the Spanish economy, as well as for evaluating the staff projections and performing scenario and policy simulations. The first version of this model was developed by Estrada et al. (2004), and since then it has been continuously updated (see Ortega et al., 2007, and Hurtado et al., 2011). In the last year, a new version of this model has been developed incorporating new estimates of all the equations parameters with a more up-to-date data sample (1995-2012[1] instead of 1995-2008). The new version also corrects some issues that had emerged using the previous one, as the Spanish crisis deepened and some macroeconomic variables started to deviate from the behaviour that could be expected by a model that was estimated mostly with data from the boom years.

The structure of MTBE is still that of a small open economy within a monetary union. The model is specified as a large set of error correction mechanism equations, and, especially in the short run, is mostly demand driven. These behavioural equations explain the main macroeconomic variables in terms of their key determinants:

— Private consumption and housing investment are explained by very similar sets of variables: income, wealth and interest rates, but also credit, the unemployment rate, and public deficit.

— Firms decide employment taking into account aggregate demand, the stock of productive capital, and the production function (Cobb-Douglas), plus other variables such as wages, population, etc.

— Private productive investment is a function of demand, the relative cost of capital and labour (i.e. interest rates and wages), credit, public deficit, and a measure of financial stress in the entrepreneurial sector.

— Core inflation (the HICP without energy and non-processed foods) depends on unit labour costs, GDP growth and indirect taxes. All other prices in the model (deflators for GDP, consumption, exports, imports, etc) are a mixture of this core-CPI and the price of imports. As a result of the small estimated coefficients for unit labour costs and GDP growth in this central equation, prices respond very slowly to the evolution of real variables.

— Market-economy wages depend on productivity and prices, and also on other variables such as the unemployment rate and public-sector wages.

— There are three equations for real exports (of goods to the euro area, of goods to the rest of the world, and of services) and another three for real imports. They

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[1]. Given that INE (the Spanish National Statistics Office) makes important revisions to the Quarterly National Accounts each September, and that these revisions affect data from not only the current year but also the year before and sometimes even further back in time, we make the compromise of updating the sample period as much as possible but exclude the last full year, in this case 2013.

all are mostly demand-driven, since the estimated price elasticity is, in general, small (usually below one, and in many cases below 0.4).

For a detailed description of the complete model, see the appendix (which also describes the shape of the main equations), and the following Bank of Spain documents:

— Estrada, Fernández, Moral and Regil (2004): "A Quarterly Macro-econometric Model of the Spanish Economy", Banco de España Working Paper 0413.

— Ortega, Burriel, Fernández, Ferraz and Hurtado (2007), "Update of the Quarterly Model of the Bank of Spain", Banco de España Working Paper 0717.

— Hurtado, Fernández, Ortega and Urtasun (2011), "Nueva Actualización del Modelo Trimestral del Banco de España", Banco de España Occasional Paper 1106.

## 2    The 2013 update

The new version of the MTBE presented here has been developed in order to include new data and to enhance the fit of the model. The previous version of the model (Hurtado et al, 2011, which we will refer to as MTBE-2011) was estimated using data from 1995 to 2008, a period in which for most of the time the Spanish economy was growing strongly. Because the sample period lacked any crisis episode, the relationships between variables were probably incomplete. The model was unable to capture, for example, the behaviour of wages and employment during the last few years of crisis.

The new version estimates the behavioural equations using data from 1995 to 2012, which includes fourteen years of expansion and four full years of crisis. With the addition of the later four years, the estimated values of some elasticities have changed markedly with respect to MTBE-2011[2]:

— Private productive investment reacts more to output: the short run output elasticity went from 0.8 to 1.25, and it is even larger if exports grow faster than internal demand (there's a specific coefficient for exports of goods to the euro area).

— Relative to the model whose sample did not include crisis years, employment depends more on output (its short run elasticity increased from 0.4 to 1.1) and less on wages (whose corresponding short-term elasticity went from –0.3 to –0.1). However, the current sample period ends prior to the important labour market reform approved in 2012, which may also have had an impact on these elasticities[3].

— The responses of prices to wages and of wages to prices are smaller, so that now inflation has less inertia: a shock to prices will be less likely to initiate a price-wage spiral than it would be in older versions of the model.

Additionally, some equations have been reshaped. The main change being the explicit inclusion of credit: it is now an endogenous variable, and it also appears as explanatory variable in the equations of the main demand components. Another important change is that all price equations are now derived from the estimated behaviour of core-CPI rather than from the market value added deflator.

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**2.** It should be noted that changes in elasticities are only a partial indication of how the response of the model has changed in relation to some shocks or variables. Simulations show a bigger picture and are the preferred method to evaluate responses in different models.

**3.** In particular, the wage moderation process deepened significantly thereafter, followed by positive employment growth in late 2013. Indeed, since the approval of the 2012 reforms, it seems that employment is above its historical relation with overall economic activity.

## 3    Main Equations

### *3.1    Household expenditure: private consumption and housing investment*

In the long term, both forms of household expenditure (private consumption and housing investment) are explained mainly by a proxy of permanent income (a combination of current income and wealth, both in real terms) and by real interest rates. As in MTBE-2011, a restriction is imposed of unitary elasticity of total household expenditure to this proxy of permanent income; but now the estimation results in a higher elasticity of consumption (0.99), and smaller for housing investment (it used to be 1.36, now it is 1.09). Also, wealth now has a bigger weight in the proxy of permanent income, and financial and non-financial wealth appear as separate determinants. Other variables now in the long-run equations, both with very significant coefficients, are: for consumption, a credit-supply indicator from the Bank Lending Survey (BLS), and for housing investment, the unemployment rate.

The short term dynamics of private consumption incorporate important changes to try to explain recent developments. We observe that, since 2011, the determinants point to a bigger fall in consumption than what has been recorded in the data. The theories used to explain the evolution of consumption in the first stages of the crisis do not hold: back then, the scenario was exactly the opposite (consumption was falling while its main determinants were growing), and phenomena such as credit restrictions, deleveraging, precautionary savings, confidence effects, etc., could explain the difference. Now the explanation has to be related to different mechanisms, for example, a minimum consumption threshold or some other source of downwards rigidity. We incorporate such effects through a time-varying loading factor for the error correction mechanism, linked to the rate of employment: when employment falls, the long-term level of consumption becomes less relevant and hence convergence towards that level becomes slower. This captures the fact that when unemployment is high it is difficult times for households and restoring the desired long-run savings rate can be postponed to better times in order to guarantee a sufficient level of consumption until income increases. The change has a small impact for the years when unemployment was relatively low, but makes the adjustment towards long-term consumption during the crisis much slower.

Another important novelty is that the short term behaviour of private consumption is free from inertia (which in previous versions helped to explain a great portion of the evolution of consumption during the boom). Regarding financial variables, we have included the growth rate of total credit to households as well as a credit-supply indicator from the BLS. Instead of consumer confidence indicators, which were often used to calibrate non-Keynesian effects of fiscal consolidation, we have now incorporated public deficit as an explanatory variable[4].

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**4.** The rationale for public deficit to appear in the private consumption equation is that it captures non-Keynesian effects of fiscal shocks. Without this component, the response of the model after a reduction in taxes is clearly positive: households' income increases, and this has a big positive effect on consumption. With public deficit partially offsetting this positive reaction, the net effect will still be positive, but the reaction of private consumption will be smaller when the increase in income is due to lower taxes than when it is caused by something else (because lower taxes increase public deficit and households can anticipate, as a consequence, higher taxes in the future). Estimation tests show that either confidence indicators or public deficit appear as significant explanatory variables for the evolution of private consumption, but introducing both of them at the same time makes their coefficients clearly non-significant. We have chosen to use only public deficit because it is a more direct way to introduce the single factor that both variables seem to be capturing, and because forecasts for this variable are readily available from the experts, which helps obtaining conditional model forecasts.

In the short term dynamics of the housing investment equation, the elasticities to income and wealth have increased from 1.0 and 0.3 in MTBE-2011 to 1.2 and 0.5 now. Other variables appearing in this short term equation are a BLS credit supply indicator that describes changes in credit conditions for mortgages, the growth of credit to construction and property development, and public deficit (which appears now, as in the case of consumption, instead of confidence indicators, whose main use was to assess non-Keynesian effects in fiscal consolidation simulations).

### 3.2 Private productive investment

The evolution of private productive investment is now more sensitive to changes in output: the short-run elasticity is 1.25 (it was 0.8 in MTBE-2011), with a bigger effect if exports are growing faster than internal demand (there's a specific coefficient for exports of goods to the euro area). And the set of financial variables that appear in this equation has changed: the percentage of firms with a high financial burden and the indicator from the Bank Lending Survey, which played a role in MTBE-2011, still appear as significant explanatory factors in the updated MTBE (in the case of the former, with a much bigger coefficient now); the indicators of confidence and of profit expectations are no longer significant, whereas public deficit[5] and the acceleration of credit, not present before, appear in this current version.

### 3.3 Employment

Average long-term growth for Total Factor Productivity (TFP) is estimated now at a rate of 0.9% per year, instead of 0.6% in MTBE-2011; this helps explain the currently higher level of output relative to employment after several years of heavy employment destruction included in the updated estimation period 1995-2012.

The real wage does not enter as a determinant in the long-run employment equation, since the estimation is unable to identify a coherent and significant relationship (employment grew most, even in relation to value added, during the boom period in which wages were growing rapidly too); and, in the short run that relationship is weak, with a wage elasticity of 0.12 (even lower than in MTBE-2011 which was 0.34). Recent labour market indicators point towards a significant response of employment to the widespread intensification of the wage moderation in the Spanish economy after the 2012 labour market reform (see Izquierdo, Lacuesta and Puente, 2013); we expect future updates of the employment equation to capture this through significantly higher wage elasticity.

Another relevant change is that employment now has less inertia and it is much more sensitive to the evolution of output: the short-run elasticity of employment to output has grown from 0.4 in MTBE-2011 to 1.1 in the current update.

### 3.4 Wages

The unitary relationship between real wages and productivity does not prevail in the data: the elasticity of wages with respect to labour productivity is estimated to be 0.4 in the long run and 0.5 in the short run (a similar short-run value was estimated in the previous version of the model). The short run response to prices is also 0.5. Public wages and the level of unemployment also help explain the short-run dynamics of wages, although their coefficients are relatively small.

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**5.** As in the case of the household expenditure equations, the confidence indicator in MTBE-2011 was often used to include non-Keynesian effects in simulations of fiscal consolidation; the presence of public deficit directly as explanatory variable in the equation captures such effects in the updated model.

### 3.5 Exports and Imports

The block for external demand displays relatively minor changes with respect to the previous version of the model. The most visible one is the use of relative unit labour costs alongside relative prices as a significant indicator of competitiveness in both the long and the short run equations of exports of goods to the euro area.

In general, the main drivers of exports and imports are demand indicators rather than relative prices. The following tables summarize the old and new elasticities in all these equations, both in the long term (LT) and in the short term (ST) dynamics.

By enlarging the estimation period with respect to MTBE-2011 to include 2008-2012 data, exports increase their demand elasticities, especially exports of goods to the euro area and total exports of services, capturing the rising exports shares in world trade of the Spanish economy. Price elasticities also increase except in the case of exports of goods to non-euro area countries, where exports growth in the recent years has been led to a large extent by non-price competitiveness gains, such as the increase in the exporting base, etc.

| Elasticities in the equations of real exports | | MTBE-2011 | | MTBE update | |
|---|---|---|---|---|---|
| | | LT | ST | LT | ST |
| Goods, euro area | demand | 1.09 | 1.10 | 1.15 | 1.27 |
| | relative prices | 0.91 | 0.00 | 1.02 | 0.49 |
| Goods, rest of world | demand | 1.15 | 1.11 | 1.05 | 1.15 |
| | relative prices | 2.84 | 0.42 | 1.86 | 0.54 |
| Services | demand | 1.96 | 0.57 | 2.66 | 0.95 |
| | relative prices | 0.56 | 0.00 | 0.61 | 0.35 |

The change in the elasticities of imports (both to demand and to prices) is less clear than in the case of exports: changes are in general small and of differing signs. The exception is the price elasticity of imports of goods from the euro area, which, especially in the long run, is remarkably higher after including 2008-2012 in the estimation period (during the crisis, imports of goods from the euro area have responded more to demand and less to relative prices, which could be explained by the international fragmentation of productive processes and by the high dependence on imports of specific products for the introduction of technological innovations).

| Elasticities in the equations of real imports | | MTBE-2011 | | MTBE update | |
|---|---|---|---|---|---|
| | | LT | ST | LT | ST |
| Goods, euro area | demand | 0.90 | 1.70 | 1.27 | 1.70 |
| | relative prices | 1.26 | 0.56 | 0.10 | 0.35 |
| Goods, rest of world | demand | 1.96 | 1.70 | 1.76 | 1.70 |
| | relative prices | 0.10 | 0.14 | 0.36 | 0.12 |
| Services | demand | 1.65 | 1.96 | 1.88 | 1.70 |
| | relative prices | 0.10 | 0.23 | 0.10 | 0.15 |

### 3.6 Prices

In older versions of MTBE, the main price indicator was the market sector value added deflator. All other prices in the model were generated as a mixture of this central price indicator and different flavours of external prices (prices of competitors, prices of imported goods or services, and oil prices). The problem with that scheme is that the market sector

value added deflator is noisy, and both observed values and forecasts can display undesirable behaviour at times (for example, when there are changes to indirect taxes or to public wages). As a consequence, this has been changed in this update: the central price indicator now is core CPI (i.e. consumer price index without energy and unprocessed foods) and all other prices are a mixture of this one and external prices.

The specification of the equation for core CPI has been provided by experts in this area at Banco de España. There is no long-run equation, just a short-run one, and it includes only a constant (which explains a yearly core inflation rate of 1.6%), unit labour costs (with a small but significant coefficient of 0.12), GDP growth (with coefficient 0.26), and indirect taxes (with a pass-through of 0.54). This particular specification has two important consequences: first, the response of prices to changes in real variables is relatively muted; and, second, since there is no long-term equation and price-wage feedback is very low, the model will not generate inflationary spirals. This fixes a previous problem of the model (the estimation used to impose a theoretical restriction of very high responsiveness of prices to costs that was not backed by the observed data) and is coherent with the behaviour expected by the experts' consensus. For example, in the updated MTBE the effect of an increase in oil prices or indirect taxes will fade out after one year: price levels will remain higher and inflation will return to baseline levels; this is different from what was observed in the previous version of the model – which had larger long-run effects and more inertia – and is closer to what can be observed in the data after recent VAT rises.
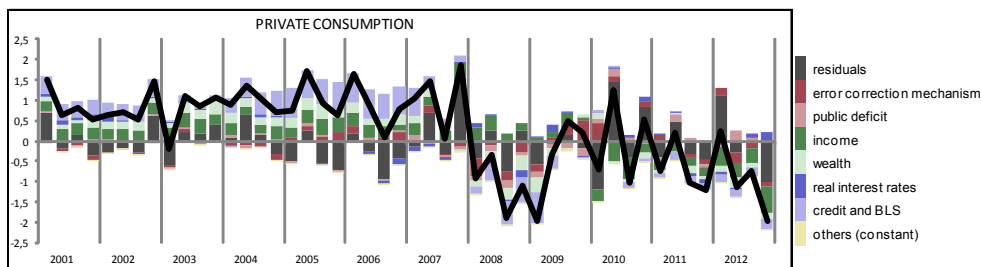
### 3.7 Credit

The model now includes three equations that explain observed credit: to households, to firms related to the construction sector, and to other firms. These credit indicators also appear, respectively, as determinants of consumption, housing investment, and private productive investment, so there is now a complete real-financial feedback channel in the model, which, to some extent, could increase the estimated effect of some shocks.

The equations that explain the evolution of these credit indicators are similar to those that are used by the experts of Banco de España in this matter. They are specified in real terms, and the main determinants are the interest rate and a scale variable: for credit to households, the sum of private consumption and residential investment; for credit to construction and property developers, the house price index; and for credit to other firms, real private productive investment.

# 4    Contribution charts

Contribution charts show the quarterly growth rate of a variable (e.g. private consumption) as explained by the various determinants of its behavioural equation (e.g. income, wealth, etc.) and the equation residual. They are a very useful tool for one of the main tasks for which MTBE is employed, namely, to validate staff projections. They can also be used to show the fit of the model over the estimation sample, together with the model's view of the evolution of the main macroeconomic variables during that period. The contribution charts in this section portray observed data until 2012Q4, that is, until the end of the estimation period. In general, they show that the model has improved significantly with respect to the previous version (MTBE-2011), and it now matches recent events more closely.

— Private consumption: the new equation gives more weight to income and wealth as determinants, instead of inertia. Still, the long-run equation says that, given its determinants (mainly income, wealth and interest rates), consumption should be lower (i.e. the savings rate should be higher). To avoid big effects of this long-run deviation, the loading factor of the error correction mechanism is made time-dependent and associated to the evolution of the employment rate. That is, the return to the long-run equilibrium is slowed down when the employment rate is low; for example, the negative contributions of the error correction mechanism in 2011-2012 are smaller than they would be without this time-varying coefficient[6].



— Housing investment: the strong fall in 2008-2009 is explained to a large extent by a credit crunch, whereas the sluggish evolution from 2011 onwards is more related to the fall in real disposable income and wealth.



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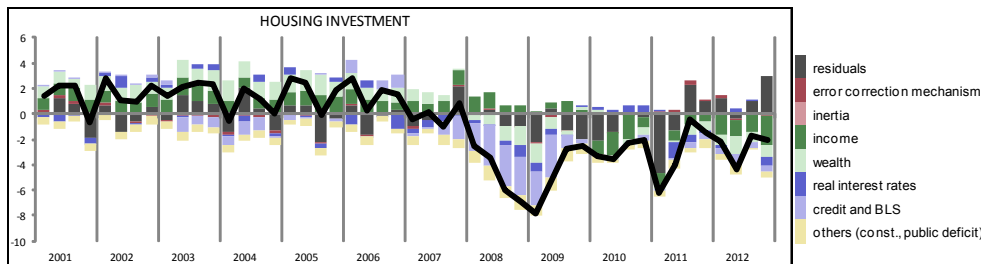
**6.** An important side effect of the substitution of inertia by fundamentals and of the inclusion of a time-varying error correction mechanism is that they help reduce dramatically the residuals from 2012 onwards.

— Private productive investment: increased demand elasticity gives more explanatory power to market-sector value added than in older model versions, and credit and other financial variables are still very relevant. Compared to MTBE-2011, residuals have clearly improved from 2009 onwards, in part because of the positive contribution of the newly included competitiveness channel (unit labour costs relative to the rest of the euro area).
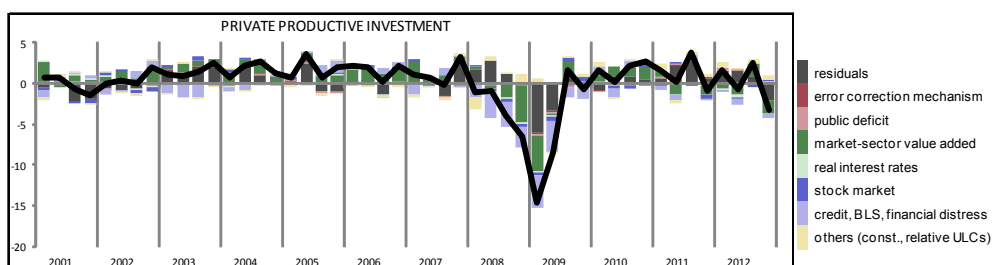


— Exports and imports: they are both relatively similar to MTBE-2011, just slightly more demand-driven and with less inertia now. Competitiveness still seems to be a very minor determinant, if judged by the contribution charts.
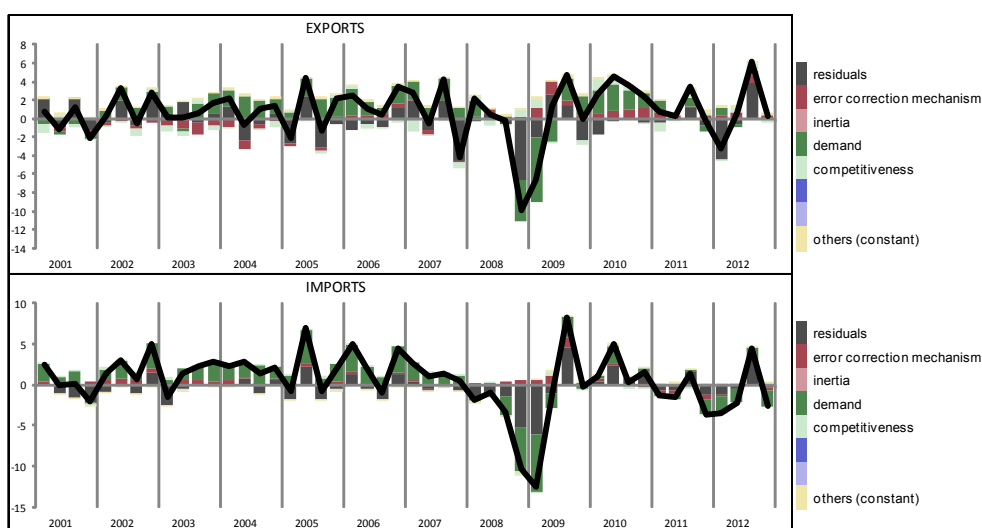


— Employment: a much higher demand elasticity in the short run, and a higher estimate for long-run TFP growth rate, have drastically changed the model's interpretation of employment growth from 2007 onwards. While the previous version of the model, which didn't include 2008-2012 data, expected more employment than observed, the updated MTBE is in line with the observed data throughout the crisis. That is, the model that was estimated with data mostly from the boom years expected lower productivity than the one that already incorporates five years of strong employment destruction in its estimation

sample[7]. In the short-run equation, there is still a need to include variables such as working age population and house prices in order to explain the strong growth of employment during the construction-related boom.



MARKET-SECTOR EMPLOYMENT
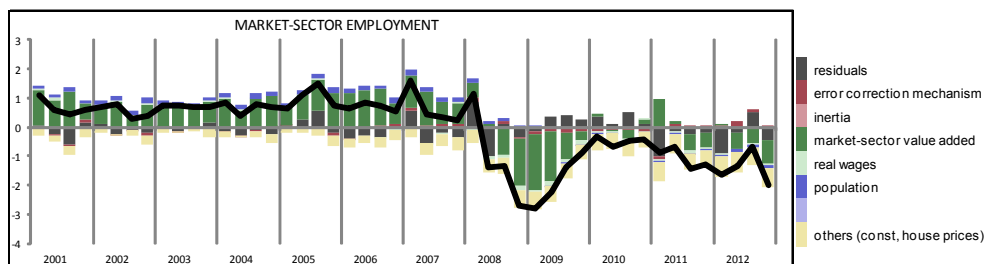
— Wages: the relatively big misalignment of the long-run equation in MTBE-2011 disappears in the new version, which makes the short-term residuals also smaller now. It is important to note that the unemployment rate has a modest – but visible – effect on wages.



MARKET-SECTOR WAGES
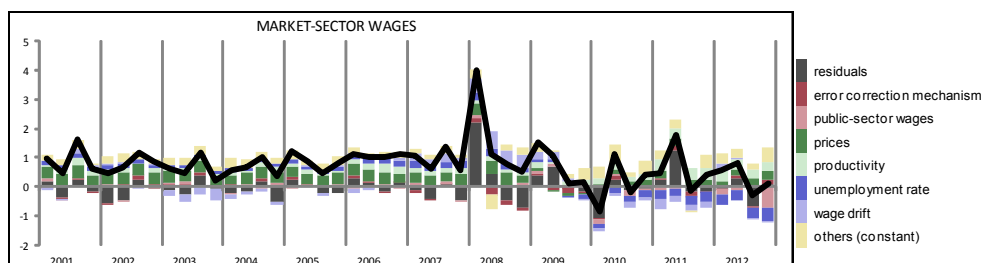
— Prices: this block has been deeply redesigned, making core CPI inflation the main driving force for price developments in the model (instead of the market value added deflator of earlier versions). This new equation is based on the one that the experts use at Banco de España, and it has the role of a seed from which every other price in the model is subsequently derived. It shows very weak elasticity of prices to unit labour costs and GDP growth, making the whole price block of the model relatively inelastic to the cycle. The residuals of this equation in the estimation sample are very small.



CORE CPI INFLATION

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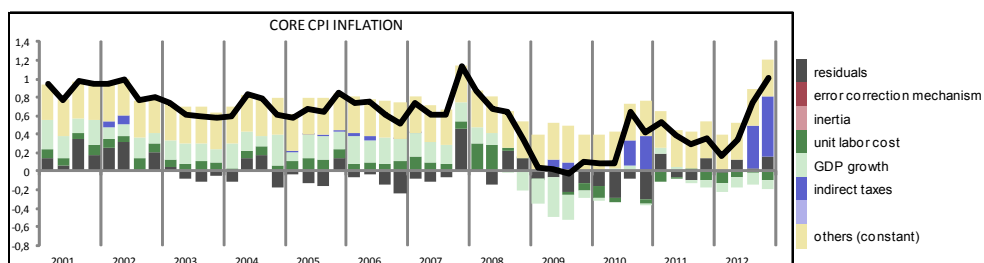
**7.** The fact that residuals of this equation are vastly improved for the 2007-2012 period grants some trust in this new interpretation of the relationship between employment and its determinants. However, it is also possible that structural breaks will appear in these relationships, and that non-linear behaviour breaks the linkages captured here, for example because of the effects of all the subsequent labour-market reforms that have been implemented in recent years, especially that of 2012. Such mechanisms cannot be anticipated by a linear equation such as this one until they are observed in the data.

## 5    Simulations

Another important use of MTBE is to construct alternative scenarios and run policy simulations, where one variable (or a small set of them) is made to deviate from its baseline evolution, and the model calculates the reaction of all other macroeconomic variables, taking into account all second-round and higher-order effects.

The main channel through which shocks are propagated to the economy in the MTBE is the demand channel: with lower demand, firms reduce private productive investment and market-sector employment, so household income falls and this affects private consumption and housing investment too; higher unemployment pushes wages down, and both slower growth and falling unit labour costs reduce inflation; the external sector shows a positive contribution to growth mainly because the fall in demand reduces imports (the effect of improved competitiveness in exports and imports is also present but minor in comparison, unless the trigger is a price shock). As a novelty, in the updated MTBE there is a credit channel in the model too, which works as an amplifier for this demand channel: lower activity reduces credit, and this in turn affects private consumption, private productive investment, and housing investment.

This section will present the results from shocks to interest rates, world demand, competitiveness, prices and wages, oil and housing prices, the stock exchange, and a wide variety of fiscal instruments. The transmission channel in most of these simulations will work as follows: there is an initial response by a limited set of variables, and once this response is translated into a change in demand, it spreads to the rest of the model following the demand channel described above.

### 5.1   Interest rates

In MTBE, the interest rate applied to households for home purchases affects both private consumption and housing investment, whereas private productive investment depends on firms' total financing cost. Any change in these interest rates triggers the demand channel described above.

The model includes transfer equations that describe how the interest rate for home purchases and firms' total financing cost react to changes in short-term and long-term interest rates, in particular, the 3-month Euribor rate and the interest rate for 10-year Spanish government bonds. Thanks to this, the model can show both how the economy reacts to changes in the interest rates that appear in the equations (the one for home purchases and firms' total financing cost) and also to basic short-term and long-term interest rates.

In the updated MTBE, the response of GDP to interest rate shocks is slightly smaller than in MTBE-2011. In particular, the effect on consumption is much smaller, and this compensates the higher response of private productive investment. As explained in previous sections, prices and wages react a lot less now than in the previous version of the model.

**MTBE update: interest-rate simulations**

Accumulated level differences.

| | All interest rates (+100bp) | | | Short-term interest rate (+100bp) | | | Long-term interest rate (+100bp) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| | | | | | | | | | |
| GDP | -0.15 | -0.24 | -0.32 | -0.11 | -0.19 | -0.26 | -0.03 | -0.09 | -0.14 |
| Private consumption | -0.24 | -0.38 | -0.53 | -0.18 | -0.30 | -0.43 | -0.06 | -0.16 | -0.24 |
| Private productive investment | -0.77 | -1.28 | -1.67 | -0.57 | -1.02 | -1.35 | -0.12 | -0.42 | -0.64 |
| Housing investment | -0.38 | -0.76 | -1.20 | -0.29 | -0.61 | -0.99 | -0.08 | -0.27 | -0.49 |
| Exports (goods and services) | 0.01 | 0.03 | 0.05 | 0.00 | 0.02 | 0.04 | 0.00 | 0.01 | 0.02 |
| Imports (goods and services) | -0.32 | -0.50 | -0.68 | -0.24 | -0.40 | -0.55 | -0.07 | -0.19 | -0.29 |
| | | | | | | | | | |
| Contributions to GDP growth | | | | | | | | | |
| Domestic demand | -0.25 | -0.41 | -0.57 | -0.19 | -0.32 | -0.47 | -0.06 | -0.15 | -0.24 |
| Net exports | 0.10 | 0.18 | 0.25 | 0.08 | 0.14 | 0.21 | 0.02 | 0.06 | 0.11 |
| | | | | | | | | | |
| Core CPI | -0.03 | -0.07 | -0.10 | -0.02 | -0.06 | -0.08 | -0.01 | -0.02 | -0.04 |
| HICP | -0.03 | -0.07 | -0.10 | -0.02 | -0.06 | -0.08 | -0.01 | -0.02 | -0.04 |
| GDP deflator | -0.05 | -0.10 | -0.15 | -0.04 | -0.08 | -0.12 | -0.01 | -0.04 | -0.06 |
| Compensation per employee | 0.00 | -0.01 | -0.02 | 0.00 | -0.01 | -0.01 | 0.00 | 0.00 | -0.01 |
| Total employment | -0.17 | -0.33 | -0.47 | -0.13 | -0.26 | -0.38 | -0.04 | -0.12 | -0.20 |
| Net lending/borrowing (% GDP) | 0.15 | 0.23 | 0.35 | 0.06 | 0.09 | 0.15 | 0.09 | 0.17 | 0.26 |
| Public balance (% GDP) | -0.19 | -0.30 | -0.44 | -0.06 | -0.11 | -0.17 | -0.12 | -0.21 | -0.32 |
| | | | | | | | | | |

### 5.2 World demand

In this simulation, the increase of exports induced by higher world demand is what triggers the demand channel described above.

The effect on exports is similar in the old and in the updated versions of MTBE, but now firms react more to their perceived demand: the overall elasticity of private productive investment to demand is higher now, and it also includes a term that makes that response even bigger if exports are growing faster than internal demand. This larger response of private productive investment is translated into a bigger effect on GDP. Employment also reacts more now, both in absolute terms and in relation to the response of GDP (i.e. labour productivity is now more clearly counter-cyclical, which can be observed in the response to this shock as well as to many others). Still, even with a bigger effect on GDP and on employment, prices and wages react slightly less in the updated MTBE than in MTBE-2011.

### 5.3 Competitiveness

There are some differences depending on how the shock is implemented (whether it is a change in foreign prices or in the exchange rate), but in general the direct effect on aggregate exports and imports is similar to that of the old model. Again, the bigger response of GDP is mainly due to the stronger reaction of private productive investment, both because of the higher demand elasticity when exports are growing faster than internal demand, and because of a new competitiveness channel that directly boosts private productive investment when unit labour costs fall in Spain in relation to those in the rest of the euro area. Also, the much smaller pass-through to internal prices in the current update of the model prevents a fall in households' real disposable income after a depreciation of the euro or an increase of competitor's prices, so that consumption and housing investment now grow instead of falling. Two side-effects of this are that in accounting terms the response of GDP now comes mainly from the contribution of internal demand (even if competitiveness and the external sector are the necessary triggers), and that it is even more difficult now to observe an improvement in the external balance in nominal terms as a result of price-competitiveness gains. This seems to be broadly in line with the characteristics of the first steps of the Spanish recovery after the crisis, as seen since the second half of 2013 (which falls outside of the estimation sample): wage moderation since the beginning of 2013 allowed for a moderate internal devaluation process that increased exports, and then private productive investment and private consumption quickly followed suit; this way, the first quarters of positive GDP growth and job creation have been characterized by strong internal demand.

### 5.4 Oil price

With the new price block of the model, the effect of price shocks has changed in the sense that now there is basically no inflation inertia at all: in the new model, after a shock such as this one, prices react but inflation doesn't accelerate beyond the initial effects. For example, after a permanent 10% rise in oil prices, HICP inflation is 0.14 percentage points higher in the first year, but remains basically unchanged thereafter (the initial price increase is consolidated, but not extended upon).

The shock is transmitted to the real side of the economy because higher prices reduce households' real disposable income, so they reduce consumption and investment and this triggers the usual demand channel of the model. In the new model there is more impact on private productive investment, but less on private consumption, than in the old version.

**MTBE update: external-sector simulations**

Accumulated level differences.

| | World demand (+1%) | | | Depreciation of the euro (1%) | | | Oil prices (+10%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| | | | | | | | | | |
| GDP | 0.32 | 0.41 | 0.47 | 0.03 | 0.05 | 0.06 | -0.04 | -0.08 | -0.10 |
| Private consumption | 0.06 | 0.12 | 0.18 | 0.00 | 0.01 | 0.01 | -0.04 | -0.09 | -0.12 |
| Private productive investment | 0.80 | 0.89 | 1.00 | 0.05 | 0.10 | 0.12 | -0.20 | -0.35 | -0.43 |
| Housing investment | 0.23 | 0.63 | 0.98 | 0.01 | 0.05 | 0.11 | -0.11 | -0.25 | -0.32 |
| Exports (goods and services) | 1.16 | 1.35 | 1.41 | 0.11 | 0.17 | 0.20 | 0.00 | 0.00 | 0.01 |
| Imports (goods and services) | 0.70 | 0.87 | 1.00 | 0.05 | 0.09 | 0.13 | -0.04 | -0.08 | -0.12 |
| | | | | | | | | | |
| Contributions to GDP growth | | | | | | | | | |
| Domestic demand | 0.14 | 0.20 | 0.27 | 0.01 | 0.02 | 0.03 | -0.05 | -0.10 | -0.13 |
| Net exports | 0.18 | 0.20 | 0.20 | 0.02 | 0.03 | 0.03 | 0.01 | 0.02 | 0.03 |
| | | | | | | | | | |
| Core CPI | 0.07 | 0.13 | 0.16 | 0.01 | 0.02 | 0.02 | -0.01 | -0.02 | -0.03 |
| HICP | 0.06 | 0.13 | 0.16 | 0.02 | 0.03 | 0.04 | 0.14 | 0.14 | 0.14 |
| GDP deflator | 0.08 | 0.16 | 0.20 | 0.01 | 0.02 | 0.03 | 0.00 | -0.01 | -0.02 |
| Compensation per employee | 0.01 | 0.03 | 0.04 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 |
| Total employment | 0.37 | 0.57 | 0.68 | 0.03 | 0.07 | 0.09 | -0.04 | -0.10 | -0.13 |
| Net lending/borrowing (% GDP) | 0.18 | 0.20 | 0.19 | -0.01 | -0.02 | -0.03 | -0.18 | -0.21 | -0.23 |
| Public balance (% GDP) | 0.15 | 0.23 | 0.28 | 0.02 | 0.03 | 0.04 | -0.02 | -0.04 | -0.06 |

### 5.5 Wealth

In MTBE, real financial and non-financial wealth determine both private consumption and housing investment. In the new version of the model, private productive investment also responds directly to the stock price index. The reaction of these macro variables to the wealth shock is what will trigger the demand channel in these simulations.

After a shock to stock prices, both private productive investment and housing investment react significantly more now than in MTBE-2011, and the effect on consumption is similar, so the cumulative effect on GDP is bigger in the new model and also more persistent: a permanent shock to stock prices has permanent effects on the level of output.

In the case of housing prices, short-term effects are similar to those seen in the previous version of the model, but again the response of the economy is more persistent in the updated MTBE.

**MTBE update: consumer-wealth simulations**

Accumulated level differences.

| | House prices (-10%) | | | Stock exchange (-10%) | | |
|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| GDP | -0.20 | -0.43 | -0.55 | -0.10 | -0.17 | -0.19 |
| Private consumption | -0.44 | -0.96 | -1.30 | -0.17 | -0.33 | -0.38 |
| Private productive investment | 0.00 | -0.21 | -0.30 | -0.35 | -0.52 | -0.56 |
| Housing investment | -2.38 | -4.20 | -4.52 | -0.58 | -1.04 | -1.06 |
| Exports (goods and services) | 0.08 | 0.10 | 0.12 | 0.00 | 0.02 | 0.03 |
| Imports (goods and services) | -0.44 | -0.91 | -1.15 | -0.21 | -0.37 | -0.40 |
| Contributions to GDP growth | | | | | | |
| Domestic demand | -0.37 | -0.76 | -0.99 | -0.17 | -0.30 | -0.34 |
| Net exports | 0.17 | 0.34 | 0.45 | 0.07 | 0.13 | 0.15 |
| Core CPI | -0.09 | -0.18 | -0.22 | -0.02 | -0.05 | -0.06 |
| HICP | -0.09 | -0.17 | -0.21 | -0.02 | -0.05 | -0.06 |
| GDP deflator | -0.46 | -0.88 | -1.18 | -0.03 | -0.08 | -0.10 |
| Compensation per employee | 0.12 | 0.12 | 0.04 | 0.00 | -0.01 | -0.02 |
| Total employment | -0.72 | -0.99 | -1.07 | -0.11 | -0.23 | -0.27 |
| Net lending/borrowing (% GDP) | 0.17 | 0.36 | 0.49 | 0.07 | 0.13 | 0.15 |
| Public balance (% GDP) | -0.29 | -0.51 | -0.64 | -0.06 | -0.11 | -0.13 |

### 5.6 Fiscal shocks

The basic public consumption and public investment shocks show similar results to those from MTBE-2011: the short-term multiplier is basically the same (around 0.7 in ex ante terms; see below). However, medium-term effects are bigger, due to two main reasons: because private productive investment now reacts more to demand shocks, and because the updated MTBE incorporates non-Keynesian effects directly in the estimation (public deficit appears now as an explanatory variable in the equations for consumption and investment, with estimated parameters), whereas in MTBE-2011 these non-Keynesian effects were introduced via calibrated add-ons, which were bigger than the new – estimated – effect.

For other fiscal instruments, multipliers are also similar in the short term and slightly bigger in the medium term, for the same reasons. This is compatible with the findings common in the literature of fiscal multipliers during crisis: once crisis years are included, multipliers tend to be slightly higher.

The following table summarizes the ex-ante and ex-post fiscal multipliers for different shocks. The ex ante multiplier is the fall in GDP after a fiscal consolidation measure of size 1% of GDP, which will typically lead to a reduction of public deficit smaller than 1 pp of GDP. The ex post multiplier is the fall in GDP after a fiscal consolidation measure of the size needed in each case to achieve a reduction of 1 pp in public deficit as a percentage of GDP.

| | Ex ante fiscal multiplier | | | | | | Ex post fiscal multiplier | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MTBE-2011 (a) | | | MTBE update | | | MTBE-2011 (a) | | | MTBE update | | |
| Fiscal shock | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| Public investment | 0.7 | 0.5 | 0.4 | 0.7 | 0.7 | 0.7 | 0.8 | 0.6 | 0.4 | 1.0 | 1.0 | 1.1 |
| Public consumption | 0.6 | 0.5 | 0.4 | 0.7 | 0.7 | 0.8 | 0.9 | 0.6 | 0.4 | 0.9 | 1.0 | 1.0 |
| Public employment | 1.0 | 1.1 | 1.0 | 1.1 | 1.2 | 1.2 | 2.2 | 2.3 | 1.8 | 2.2 | 2.6 | 2.9 |
| Public wages | 0.1 | 0.1 | 0.0 | 0.1 | 0.2 | 0.2 | 0.2 | 0.3 | 0.0 | 0.2 | 0.5 | 0.9 |
| Direct taxes to households | 0.1 | 0.4 | 0.6 | 0.2 | 0.4 | 0.5 | 0.1 | 0.4 | 0.6 | 0.2 | 0.5 | 0.8 |
| Direct taxes to firms | 0.0 | 0.0 | 0.1 | 0.2 | 0.4 | 0.6 | 0.0 | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 |
| Indirect taxes | 0.1 | 0.3 | 0.4 | 0.3 | 0.6 | 0.7 | 0.1 | 0.3 | 0.3 | 0.3 | 0.6 | 0.7 |
| Social contributions | 0.1 | 0.4 | 0.5 | 0.2 | 0.4 | 0.5 | 0.1 | 0.4 | 0.6 | 0.2 | 0.5 | 0.7 |
| Unemployment benefits | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.3 | 0.2 | 0.2 | 0.5 | 0.8 |
| Pensions | 0.1 | 0.3 | 0.4 | 0.2 | 0.3 | 0.5 | 0.1 | 0.4 | 0.5 | 0.2 | 0.5 | 0.7 |
| Transfers to households | 0.1 | 0.4 | 0.4 | 0.2 | 0.4 | 0.5 | 0.1 | 0.4 | 0.6 | 0.2 | 0.5 | 0.7 |
| Transfers to firms | 0.0 | 0.0 | 0.1 | 0.3 | 0.4 | 0.6 | 0.0 | 0.0 | 0.1 | 0.3 | 0.6 | 0.8 |

(a) In this table all MTBE-2011 results incorporate a calibrated non-Keynesian add-on.

The following tables provide detailed results for a subset of these fiscal simulations:

**MTBE update: public-sector simulations**

Accumulated level differences.

| | Public investment (-1% of GDP) | | | Direct taxes (+1% of GDP) | | | Indirect taxes (+1% of GDP) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| GDP | -0.66 | -0.67 | -0.70 | -0.19 | -0.43 | -0.54 | -0.29 | -0.55 | -0.67 |
| Private consumption | -0.07 | -0.13 | -0.21 | -0.42 | -0.98 | -1.27 | -0.30 | -0.67 | -0.86 |
| Private productive investment | -0.73 | -0.67 | -0.73 | -0.14 | -0.41 | -0.57 | -2.02 | -3.55 | -4.31 |
| Housing investment | -0.35 | -0.88 | -1.35 | -1.35 | -2.93 | -3.45 | -0.94 | -1.91 | -2.29 |
| Exports (goods and services) | 0.04 | 0.11 | 0.13 | 0.01 | 0.06 | 0.09 | -0.03 | -0.02 | 0.02 |
| Imports (goods and services) | -1.43 | -1.41 | -1.45 | -0.42 | -0.92 | -1.15 | -0.57 | -1.09 | -1.35 |
| Contributions to GDP growth | | | | | | | | | |
| Domestic demand | -1.12 | -1.17 | -1.25 | -0.32 | -0.75 | -0.97 | -0.45 | -0.89 | -1.14 |
| Net exports | 0.46 | 0.51 | 0.56 | 0.13 | 0.32 | 0.43 | 0.17 | 0.34 | 0.47 |
| Core CPI | -0.15 | -0.23 | -0.24 | -0.03 | -0.13 | -0.18 | 0.72 | 0.78 | 0.74 |
| HICP | -0.14 | -0.22 | -0.24 | -0.03 | -0.13 | -0.18 | 0.71 | 0.76 | 0.73 |
| GDP deflator | -0.14 | -0.22 | -0.24 | -0.08 | -0.22 | -0.30 | 0.57 | 0.63 | 0.61 |
| Compensation per employee | -0.03 | -0.04 | -0.05 | 0.00 | -0.01 | -0.01 | 0.15 | 0.35 | 0.37 |
| Total employment | -0.75 | -0.89 | -0.93 | -0.23 | -0.63 | -0.85 | -0.34 | -0.73 | -0.87 |
| Net lending/borrowing (% GDP) | 0.46 | 0.47 | 0.48 | 0.13 | 0.28 | 0.36 | 0.25 | 0.40 | 0.48 |
| Public balance (% GDP) | 0.69 | 0.65 | 0.63 | 0.97 | 0.83 | 0.72 | 1.01 | 0.93 | 0.93 |

| | Public consumption (-1% of GDP) | | | Public wages (-1% of GDP) | | | Public employment (-1% of GDP) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| GDP | -0.69 | -0.71 | -0.75 | -0.09 | -0.18 | -0.23 | -1.11 | -1.17 | -1.24 |
| Private consumption | -0.08 | -0.15 | -0.26 | -0.28 | -0.62 | -0.85 | -0.19 | -0.35 | -0.51 |
| Private productive investment | -0.79 | -0.80 | -0.93 | 0.28 | 0.38 | 0.39 | 0.04 | 0.13 | 0.10 |
| Housing investment | -0.37 | -0.99 | -1.59 | -0.91 | -1.81 | -2.20 | -0.93 | -2.16 | -3.07 |
| Exports (goods and services) | 0.04 | 0.12 | 0.14 | 0.09 | 0.19 | 0.24 | 0.04 | 0.13 | 0.18 |
| Imports (goods and services) | -1.49 | -1.50 | -1.57 | -0.19 | -0.38 | -0.46 | -0.19 | -0.25 | -0.34 |
| Contributions to GDP growth | | | | | | | | | |
| Domestic demand | -1.17 | -1.24 | -1.35 | -0.18 | -0.39 | -0.50 | -1.17 | -1.30 | -1.43 |
| Net exports | 0.48 | 0.54 | 0.60 | 0.09 | 0.21 | 0.27 | 0.07 | 0.14 | 0.21 |
| Core CPI | -0.15 | -0.24 | -0.27 | -0.09 | -0.21 | -0.27 | -0.22 | -0.35 | -0.38 |
| HICP | -0.15 | -0.24 | -0.26 | -0.09 | -0.20 | -0.27 | -0.22 | -0.34 | -0.38 |
| GDP deflator | -0.14 | -0.23 | -0.27 | -1.14 | -1.25 | -1.30 | -0.18 | -0.30 | -0.33 |
| Compensation per employee | -0.03 | -0.04 | -0.05 | -2.80 | -3.15 | -3.35 | -0.31 | -0.48 | -0.57 |
| Total employment | -0.82 | -1.03 | -1.14 | -0.08 | -0.22 | -0.34 | -1.77 | -1.88 | -1.97 |
| Net lending/borrowing (% GDP) | 0.48 | 0.49 | 0.52 | 0.10 | 0.20 | 0.24 | 0.08 | 0.12 | 0.15 |
| Public balance (% GDP) | 0.77 | 0.75 | 0.74 | 0.45 | 0.33 | 0.25 | 0.50 | 0.46 | 0.43 |

Regarding the shock to indirect taxes and its effect on prices, there is a similar case as with the oil price shock: the new price block of the updated MTBE shows almost no inertia. That is, after 12 months, inflation returns to its baseline path, leaving the price level permanently increased but not growing at a faster rate. This is different from the behaviour of the older version of the model, and it now seems like a better description of the reaction of prices after this kind of shock.

### 5.7 Wages and prices

Because the price-wage feedback is smaller in the updated MTBE than in the old version, a wage moderation shock now has a bigger effect on households' disposable income (in the old model, the fall in prices made it basically invariant to the shock), and long-run competitiveness gains are smaller too (prices don't fall as much, exports don't grow as much), so this simulation shows no clear positive effects: consumption and housing investment fall, and the rise in exports and fall of imports are not big enough to compensate the contraction of domestic demand; as a result, GDP basically doesn't grow.

However, when wage moderation is coupled with price moderation (that is, when firms reduce prices following a fall in nominal wages) then there are much bigger positive

effects on exports, higher employment, and an increase in disposable income that triggers the demand channel upwards, generating higher consumption and investment. GDP grows and the contribution to growth by net exports improves (although, as in the old model, the effect on the net lending/borrowing position is not positive[8]).

**MTBE update: price and wage simulations**

Accumulated level differences.

| | Prices (-1%) | | | Private-sector wages (-1%) | | | Prices and wages (-1%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 | Year 1 | Year 2 | Year 3 |
| GDP | 0.14 | 0.25 | 0.27 | 0.05 | 0.02 | -0.01 | 0.20 | 0.29 | 0.29 |
| Private consumption | 0.16 | 0.29 | 0.28 | -0.08 | -0.16 | -0.23 | 0.16 | 0.31 | 0.31 |
| Private productive investment | 0.41 | 0.90 | 1.09 | 0.68 | 0.65 | 0.59 | 0.97 | 1.19 | 1.26 |
| Housing investment | 0.44 | 0.61 | 0.47 | -0.25 | -0.40 | -0.52 | 0.48 | 0.74 | 0.65 |
| Exports (goods and services) | 0.19 | 0.36 | 0.41 | 0.17 | 0.19 | 0.19 | 0.31 | 0.40 | 0.43 |
| Imports (goods and services) | 0.28 | 0.55 | 0.60 | 0.10 | 0.05 | -0.01 | 0.43 | 0.64 | 0.66 |
| Contributions to GDP growth | | | | | | | | | |
| Domestic demand | 0.16 | 0.30 | 0.31 | 0.02 | -0.03 | -0.09 | 0.23 | 0.35 | 0.36 |
| Net exports | -0.02 | -0.05 | -0.04 | 0.03 | 0.05 | 0.08 | -0.03 | -0.06 | -0.06 |
| Core CPI | -1.01 | -1.00 | -1.00 | -0.14 | -0.17 | -0.20 | -0.99 | -0.95 | -0.95 |
| HICP | -0.99 | -0.99 | -0.99 | -0.13 | -0.17 | -0.20 | -0.97 | -0.94 | -0.93 |
| GDP deflator | -0.83 | -0.82 | -0.83 | -0.12 | -0.16 | -0.19 | -0.81 | -0.77 | -0.77 |
| Compensation per employee | -0.22 | -0.40 | -0.46 | -1.00 | -1.09 | -1.15 | -1.00 | -0.94 | -0.89 |
| Total employment | 0.10 | 0.26 | 0.29 | 0.12 | 0.09 | 0.01 | 0.25 | 0.37 | 0.35 |
| Net lending/borrowing (% GDP) | -0.06 | -0.12 | -0.12 | 0.02 | 0.05 | 0.08 | -0.07 | -0.12 | -0.13 |
| Public balance (% GDP) | -0.10 | -0.07 | -0.07 | -0.13 | -0.16 | -0.20 | -0.16 | -0.10 | -0.10 |

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**8.** This is due to the small price elasticity of exports: with an elasticity below one, after a fall in export prices, real exports grow but nominal exports fall. Therefore, the net lending/borrowing position, which is calculated in nominal terms, cannot improve.

# 6 Conclusion

The new version of the MTBE model presented here provides a better approximation to the behaviour of the Spanish economy in the last two decades, as its estimation relies on more recent data covering part of the crisis period.

In this new version, private productive investment and employment react more to output, capturing the higher sensitivity of these variables observed especially during the crisis, and prices and wages react less both to each other and to the evolution of real variables, a behaviour that is more in line with the observed data than the one displayed by the previous version of the model. Credit is now an endogenous variable in the model and it also helps explain the behaviour of the main demand components.

As a result of the previous adjustments, model simulations now generally display a somewhat stronger demand channel, and show nominal effects that are both smaller and with less inertia. Also, the updated version of the model describes an economy that is more reactive to financial shocks other than changes in interest rates, where wage moderation can generate growth and employment if it is followed by price moderation, and where fiscal consolidation is effective and has negative but moderate effects on GDP.

## Appendix. Model equations and coefficients

The following tables present a simplified summary of the variables and coefficients in the main behavioural equations in the updated MTBE. As an example on how these tables represent the actual model, the full equation for private consumption is also provided.

| PRIVATE CONSUMPTION | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Disposable income | 0.904 | Error Correction Mechanism | -0.601 |
| Financial wealth | 0.062 | ECM * Employment rate | 1.190 |
| Non-financial wealth | 0.024 | Disposable income | 0.346 |
| Real interest rate | -0.010 | Financial wealth | 0.044 |
| Bank Lending Survey indicator | -0.071 | Non-financial wealth | 0.054 |
| Unemployment rate | -0.074 | Real interest rate | -0.010 |
| | | Bank Lending Survey indicator | -0.016 |
| | | Credit | 0.146 |
| | | Public deficit | -0.073 |

$$pcr^* = -0.173 + 0.904 \cdot hdyr + 0.062 \cdot fwr + 0.024 \cdot nfwr - 0.010 \cdot RR$$
$$- 0.071 \cdot BLS_{-2} - 0.074 \cdot URX$$

$$\Delta pcr = -0.0002 + 0.087 \cdot \Delta hdyr + 0.087 \cdot hdyr_{-1} + 0.087 \cdot hdyr_{-2} + 0.087 \cdot hdyr_{-3}$$
$$+ 0.011 \cdot \Delta fwr + 0.011 \cdot \Delta fwr_{-1} + 0.011 \cdot \Delta fwr_{-2} + 0.011 \cdot \Delta fwr_{-3}$$
$$+ 0.013 \cdot \Delta nfwr + 0.013 \cdot \Delta nfwr_{-1} + 0.013 \cdot \Delta nfwr_{-2} + 0.013 \cdot \Delta nfwr_{-3}$$
$$+ 0.036 \cdot \Delta CRDT_{-1} + 0.036 \cdot \Delta CRDT_{-2} + 0.036\Delta CRDT_{-3} + 0.036\Delta CRDT_{-4}$$
$$- 0.005 \cdot \Delta RR - 0.005 \cdot \Delta RR_{-1} - 0.016 \cdot BLS_{-1} + 0.043 \cdot \Delta PDY_{-1}$$
$$+ (-0.601 + 1.190 \cdot ERX) \cdot (pcr_{-1} - pcr^*_{-1})$$

Where:

pcr = log of real private consumption

pcr* = log of long-term real private consumption

hdyr = log of real household disposable income

fwr = log of real financial wealth of households

nfwr = log of real non-financial wealth of households

RR = real interest rate for private consumption

BLS = credit supply indicator from the Bank Lending Survey

URX = unemployment rate

ERX = employment rate

CRDT = total real credit to households

PDY = public deficit as percentage of GDP

| HOUSING INVESTMENT | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Disposable income | 0.992 | Error Correction Mechanism | -0.129 |
| Financial wealth | 0.068 | ECM * Employment rate | 0.192 |
| Non-financial wealth | 0.026 | Disposable income | 1.232 |
| Real interest rate | -0.023 | Financial wealth | 0.172 |
| Unemployment rate | -0.034 | Non-financial wealth | 0.330 |
| | | Real interest rate | -0.017 |
| | | Bank Lending Survey indicator | -0.066 |
| | | Credit | 0.041 |
| | | Public deficit | -0.250 |

| PRIVATE PRODUCTIVE INVESTMENT | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Output | 1.000 | Error Correction Mechanism | -0.050 |
| Real wage | 0.618 | Output | 0.953 |
| Real interest rate | -0.039 | Exports of goods to the euro area | 0.313 |
| TFP | 0.476 | Real interest rate | -0.027 |
| ULC (relative to euro area) | -0.373 | % firms with high financial burde | -0.618 |
| | | Public deficit | -0.092 |
| | | Bank Lending Survey indicator | -0.065 |
| | | Credit | 0.086 |
| | | Stock price index | 0.029 |
| | | ULC (relative to euro area) | -0.371 |

| EMPLOYMENT | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Output | 1.617 | Error Correction Mechanism | -0.100 |
| Stock of capital | -0.617 | Output | 1.110 |
| TPF | -0.219 | Real wages | -0.123 |
| Working-age population | 1.015 | Working-age population | 0.346 |
| | | Real estate margins | 0.077 |

| WAGES | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Prices | 1.000 | Error Correction Mechanism | -0.150 |
| Output | 0.411 | Prices | 0.484 |
| Employment | -0.411 | Output | 0.531 |
| Wage drift | 0.849 | Employment | -0.391 |
| Real public-sector wages | 0.235 | Unemployment rate | -0.043 |
| | | Real public-sector wages | 0.069 |
| | | Wage drift | 1.000 |

| CORE CPI | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| | | Unit labor costs | 0.123 |
| | | Output | 0.257 |
| | | Indirect taxes | 0.536 |

| PRIVATE CONSUMPTION DEFLACTOR | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Core CPI | 0.975 | Error Correction Mechanism | -0.030 |
| Oil price | 0.025 | Core CPI | 0.987 |
| | | Oil price | 0.013 |

| MARKET GROSS VALUE ADDED DEFLACTOR | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Core CPI | 1.000 | Error Correction Mechanism | -0.033 |
| Indirect taxes | -0.500 | Core CPI | 1.000 |
| | | Indirect taxes | -0.500 |

| EXPORTS OF GOODS TO THE EURO AREA | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Demand | 1.149 | Error Correction Mechanism | -0.209 |
| Relative prices | -0.846 | Demand | 1.266 |
| Relative unit labor costs | -0.170 | Relative prices | -0.010 |
| | | Relative unit labor costs | -0.475 |

| EXPORTS OF GOODS TO THE REST OF THE WORLD | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Demand | 1.049 | Error Correction Mechanism | -0.150 |
| Relative prices | -1.855 | Demand | 1.150 |
| | | Relative prices | -0.536 |

| EXPORTS OF SERVICES | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Demand | 2.662 | Error Correction Mechanism | -0.150 |
| Relative prices | -0.611 | Demand | 0.954 |
| | | Relative prices | -0.347 |

| IMPORTS OF GOODS FROM THE EURO AREA | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Demand | 1.266 | Error Correction Mechanism | -0.150 |
| Relative prices | 0.100 | Demand | 1.700 |
| | | Relative prices | 0.350 |

| IMPORTS OF GOODS FROM THE REST OF THE WORLD | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Demand | 1.759 | Error Correction Mechanism | -0.150 |
| Relative prices | 0.362 | Demand | 1.700 |
| | | Relative prices | 0.123 |

| IMPORTS OF SERVICES | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Demand | 1.882 | Error Correction Mechanism | -0.150 |
| Relative prices | 0.100 | Demand | 1.700 |
| | | Relative prices | 0.150 |

| REAL CREDIT TO HOUSEHOLDS | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Consumption+housing investmer | 0.840 | Error Correction Mechanism | -0.163 |
| Interest rate | -0.017 | Intertia | 0.709 |
| Total real wealth | 0.415 | Private consumption deflactor | -0.439 |
| Average maturity | 0.077 | | |

| REAL CREDIT TO CONSTRUCTION AND PROPERTY DEVELOPERS | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| House Prices | 1.738 | Error Correction Mechanism | -0.061 |
| Interest rate | -0.096 | Intertia | 0.538 |
| | | Interest rate | 0.011 |

| REAL CREDIT TO OTHER FIRMS | | | |
|---|---|---|---|
| **Long run coefficients** | | **Short run coefficients** | |
| Private Productive Investment | 0.933 | Error Correction Mechanism | -0.052 |
| Interest rate | -0.050 | Inertia | 0.237 |

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