Financial frictions and shock transmission: the Portuguese case[1]

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ABSTRACT

This article uses the *PESSOA* model to assess the macroeconomic impact of two relevant shocks that conditioned the Portuguese economy in the recent past: the fall in external demand and the rise in sovereign debt risk premium. *PESSOA* is a general equilibrium model, calibrated to incorporate the main features of the Portuguese economy. The recession driven by the external demand shock is magnified by the prevalence of financial frictions, in particular due to the drop in investment, which does not occur in the case of the risk premium shock. Financial frictions increase the persistence of recessionary effects, especially in the external demand shock, to the extent that capital holders experience a persistent reduction of their net worth, which increases the degree of leverage, the risk levels associated with investment projects, and the costs of external financing. Results show also that the recession causes a decrease in fiscal revenues in both shocks, and thus fiscal policy must take a restrictive stance to ensure the stability of public debt in the medium and long term.

1. Introduction

Over the last decade, the Portuguese economy has been affected by several events which shaped its evolution. These events are usually termed in the literature on economic models as shocks.

This article analyses the impact of two external shocks on the Portuguese economy: the sudden contraction of global economic activity and international trade flows at the end of 2008; and the increased cost of sovereign debt from mid-2010. The analysis of these shocks is of particular importance, given their magnitude and the evidence of their impact on the Portuguese economy. Additionally, these shocks are clearly exogenous and thus independent of contemporary economic policy decisions of authorities. This allows to threat them as structural shocks – a crucial feature for the interpretation of the role of these shocks on economic developments and on the decisions of policymakers, including decisions on fiscal policy.

This article uses a general equilibrium model for a small euro-area economy – the *PESSOA* model (see Almeida *et al*., 2013) – to explore the main transmission mechanisms of the above-mentioned shocks. The model is endowed with a financial block that allows the analysis of the role of financial frictions in the transmission of shocks. The analysis therefore attaches a particular importance to the financial mechanisms in the transmission of these shocks to real variables, by taking into account the role played by the international financial crisis and the financial markets fragmentation observed in the euro area.

The next section motivates the analysis. Section 3 presents briefly the *PESSOA* model and analyses the impact of shocks to external demand and to the sovereign risk premium on the Portuguese economy according to the model. Section 4 concludes, presents the limitations of this analysis, and suggests possible topics for future research.

2. Motivation

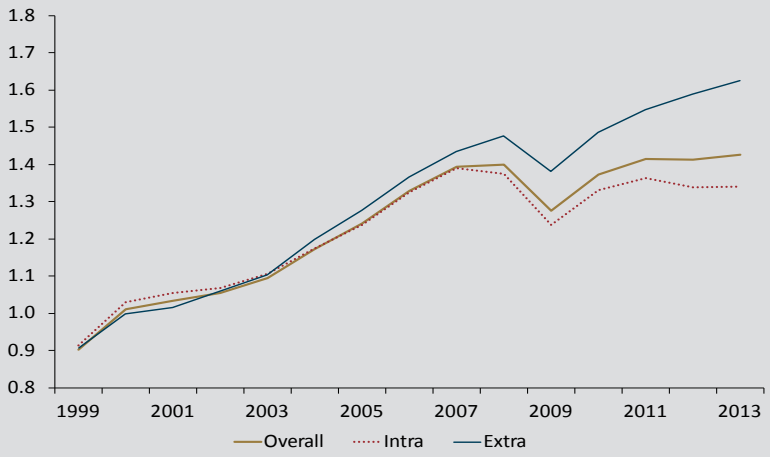
The evolution of the world economy in the 2003-2013 period was marked by a series of unanticipated events as rich and vast for economic analysis as disturbing to the smooth functioning of global economic relations. Within that period, special mention should be placed on the years following the outbreak of the international financial crisis in 2007, commonly known as the Great Recession, which constitute the most comprehensive and prolonged period of crisis since the Great Depression of the 30s of the twentieth century. The Great Recession occurred after a period of over two decades of seemingly harmonious functioning of developed economies – the Great Moderation – which was marked by relatively short and confined periods of crisis.

The onset of the Great Recession was marked by the outbreak of the international financial crisis in the United States of America (US) in mid-2007. This crisis challenged the financial system credibility, primarily in the US, and at a later stage in most developed economies. Against a background of exacerbated uncertainty, the bankruptcy of Lehman Brothers marked a period of great instability which was quickly transmitted to the real economy. The increased perception of risk by financial market participants, as well as falling confidence levels, led to a sharp decline in economic activity.

The collapse of the global economic activity led to a fall in trade flows, with strong impact in developed economies and in the main trading partners of Portugal. For a small open economy, with a strong trade exposure to euro area countries, as is the case of Portugal, the transmission of this shock was immediate, affecting exports directly and, hence, economic activity and employment levels. For the Portuguese economy, this was a shock without parallel in the history of Portugal's participation in the European project.

Chart 2.1 shows the evolution between 1999 and 2013 of an indicator that measures the external demand for Portuguese goods and services. As shown, external demand fell sharply in 2009, both in intra- and in extra-euro area markets. Despite the slight recovery, external demand from euro area countries in 2013 was still below that recorded in 2007. On the contrary, economies outside the euro area, with emphasis on emerging market economies and developing countries, experienced a rapid recovery immediately after the collapse of international trade in late 2008 and early 2009. This pattern of global economic growth is particularly unfavourable for an economy with high exposure to euro area trading partners, as is the case of the Portuguese economy.

Chart 2.1 • Foreign demand of Portuguese goods and services | In logs (1989=0)



Sources: ECB and authors' calculations.
Note: Annual data.

The economic contraction described above had a marked global nature, having affected most of the developed economies. However, the increase in risk perception by financial market participants had clearly heterogeneous impacts with regard to the reassessment of risk pricing, which reflected abruptly in the financing costs of some euro area economies, whose structural fragilities were highlighted by the recession.

Euro area economies, which abdicated from having own currencies and from defining independent monetary and exchange rate policies, have benefitted during the first ten years of participation in the euro from favourable financing conditions and from a framework of macroeconomic stability provided by the credibility of the euro. In this context, the accumulation of a set of macroeconomic imbalances resulting from the structural fagilities was not reflected in the interest rates on sovereign debt in an obvious manner over a prolonged period. The money market functioned smoothy and the monetary policy transmission was regular. This situation, perceived as given by resident agents, changed abruptly in a framework marked by a new risk perception of financial market participants associated with an increase in the materialization of credit risk. In an initial stage this involved a rapid increase in sovereign debt interest rate differentials of countries with structural fragilities (Ireland, Greece, Portugal, Cyprus, Italy and Spain) against countries with stronger economic fundamentals (notably Germany). The increase in interest rates on sovereign debt in euro-area economies with fragilities was accompanied by the emergence of financial tensions, in particular the loss of access by banks of these countries to international wholesale funding markets, which determined the transmission of sovereign risk to the private sector, with incidence on the funding conditions of non-financial corporations.

The intensification of the sovereign debt crisis throughout 2010, particularly following the request for international financial support by the Greek government, determined the loss of access to market funding by some sovereign states that experienced significant increases in debt in previous years, including Portugal. Interest rates of sovereign debt ceased to reflect solely the underlying risk of default (e.g. incorporating a premium due to the low liquidity of these securities). The loss of regular access to market financing entailed the need to resort to a financial assistance program, with the cost of public sector borrowing starting to be determined by lending rates of international institutions, particularly the International Monetary Fund (IMF) and the European Union (EU).

The evolution of interest rates implied in the public debt of Portugal and of the euro area, which reflect effective funding costs, showed a significant increase in the spread after 2010 and a close proximity in the proceeding period (see Chart 2.2). This article analyses the impact of the rising cost of public sector funding, based on the spread between these interest rates, which recorded a remarkable increase in 2010, followed by a reduction over the two subsequent years.

3. The *PESSOA* model

The *PESSOA* model is a general equilibrium model designed to incorporate the key features of an euro-area small open economy. In this context, it is assumed that domestic shocks do not impact the external environment, as in Adolfson *et al*. (2007), nor affect the monetary policy decisions of the European Central Bank (ECB). The stability of the economy in nominal terms is ensured by the assumption of perfect credibility of the inflation target, set exogenously by the ECB. The integration in the monetary union implies that the nominal exchange rate is irrevocably fixed, assuming perfect credibility. The dynamic stability of the model is ensured by the reaction of international trade flows to fluctuations in the real exchange rate.

The *PESSOA* model follows closely the Global Integrated Monetary and Fiscal Model (Kumhof, Muir, Mursula and Laxton, 2010). The model is intrinsically neo-Keynesian, whereby the functioning of labour and product markets is based on the assumption of monopolistic competition and nominal rigidities in wage and price determination. The model also includes real rigidities that allow for realistic responses of investment and imports. The model version used herein incorporates a financial sector that interacts with the rest of the economy, particularly through the decisions of those agents responsible for the acquisition of capital goods – the entrepreneurs.

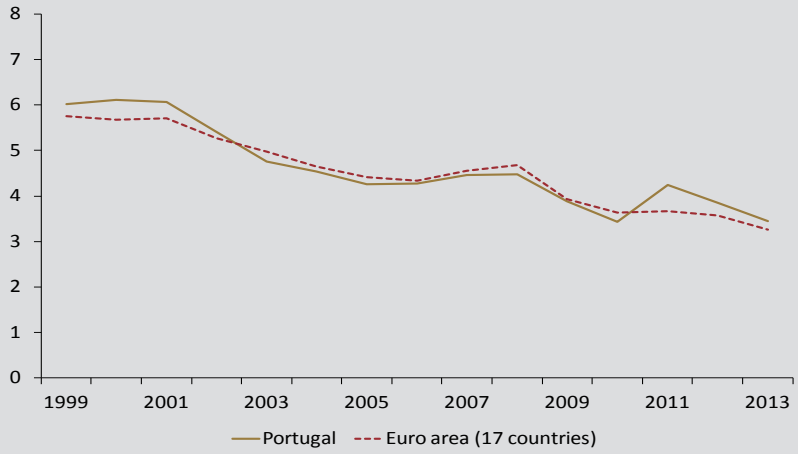
Section 3.1 outlines the *PESSOA* model. Almeida *et al*. (2011) contains an identical description, though without reference to the financial sector, while Almeida *et al*. (2013) contains a detailed description, including the derivation of all equilibrium conditions of the model. Section 3.2 presents in a stylized manner the shocks analysed in this article, namely the decline in external demand for Portuguese goods and services and the sharp rise in the sovereign risk premium (in line with the empirical evidence presented in section 2). Shocks are not anticipated by economic agents, so their occurrence is a surprise. Once the shocks occur, perfect foresight is assumed on its future path. Finally, section 3.3 presents the macroeconomic impacts of these shocks, identifying the contribution of financial constraints for their transmission and interaction with the real variables of the economy.

3.1. Presentation of the model

Figure 3.1.1 shows the *PESSOA* model in a flowchart. Economic agents operating in the non-financial sector of the economy establish among themselves a relationship involving flows of labour, intermediate goods and final goods, as well as income flows (compensation of employees, dividends, taxes, transfers from government to households).

The decisions of economic agents are conditioned by an external environment, which, as noted, remains unchanged despite domestic shocks. For sake of simplicity, it is assumed that the external environment corresponds to the remaining countries of the euro area. The relationship of the domestic economy with the foreign economy includes flows of imports and exports of goods and services as well as financial flows associated with transactions of assets/debt.

Chart 2.2 • Interest rates implied in the Portguese and Euro Area public debt | In percentage



Sources: Eurostat and authors' calculations.
Notes: Annual data. Interest rates were computed by taking into account gross consolidated public debt in euros and interest payments including swaps and FRA. Euro area data considers 17 countries.

The *PESSOA* model is a dynamic model that evolves towards a well-defined equilibrium labelled "steady state". The economy is in a stable and lasting equilibrium in the steady state, in which inflation is stabilized and economic growth depends only on technological progress, in a context where it is assumed that there is no population growth. Given an exogenous shock in a given period t, for example an unexpected fall in external demand, the economy deviates from the steady state that existed in period $t-1$ (hereinafter "initial steady state") and starts to reflect the set of decisions of economic agents in periods t, $t+1$, $t+2$,... In a general equilibrium framework, demand equals supply in all markets and in all periods; however the endogenous variables of the model will adjust in all periods, reflecting the decisions of economic agents as a result of the shock. The economy only stabilizes in the new steady state after the dissipation of the impacts of all shocks. The model's endogenous variables stabilize in levels that may or may not correspond to the initial steady state, depending on the type and nature of the shock.

The transitional equilibria always results from the optimizing behaviour of agents, which use all available information and anticipate future developments in relevant variables. In the case of temporary shocks, as discussed in this article, the final steady state coincides with the initial one, and only the transitional dynamics of the economy is affected. The characterization of the economy in the period between the onset of the shock and the stabilization around the new steady state depends crucially on the shock duration and on the adjustment conditions of the economy (degree of nominal and real rigidities, degree of market competition, prevailing financial constraints). The mechanisms that ensure the dynamic stability of the model, *i.e.*, the convergence to a well-defined steady state, are essentially based on the adjustment of prices and wages, which determine at all times the real exchange rate and in interaction of this adjustment with trade and financial flows with the rest of the euro area.

Households have finite life with random duration in *PESSOA*, facing an instant probability of death, independent of age, in line with the overlapping generation model proposed by Blanchard (1985) and Yaari (1965). Through an insurance contract, the surviving households divide among themselves, at all times, the assets of the households that pass away. The modeling setup includes a wage income profile which translates into adjusted labour-productivity earnings of each generation, assuming that younger generations are more productive than older generations (a constant productivity decay rate throughout life is considered). Households derive utility from consumption

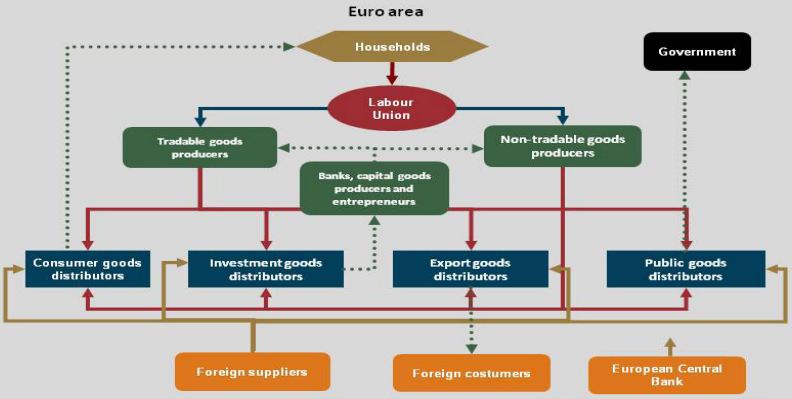


Chart 3.1.1 • The *PESSOA* model

Source: Made by the authors.

and leisure, through a utility function with constant relative risk aversion. There are two types of households in the model: the assets/liabilities holders, which perform intra- and inter-temporal optimization, smoothing consumption; and those which simply perform intratemporal optimization, in line with Galí, López-Salido and Vallés (2007). This distinction is not however significant to frame the relevant transitional equilibria analysed in this article.

"Labour unions" are agents that operate in a context of monopolistic competition in the labour market. Unions give workers bargaining power, enabling them to obtain a wage higher than their marginal rate of substitution between consumption and leisure, thus giving rise to a wage premium. The model incorporates wage rigidities in the form of adjustment costs associated with wage changes.

The non-financial sector of *PESSOA* incorporates firms producing intermediate goods (tradable and non-tradable), which use labour and capital. The production function assumes a constant elasticity of substitution between production factors. In turn, firms producing final goods use intermediate goods and imports to produce final goods demanded by the various agents in the economy (consumer goods, investment goods, goods for public consumption and export goods). Each agent in the economy demands a different type of final good.

The Government sets the public consumption level and performs transfers to households. Revenues stem primarily from tax collection. Although transfers from EU can also be considered, this article assumes that these remain unchanged. Government spending and revenues need not to be equal over time, and the Government may incur in budget deficits or surpluses. In this context, the tax collection can be deferred through the issuance of public debt, which gives rise to interest payments associated with the stock of outstanding bonds (held by households with access to asset markets). The interest rate on sovereign domestic debt i_t may differ from the interest rate that prevails elsewhere in the euro area i_t^* though a sovereign risk premium φ_t. More precisely,

$$i_t = \varphi_t \; i_t^* \tag{1}$$

It is considered in this article that tax rates on labour income (including income tax and social contributions paid by employees and firms) will be determined endogenously in order to maintain unchanged, in the steady state, the public debt-to-GDP ratio. The remaining tax rates, particularly on household consumption and on corporate income, remain exogenous and do not change.

It is assumed that all bonds issued by the Government are held by domestic households, which may, however, borrow abroad. Given that the domestic economy is sufficiently small, changes in its international investment position (IIP) have no impact on the euro-area interest rate. Contrary to models that consider infinitively-lived agents, the IIP in the long run is determined endogenously in models with finite lifetimes as *PESSOA* (Frenkel and Razin, 1996; Harrison *et al*., 2005). Besides household borrowing from abroad, IIP is determined by external transfers and by the trade balance. This article highlights the behaviour of domestic exports Y_t^X, which depends on the following demand curve,

$$Y_t^X = \alpha^{A^*} \left(\frac{P_t^X}{P^*} \right)^{-\xi^{A^*}} Y_t^{A^*} \tag{2}$$

where α^{A^*} is a parameter associated with the production technology in the rest of the euro area,

P_t^X is the price of domestic exports, P^* is the exogenous price that prevails in the rest of the euro area, and $Y_t^{A^*}$ is the external demand for domestic goods. The parameter ξ^{A^*} measures the elasticity of substitution between domestic and foreign goods. It should be noted that the (exogenous) external variables include an asterisk (*) and that α^{A^*} and P^* remain unchanged.

Finally, the financial sector includes agents that will be labelled as "banks and entrepreneurs". The modeling of such agents, which interact closely with the producers of capital goods, closely follows the approach suggested by Bernanke, Gertler and Gilchrist (1999). Banks are relatively passive financial intermediaries, whose main function is to intermediate funds between households and entrepreneurs. Households are indifferent between making deposits in banks or purchasing public debt, as the interest rate received by them is equal in both cases. Banks, in turn, charge an interest rate conditional on the state of the economy, which will be determined in all periods. It is assumed that the banking sector operates under perfect competition, so the interest rate implies ex-post zero profit in all periods. The interest rate charged by banks effectively depends on several factors, including the success of financed projects, which are subject to the uncertainty associated with each project, as well as all aggregate shocks that affect the economy's operating conditions.

Entrepreneurs are agents with insufficient net worth to finance their optimal capital levels. They are involved in risky activities, since each of them is unaware if their projects are sufficiently productive to honour the lending contract signed with the bank. If the project is sufficiently productive, the bank receives a contractually agreed share and the entrepreneur gets the remaining part. If the project is not sufficiently productive, the entrepreneur declares bankruptcy and hands over the capital to the bank. This amount will thus be insufficient to fulfil the established lending contract; in addition, the bank can only recover a share of that value. This cost, labelled the monitoring cost, has a positive and direct correlation with the level of financial frictions in the economy.

In all periods there are a number of bankruptcies in the economy, reflecting the risk associated with ongoing projects. A bank may record losses with a particular entrepreneur, but given that it assumes a fully diversified portfolio of projects, the zero profit is assured by charging an appropriate rate of interest to all projects in the portfolio that prove sufficiently productive so as to cover losses on projects that failed. This interest rate is naturally higher than the one associated with the sovereign debt, which is the rate at which the bank can borrow from households. After obtaining enough external funds, the entrepreneur purchases in each period capital from capital goods producers, immediately renting it to firms producing intermediate goods, which demand this production factor (in addition to labour).

The credit market functioning incorporates a mechanism – usually called "financial accelerator" - with implications for the propagation and amplification of shocks. The mechanism translates into an endogenous association between external finance premium and net worth. Given the need for bank loans to finance optimal levels of expenditure, entrepreneurs will have to incorporate finance premiums positively correlated with the degree of leverage, defined as the ratio between loans and net worth. *Ceteris paribus*, a fall in net worth implies an increase in leverage and in financing costs. In a context where net worth is pro-cyclical, the functioning of the credit market introduces a countercyclical external finance premium, which amplifies credit fluctuations and thus investment, spending, and production.

The modeling of a small open economy combines the necessary complexity such that the model is useful for the conduct of economic policy, with enough simplicity such that the analytical model is computationally tractable. The *PESSOA* model remains – like all economic models – a simplified representation of reality. The assumption of perfect foresight on the part of households and

firms collides, for instance, with the existence of limits in practical terms to formulating and solving complex problems, either due to the amount of information required, or to the inability to process and compute the utility of each alternative action in order to ensure the optimal choice. The modeling of the financial system, in particular the assumption of zero profits by banks, is admittedly insufficient. The *PESSOA* model is calibrated so as to reproduce the major macroeconomic data of the Portuguese economy (ratio of expenditure to GDP, negative net external position, etc.). A detailed description of the calibration of the model can be found in Almeida *et al*. (2013).

3.2. The external demand shock and the sovereign risk premium shock

Charts 3.2.1 and 3.2.2 show the external demand and the sovereign risk premium shocks, respectively. The external demand for Portuguese goods and services showed a continued decline from the fourth quarter of 2008 up to the third quarter of 2009, recovering thereafter. As can be seen in chart 3.2.1, this dynamics is well approximated by an autoregressive process (AR)

$$\ln x_t = \rho \ln x_{t-1} + \varepsilon_t \qquad (3)$$

where $\ln x_t$ stands for the logarithm of variable x_t, the parameter is a constant which determines the persistence of the AR process, and ε_t stands for the innovation in period t. In the case of the external demand shock, $x_t \equiv Y_t^{A^*}$, in line with the notation in equation (2). The calibration of the parameters of equation (3) implies $\rho = 0.8$ and $\varepsilon_t = -0.15$, which corresponds to a drop of 15 per cent in the quarter in which the innovation occurs, followed by a gradual reversion at a rate of approximately 60 per cent per year. The average reduction in $Y_t^{A^*}$ in the first four quarters is 11 per cent, which compares with an observed value of 11.6 per cent in 2009.

The sovereign risk premium, measured by the annual value of the spread of implied sovereign debt interest rates *vis-à-vis* the euro-area average, reported in chart 3.2.2, stood close to 60 basis points (bp) in 2011, declining in 2012 and 2013 to about 30 and 15 bp, respectively. *PESSOA* is designed for quarterly frequency, and thus the observed annual data must be converted. The shock analysed in this article considers an AR process, as shown in equation (3), where $\rho = 0.86$ and $\varepsilon_t = 70$. This shock corresponds to an increase of about 70 basis points in the first quarter of 2011, followed by a gradual decrease at a rate of approximately 45 per cent per year. In this case, it should be noted that $x_t \equiv \varphi_t$, in line with the notation in equation (1). The magnitude of the initial shock and the rate of decline were defined to minimize the sum of squared deviations between the estimates of the annual value of sovereign debt risk premium and the average annual projection process associated with AR process.

3.3. Macroeconomic impacts

This section assesses the impact of these shocks and analyses how financial frictions may have affected their propagation and interaction with the real variables of the economy.

3.3.1. The external demand shock

The macroeconomic impacts of the external demand shock and the role of financial frictions in their transmission are shown in chart 3.3.1.1. Simulation results allow for the conclusion that a sudden drop in external demand causes a recession. This conclusion is independent of the presence of financial frictions, although in the latter case investment is substantially hindered.

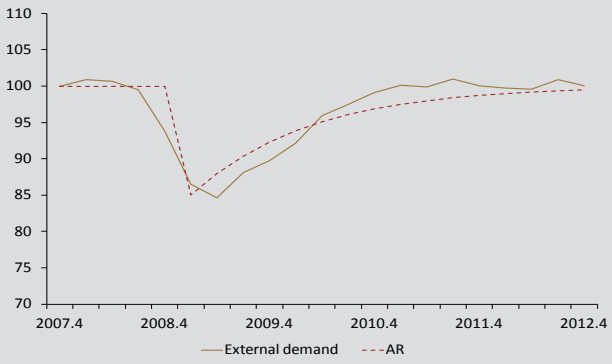
Exports, which are directly affected by the aggregate shock, exhibit a strong reduction in the first year (about 7 per cent). Financial frictions do not affect the size of this decline. The demand for domestic intermediate goods is reduced, particularly in the tradable goods sector, to the extent that exports are extremely intensive in this type of intermediate goods. This determines a contraction of factor demand, particularly labour, inducing a decline in the equilibrium wage rate.

Household consumption shrinks about 0.6 per cent in the first year. The contribution of financial frictions for this fall is virtually nil. The evolution of consumption reflects a reduction in disposable income, resulting not only from the decline in the number of hours worked and wages, but also from the increase in labour income taxes. The economic contraction triggers a decline in tax revenues, making it necessary to increase taxes in order to ensure the sustainability of public debt in the medium and long term. The volatility displayed by household consumption reflects the volatility of the real interest rate, which stems from inflation expectations, since the nominal interest rate is exogenously determined and does not change with the shock. The decline in wages leads to a decrease in production costs, affecting firms' price setting and implying a decline in inflation and thus a real exchange rate depreciation. This price competitiveness effect plays an important role both in cushioning the impact of the external demand shock on exports and in reducing the imported content of aggregate demand.

The main distinguishing factor of the external demand shock, when considering a context in which financial frictions are present, is the investment behaviour, which is reflected in the dynamics of the capital stock. Rather than increasing 0.2 per cent, investment declines by 1.1 per cent in the first year.

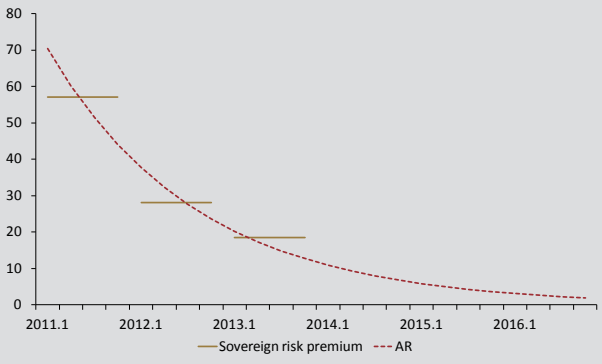
If the economy is characterized by the absence of financial frictions, it would not be in the economic agents best interest to significantly change the levels of investment due to the presence of adjustment costs. The anticipation of a recovery in exports, not only because of the temporary nature and low persistency of the fall in external demand, but also due to the real exchange rate depreciation, would result in a marginal increase in investment (the production of tradable goods is relatively capital intensive). Thus, investment has a counter-cyclical behaviour, contradicting the stylized fact that investment is a strongly pro-cyclical variable. When considering an environment with financial frictions, investment becomes clearly pro-cyclical, making the model more realistic. In this case, the increase in the real interest rate reduces the value of the firm's net worth. This

Chart 3.2.1 • External demand | Index 2007T4=100



Sources: ECB and authors' calculations.
Notes: Quarterly data. The actual figures are identical to those in Chart 2.1.

Chart 3.2.2 • Sovereign risk premium | Interest rate differential *vs.* euro area | In percentage points

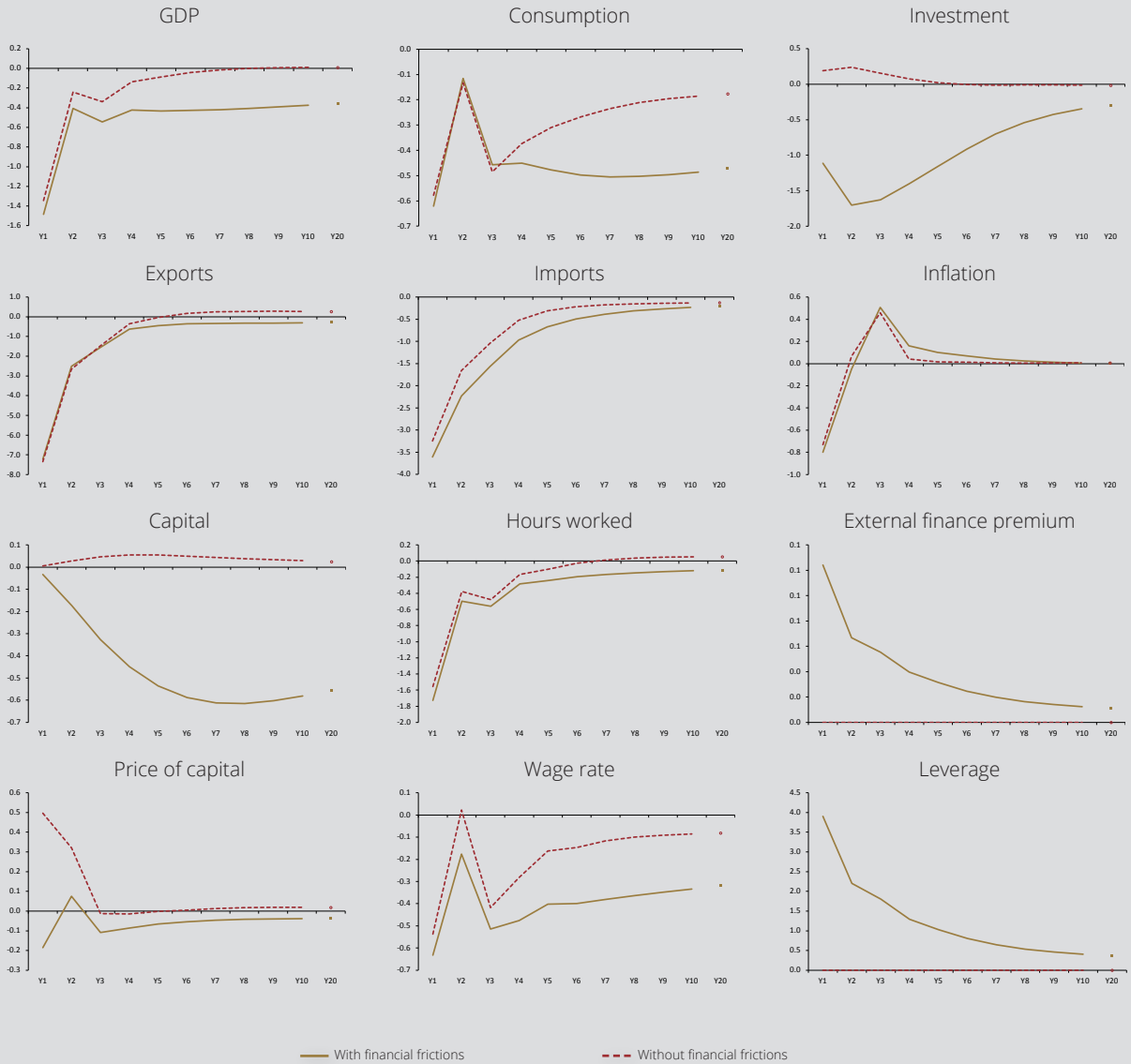


Sources: ECB and authors' calculations.
Notes: Quarterly data. The actual figures are identical to those in Chart 2.2.

adds to the reduction in the demand and the price of capital and triggers an increase in leverage, defined as the entrepreneurs borrowing to equity ratio. The deterioration of the financial situation leads to an increase in the risk premium charged by banks and places a larger fraction of firms under financial distress and facing a larger bankruptcy risk, ultimately determining a fall in investment.

The second distinguishing factor that should be emphasized in the transmission of the external demand shock is that financial frictions worsen the recession, not only in magnitude but also in terms of the persistence. GDP is reduced by 1.5 per cent in the first year, of which 0.2 percentage points are associated with those frictions. From then onwards, the economy remains constrained by the time period that firms will take to restore net worth and thus leverage and external financing costs to the levels that prevailed before the shock. While these differentials

Chart 3.3.1.1 • Macroeconomic impacts of a external demand shock | Deviations from initial steady-state



Source: Authors' calculations.
Notes: Annual figures. The lines show the first 10 years while the dots refer to a 20 years horizon. All results are expressed as percentage deviations from the steady state, except for the values obtained for inflation (calculated year on year) and leverage, which are in percentage points. Inflation is calculated based on the prices of consumer goods paid by households. Leverage is defined as the share of loans to entrepreneurs as a percentage of equity.

persist, the investment will be hindered and the economy will remain depressed as compared with the initial situation.

The deeper recession when the model incorporates financial frictions generates also the need for further increases in taxation in order to ensure a sustainable public debt path. Increased taxation exacerbates the recessive nature of the shock and has a visible impact on the evolution of household consumption. In line with the reduction in aggregate demand, imports drop 3.6 per cent with financial frictions, which creates an additional contribution of -0.4 percentage points relative to a framework without financial frictions.

3.3.2. The sovereign risk premium shock

The macroeconomic impacts of the shock on the sovereign risk premium are shown in chart 3.3.2.1. As in the previous section, this shock causes a recession, which stands at 0.6 per cent in the first year. The contribution of financial frictions for this decline is about 0.1 percentage points. The economy recovers as the shock dissipates.

The increase in domestic interest rates generates a fall in household consumption in the first year of 1.1 per cent (contribution of -0.2 percentage points associated with the presence of financial frictions). The sovereign risk premium shock induces households to postpone their consumption expenditures, not just because of a negative wealth effect, reflecting the decrease of the present discounted value of the after-tax households' income, but also due to a significant substitution effect, insofar as the return from savings – that is, the relative price of present consumption vis-à-vis future consumption – increases. The reduction in aggregate demand induces firms to reduce labour demand, yielding a reduction both in hours worked and in wages.

Investment declines by 1.2 per cent in the first year, with the contribution associated with the existence of financial frictions being nil. The persistent contraction in activity generates a reduction in the demand for capital, leading to a downward adjustment of the stock used by intermediate goods producers. *Ceteris paribus*, this process of deleveraging should lead to a reduction in the cost of bank lending to entrepreneurs, to the extent that they would not need to resort to such a high percentage of external funding to meet their optimal spending level. However, this result does not hold, as the effect is fully offset by the reduction in entrepreneurs' net worth determined by the rise in the real interest rate of the economy as well as by the reduction in the price of capital. Indeed, in the first year, leverage even increases, though only marginally.

As in the previous section, the recession generates a decline in tax revenue, and hence the tax rate on labour income has to increase in order to ensure the sustainability of public debt.

Exports are marginally affected in the short term, increasing 0.3 per cent in the first year and recording a contribution of about 0.1 percentage points associated with the presence of financial frictions. This development primarily reflects the marginal depreciation of the real exchange rate. Despite the decline in production implied by the sovereign risk premium shock, in both the tradable and non-tradable goods sectors, the positive effect on exports justifies a temporary reallocation of resources in the economy, in relative terms, towards the tradable goods sector. Imports fall sharply, in line with the imported content of aggregate demand components.

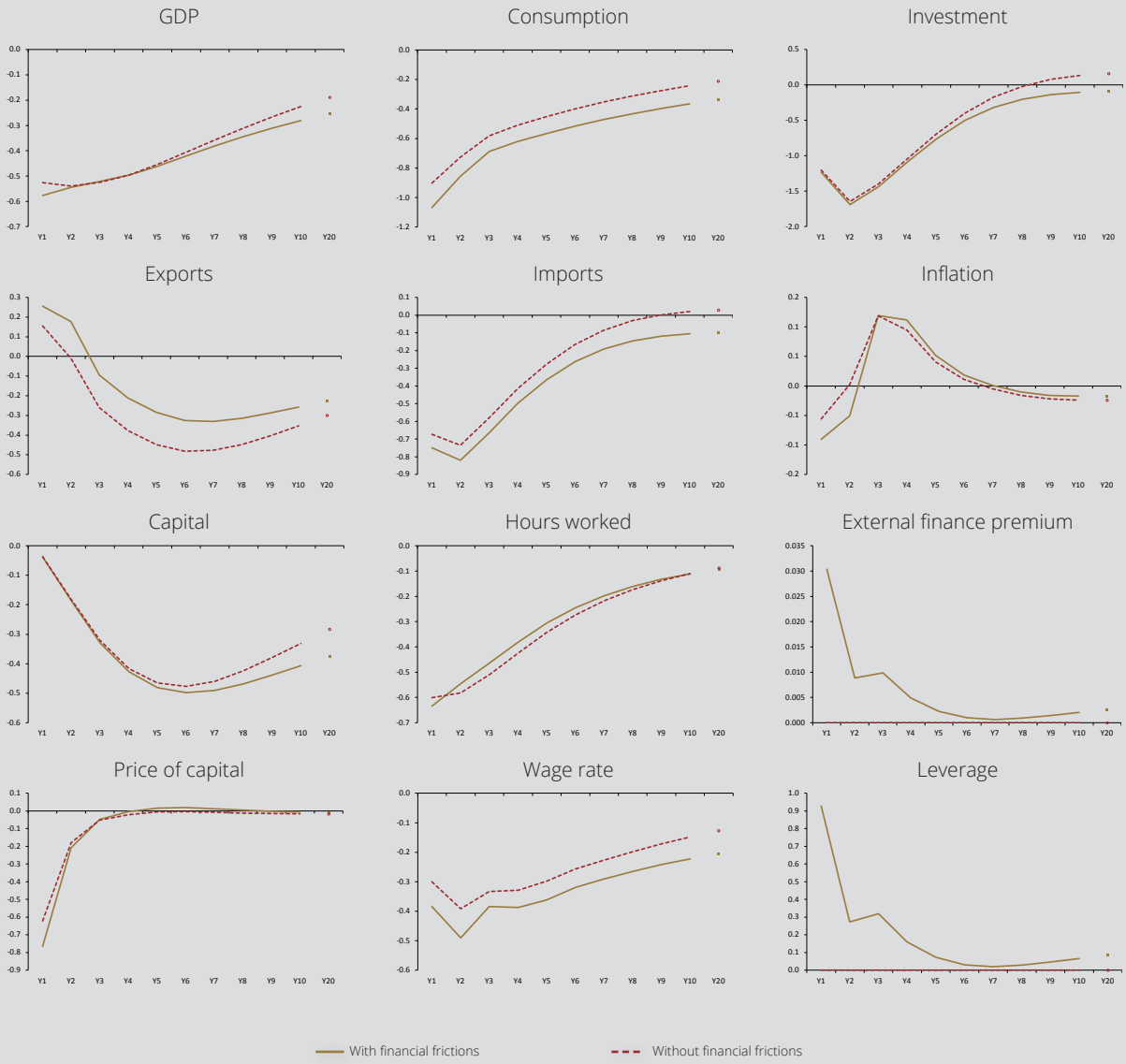
The simultaneous contraction of supply and aggregate demand generates a small effect on the prices of consumer goods. Inflation is marginally reduced, which contributes to explain the negligible impact of financial frictions in the transmission of the sovereign risk premium shock. The shock is transmitted integrally to all sectors of the economy, though there is no significant increase in leverage or an additional premium charged by banks. Since banks pay households

an interest rate identical to the interest rate of Government bonds, the increase in bank lending rates is directly passed on to the corporate sector.

4. Conclusions

This article analyses the role of the contraction of the world economy and of international trade flows recorded in late 2008 and in 2009, as well as of the increase in the risk premium of sovereign debt, on the evolution of the Portuguese economy in recent years. This analysis is conducted in a general equilibrium framework using the *PESSOA* model (Almeida *et al*., 2013), which captures a set of effects and interactions that are not considered in a consistent manner from a theoretical standpoint in reduced form models. The model incorporates a financial sector, allowing for the

Chart 3.3.2.1 • Macroeconomic impacts of a sovereign risk premium shock | Deviations from initial steady-state



Source: authors' calculations.
Notes: Annual figures. See chart 3.3.1.1 for details.

analysis of the role played by financial frictions and thus of an important set of constraints inherent to the Great Recession.

The simulations presented in this article reveal that both the collapse of international trade flows and the rise in the sovereign debt risk premium generate a significant contraction in economic activity. This reduction is more persistent the higher is the degree of financial frictions, which constitute an important mechanism in the analysis of the shocks considered.

Results support the conclusion that the amplification of shocks depends on their nature. In particular it is noted that the impact of negative demand shocks is larger the higher is the downward effect on prices. Financial frictions play an important role in the amplification of the impacts associated with the negative global economic activity shock. In case of the increase in the sovereign risk premium there is a contraction in aggregate demand, which is accompanied by a downward revaluation of the optimal level of capital stock, taking into account the change in financing conditions. Leverage levels are not significantly affected, given that the decrease in the price of capital and the increase in real interest rates reduce the value of equity. Hence financial frictions play a limited role in this case.

The analysis presented in this article is conditioned by the model used and its calibration. In particular, the interaction between real and financial variables of the model depends on the transmission mechanism considered. The inclusion of a fully-fledged financial sector, in which the banking sector plays a more active role, would enrich the model setup and will make it more realistic. This is a research topic to develop in future work.

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Notes

1. The opinions expressed in the article are those of the authors and do not necessarily coincide with those of Banco de Portugal or the Eurosystem. Any errors and omissions are the sole responsibility of the authors.

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