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# Financial fragmentation shocks

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**Abstract**
We define "financial fragmentation shocks" as fluctuations in credit market frictions in a small euro area economy. The shock changes the financial integration *status quo* of the monetary union, given its negligible international spillover. An increase in credit market frictions triggers a recession in the small economy. Perfect competition and the absence of nominal rigidities attenuate output volatility. Expectations also matter: real impacts weaken when long fragmentation time spans are perceived to be short lived. Contrarily to "risk shocks," defined as fluctuations in borrowers' riskiness, fragmentation shocks do not imply strongly countercyclical bankruptcy rates. The results are based on *PESSOA*, a general equilibrium model with a Bernanke-Gertler-Gilchrist financial accelerator mechanism.

JEL: D53, E27, E44, G17

Keywords: DSGE model, small euro area economy, financial fragmentation shock, monitoring cost shock, financial frictions.

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## 1. Introduction

The financial crisis had a major impact on the financing conditions of euro area countries. Markets become increasingly fragmented, hampering monetary policy transmission channels. The President of the European Central Bank (ECB), Mr. Mario Draghi, recognized in August 2012 that "our greatest concern is financial market fragmentation."[1]

Identifying the triggering sources behind financial fragmentation is a multidimensional task. Among other reasons, the different financing conditions may simply reflect structural differences between national markets (Dombret 2013). The benchmark nature of Government bond prices also implies that segmentation in this market is always reflected to some extent in other markets, with possible country-specific feed-back loops between sovereigns and the banking system (Constâncio 2014).

Households, governments and firms were all affected by the ordeal of financial fragmentation. Equilibrium in money, government, and corporate bond markets changed significantly during the crisis (ECB 2014), creating spillover impacts both domestically and across borders, in many cases embodying immediate pass-through effects. Spillover effects were however not confined to money and capital markets. The financial crisis showed that the interaction with real variables can lead to significant output and employment losses.

This article focuses primarily on the real effects of "financial fragmentation shocks." The shock is defined as an exogenous fluctuation in credit market frictions directly affecting the financing conditions of non-financial corporations (NFCs), and is assumed to take place in a small euro area economy. The shock changes the financial integration *status quo* of the monetary union, as the small economy witnesses a fluctuation without any international spillover. Homogeneous financial markets across euro area Member States require identical degrees of market frictions.

Financial fragmentation shocks are implemented in the asymmetric information environment laid out by Bernanke, Gertler, and Gilchrist (1999), henceforth BGG. It is well known that the degree of credit market frictions in this context depends on a "monitoring cost parameter"—a cost that the lender must pay to observe the borrower's realized return on capital. The fragmentation shock can thus be evaluated by taking a *lato sensu* interpretation of this operational cost, and by treating it as the realization of a stochastic process.

We claim that fluctuations in credit market frictions are important drivers of business cycles, belonging to the class of fundamental shocks that create a

1. See Draghi (2012). A stylised representation of market fragmentation and the impairment of the monetary policy transmission mechanism is clarified in ECB (2012).

"financial wedge" between the expected return on capital and the risk free rate. Christiano *et al.* (2015) claim that the bulk of the decline in economic activity in the US, during the Great Recession, was due to an higher financial wedge.

We evaluate the macroeconomic impacts of fragmentation shocks using *PESSOA*, a dynamic stochastic general equilibrium (DSGE) model for a small euro area economy (Almeida *et al.* 2013a). Besides nominal and real rigidities in labour and product markets, the model features a BGG financial accelerator mechanism, where each entrepreneurs' success depends on idiosyncratic uncertainty. Domestic developments have by design negligible impacts in the rest of the monetary union.

The time-varying "monitoring cost parameter" is herein labelled $\mu_t$ (the frictionless case corresponds to $\mu_t = \mu = 0$). Results show that a temporary increase in $\mu_t$ creates a financial distress that causes output losses and a reduction in hours worked. Real variables are less responsive under no nominal rigidities and perfect competition. The reduction in output volatility is noteworthy. We depart from the perfect foresight framework to show that expectations also mark business cycle fluctuations. For identical increases in $\mu_t$, the recession becomes less severe when agents expect short-lived fragmentation time spans (even when they are long lived). Finally, we show that fragmentation shocks imply acyclical bankruptcy rates, as the risk structure of the economy remains unaffected. This result contrasts with "risk shocks," defined as a fluctuation in the volatility of the cross-sectional idiosyncratic uncertainty. Risk shocks are another prominent disturbance affecting the financial wedge, but require strongly countercyclical bankruptcy rates. All other macroeconomic implications are relatively similar. Christiano *et al.* (2014) claim that the risk shock is the most important driver of the United States (US) business cycle.

We add to the literature by investigating the importance of the financial fragmentation shock. To our knowledge, this disturbance has not been analysed thoroughly in the context of a medium-scale DSGE model featuring alternative nominal rigidities and distortions in competition, as well as in an environment in which capital expenditures are influenced by expectational errors. By fitting the main characteristics of a small economy integrated in a monetary union, we depart from the standard hypothesis of a large economy with independent monetary policy. The similarities between fragmentation and risk shocks may contribute to explain why Christiano *et al.* (2014) emphasize the importance of risk shocks (for a constant $\mu$ estimate), while Levin, Natalucci, and Zakrajsek (2004) turn to the importance of $\mu_t$ developments (not risk). Identifying the true shock hitting the economy is crucial to define adequate policy responses.

This article recovers several research agendas addressed in the literature. The informational perimeter of $\mu$ was discussed for instance in Carlstrom and Fuerst (1997). Time-varying estimates for the US using non-linear least squares are available in Levin *et al.* (2004). The interpretation behind distinct monitoring cost parameters across countries was discussed in Gilchrist, Hairault, and Kempf (2002). The link between economic activity and expectations is also commonly addressed—it goes back at least to Pigou (1927) and Keynes (1936)—and Christiano and Davis (2006) have already clarified that the financial wedge is directly affected by uncertainty. None of these authors claim however that financial distress and output can occur with barely moving bankruptcy rates.

The structure of the article is as follows. Section 2 briefly reports empirical evidence from aggregate indicators that measure the degree of financial integration in the euro area. Section 3 briefly describes *PESSOA* and places a special focus on the equations affected by the disturbances. Section 4 discusses the information content of $\mu_t$, and clarifies the expectational environment in which fragmentation shocks may occur. Section 5 reports macroeconomic impacts, including comparisons between fragmentation and risk shocks. Section 6 concludes and puts forward tentative policy implications.

## 2. Selected empirical evidence

Euro area markets were severely hit by the international crisis. The European financial integration registered a severe setback, leading in some cases to market malfunctioning and detached national markets—at odds with the concept of a monetary union. The evidence that the euro area was forced to cope with unprecedented financial disparities is widespread (ECB 2014). In the current article it is helpful to track euro area aggregates that capture, in broad terms, the overall level of financial integration.

Figure 1 reports FINTEC indexes, which are price- and quantity-based composite indicators of financial integration used by the ECB. The results suggest that financial markets moved persistently into higher integration levels after the inception of the euro, both in terms of prices and quantities. This movement came however to a halt in the late 00s and was followed by an impressive reversion. This fragmentation process was remarkably persistent. Between 2007 and 2013, the price and quantity-based FINTEC decreased 64% and 18%, respectively. By 2013, the price-based FINTEC index remained below the level recorded in 1999, while the quantity-based index was below the level recorded in 2001.

Banking and equity markets indexes, sub-component of the price-based FINTEC index, are reported in Figure 2. The results confirm that financial fragmentation was a widespread phenomena and suggest that identifying the triggering sources is a multidimensional task. Between 2007 and 2013, the banking and equity indexes decreased 52% and 68%, respectively.

In this article we focus on the financing conditions of NFCs, in which borrowing costs are an important element. Available evidence is again consistent with the existence of fragmentation, given the large variation in borrowing costs, especially for small and medium enterprises—a key concern of the ECB (ECB 2014).

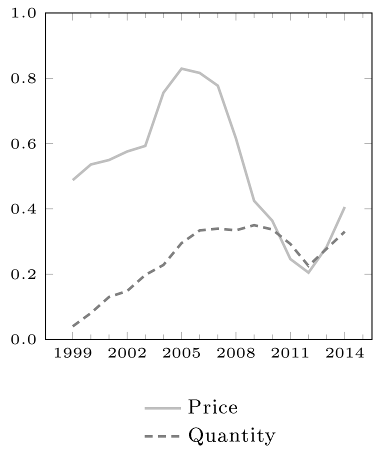



FIGURE 1: FINTEC indexes

Source: ECB.

Notes: FINTEC indexes are bounded between zero (full fragmentation) and one (full integration). For details, see ECB (2015) and Hoffmann *et al.* (2015).

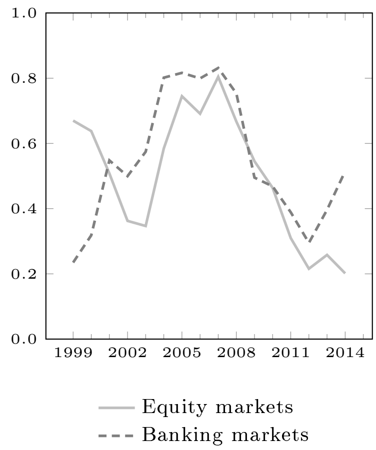



FIGURE 2: FINTEC sub-indexes

Source: ECB.

Notes: The overall price-based FINTEC covers indicators from banking and equity markets, as well as money and bond markets.

## 3. A small euro area economy model

This section parsimoniously presents *PESSOA*, a New-Keynesian DSGE model for a monetarily-integrated small open economy.[2] The model features a multi-sectoral production structure, non-Ricardian characteristics, imperfect market competition, nominal and real rigidities, as well as financial frictions, following Bernanke *et al.* (1999). The economy comprises households, labour unions, intermediate goods producers (manufacturers), final goods producers (distributors), capital goods producers, entrepreneurs, banks, the government, and foreign agents (the rest of the monetary union). The nominal effective exchange rate is irrevocably set to unity. Monetary policy is set by the monetary union authority, *viz* the ECB. The rest of the monetary union is assumed to be immune to domestic shocks. The model is closed by market clearing conditions.

### *3.1. Households and labour unions*

Households evolve according to the overlapping generations scheme first proposed in Blanchard (1985). They are subject to stochastic finite lifetimes

2. A detailed description of *PESSOA* can be found in Almeida *et al.* (2013a). Additional details may be found in Almeida *et al.* (2013b) and Castro *et al.* (2015). The main theoretical reference behind the model is Kumhof *et al.* (2010).

and face an identical and constant probability of death, independent of age. Population is constant. The overlapping generations framework is linked to a life insurance scheme along the lines in Yaari (1965), which ensures net wealth transfers from succumbing households to those that survive. Households rent labour services to a labour union, receiving in return a productivity adjusted wage rate, over which they pay a labour income tax. Labour productivity is assumed to decay over lifetime at a constant rate.

Two types of households coexist in the model: asset holders (type-$\mathcal{A}$), who are able to smooth consumption; and hand-to-mouth households (type-$\mathcal{B}$, *à la* Galí *et al.* 2007). Both household types derive utility from consumption and leisure, according to a constant relative risk aversion utility function. Budget constraints are standard.

Aggregate consumption, $C^H_{a,t}$, where $H \in \{\mathcal{A}, \mathcal{B}\}$, is a bundle of different varieties of consumption goods $c$, $C^H_{a,t}(c)$, also obtained by a standard aggregator, namely

$$C^H_{a,t} = \left( \int_0^1 C^H_{a,t}(c)^{\frac{\sigma^{\mathcal{C}}_t - 1}{\sigma^{\mathcal{C}}_t}} \mathrm{d}c \right)^{\frac{\sigma^{\mathcal{C}}_t}{\sigma^{\mathcal{C}}_t - 1}}, \tag{1}$$

where $\sigma^{\mathcal{C}}_t \geq 0$ stands for the elasticity of substitution between varieties.

Labour unions hire labour services from households and sell them to manufacturers operating in the intermediate goods market. Labour unions are perfectly competitive in the input market and monopolistically competitive in the output market. Labour varieties are aggregated following a CES specification similar to the one reported in equation (1). Labor unions face adjustment costs on wage changes in order to mimic the dynamics of sticky wage growth.

### *3.2. Manufacturers, distributors, and capital goods producers*

Manufacturers combine capital rented from entrepreneurs with labour services hired from labour unions to produce an intermediate good, which is thereafter sold to distributors. There are two types of manufacturers: those producing tradable goods, and those producing nontradable goods (indexed by $\mathcal{T}$ and $\mathcal{N}$, respectively). Manufacturers are perfectly competitive in the input market and monopolistically competitive in the output market, charging a markup over marginal cost to distributors. The production process is based on a constant elasticity of substitution (CES) production function with labour augmenting technology. Manufacturers pay social security contributions on their payroll and capital income taxes on profits. After-tax profits are distributed to asset holders in the form of dividends.

Sluggish adjustment of hours worked are obtained through quadratic adjustment costs. The same applies to inflation persistence. More precisely, firm $j$ operating in sector $J \in \{\mathcal{T}, \mathcal{N}\}$ faces a cost $\Gamma_t^{PJ}(j)$ whenever it changes the intermediate price $P_t^J(j)$. The functional form is given by

$$\Gamma_t^{PJ}(j) = \frac{\varphi_{PJ}}{2} Z_t^J \left( \frac{\frac{P_t^J(j)}{P_{t-1}^J(j)}}{\frac{P_{t-1}^J}{P_{t-2}^J}} - 1 \right)^2, \tag{2}$$

where $\varphi_{PJ}$ is a scaling factor, and $Z_t^J$ and $P_t^J$ represents the aggregate quantity and price, respectively.

Distributors produce final consumption goods that are acquired by households, investment goods by capital goods producers; government consumption goods by the government; and export goods by foreign distributors. Final goods depend on a CES production technology that assembles tradable goods with imported goods, combined afterwards with domestic nontradable goods. Economy-wide aggregates follow CES specifications similar to equation (1). Distributors are perfectly competitive in the input market and monopolistically competitive in the output market. They pay income taxes on profits and distribute dividends to asset holders.

Capital goods producers are the sole producers of capital. Before each production cycle, they buy the undepreciated capital from entrepreneurs and combine it with investment goods bought from distributors to produce new installed capital, which is thereafter sold to entrepreneurs. Capital goods producers face quadratic adjustment costs when changing investment levels and are assumed to operate in a perfectly competitive environment in both input and output markets.

### *3.3. Entrepreneurs and the financial intermediary*

Entrepreneurs and financial intermediaries are the core agents of the BGG framework. Each entrepreneur $l$ buys the new capital stock $\bar{K}_{t+1}^J(l)$ from capital goods producers at the end of period $t$, and rent it, partially or entirely, to manufacturers, for usage in the production process at period $t+1$. Their balance sheet is given by $P_t^{\mathcal{K}J} \bar{K}_{t+1}^J(l) = B_t^J(l) + N_t^J(l)$, where $P_t^{\mathcal{K}J}$ is the price of capital, $B_t^J(l)$ is the amount of loans (external funds), and $N_t^J(l)$ is net worth (internal funds). Leverage is defined as $B_t^J(l)/N_t^J(l)$. At period $t+1$, entrepreneur $l$ faces an idiosyncratic shock $\omega_{t+1}^J$ that changes the value of the capital stock. This shock is assumed to follow a log-normal distribution, distributed independently over time and across entrepreneurs, with standard deviation $\sigma_{t+1}^J$. More precisely,

$$\ln \omega_t^J \sim \mathcal{N}\left( -\frac{1}{2} \left(\sigma_t^J\right)^2, \left(\sigma_t^J\right)^2 \right). \tag{3}$$

If hit by a severe shock, the value of capital collapses, and the entrepreneur declares bankruptcy, handing over the value of the firm to the financial intermediary. Contrarily, if hit by a propitious shock, the value of capital and net worth rises. The mass of entrepreneurs is by design constant over time, implying that all those who went bankrupted in period $t$ are replaced by new ones in $t+1$. Let $\mathfrak{F}_t^J(x) = \Pr[\omega_{t+1}^J < x]$ denote the cumulative distribution function, $\mathfrak{f}_t(x)$ the corresponding probability density function, and $\bar{\omega}_{t+1}^J$ the threshold level below which the entrepreneur declares bankruptcy (implying that the probability of default with a risk level $\sigma_{t+1}$ is given by $\mathfrak{F}_t^J(\bar{\omega}_{t+1}^J;\sigma_{t+1})$).

Entrepreneurs face two key decisions. First, they set the level of capital that maximizes the value of the firm. As net worth is taken as given, this decision directly determines the balance sheet composition and leverage (Appendix A gives details of this maximization problem). Second, they must select the capital utilization rate that maximizes the present discounted after-tax value of their capital renting activity.

Financial intermediaries operate in a perfectly competitive environment, thus making zero *ex-ante* and *ex-post* profits at all times. Their *ex-ante* profit condition is

$$\begin{aligned}&[1-\mathfrak{F}(\bar{\omega}_{t+1}^J;\sigma_{t+1})]\, i_{t+1}^{BJ} B_t^J(l)\\&\quad + (1-\mu_{t+1})\int_0^{\bar{\omega}_{t+1}^J} \omega_{t+1}^J Ret_t^{\mathcal{K}J} P_t^{\mathcal{K}J} \bar{K}_{t+1}^J(l)\, \mathfrak{f}(\omega_{t+1}^J;\sigma_{t+1})\mathrm{d}\omega_{t+1}^J = i_t B_t^J(l). \qquad (4)\end{aligned}$$

Here, $i_{t+1}^{BJ}$ is the intermediary's lending rate, and $Ret_t^{\mathcal{K}J}$ is the expected (nominal) return on capital at period $t+1$, conditional on information until $t$. The "External Finance Premium" ($EFP_t$) is defined as the ratio between bankruptcy costs (which are directly influenced by the monitoring cost parameter $\mu_{t+1}$) and loans, *i.e.* the intermediary's operational costs per unit of credit. More precisely,

$$EFP_t = \frac{\mu_{t+1}\int_0^{\bar{\omega}_{t+1}^J} \omega_{t+1}^J Ret_t^{\mathcal{K}J} P_t^{\mathcal{K}J} \bar{K}_{t+1}^J(l)\mathfrak{f}(\omega_{t+1}^J)\mathrm{d}\omega_{t+1}^J}{B_t^J(l)}. \qquad (5)$$

The frictionless case corresponds to a situation where $\mu_{t+1}=0$, and therefore $EFP_t = 0$.[3] The contract celebrated between the entrepreneur and the intermediary features a menu of state-contingent lending interest rates $i_{t+1}^{BJ}$. For instance, if the economy is hit by a severe shock that increases the number of firms in financial distress and unexpected bankruptcy losses, financial intermediaries will charge higher interest rates on performing contracts to break-even *ex-post*. For simplicity, we on occasions use the terms "financial intermediaries" and "lenders" interchangeably. It should be acknowledge however that households are also part of the financial sector, namely as lenders to the financial intermediary at the risk-free interest rate $i_t$.

3. As discussed by Levin, Natalucci, and Zakrajsek (2004), $\mu_{t+1}=0$ implies that $Ret_t^{\mathcal{K}J} = i_t$, although $i_{t+1}^{BJ} - i_t > 0$ as long as the probability of default is positive. Quantity $EFP_t$ was introduced by Bernanke *et al.* (1999) and used for instance by Christiano *et al.* (2010).

### 3.4. The government

The government buys public consumption goods from distributors and performs lump-sum transfers across households. These activities are financed through tax levies on wage income, capital income, households' consumption (and eventually through transfers from abroad). The government can issue one-period bonds to finance expenditure, paying the risk-free interest rate $i_t$.

The fiscal policy rule is defined as

$$\frac{SG_t}{GDP_t} = \left(\frac{SG_t}{GDP_t}\right)^{\text{target}} + d_1 \left[\frac{B_t}{GDP_t} - \left(\frac{B_t}{GDP_t}\right)^{\text{target}}\right] + d_2\, ln \left(\frac{GDP_t}{GDP_t^{\star}}\right), \quad (6)$$

where $SG_t$ is government surplus, $B_t$ is government debt, $GDP_t^{\star}$ is the average GDP value over the previous 8 quarters, and $d_1 > 0$ and $d_2 > 0$ are parameters that determine the authority's reaction to deviations from target values.

### 3.5. The rest of the world

The rest of the world corresponds to the rest of the monetary union. The domestic economy interacts with the foreign economy *via* the goods market and the financial market. In the goods market, domestic distributors buy imported goods from abroad to be used in the production of final goods. Likewise for foreign distributors, who buy export goods from domestic distributors.

In the international financial market, asset holders can trade assets to smooth out consumption. All foreign variables, as well as monetary policy, are assumed to be unaffected by domestic developments.

### 3.6. Calibration

*PESSOA* is calibrated to match Portuguese and euro area data. Appendix B reports key parameters and steady-state ratios. The main steady-state financial parameters are displayed in Table 1, including a comparison with actual data, when available.

The leverage ratio of NFCs, $B/N$, the probability of default, $\mathfrak{F}(\bar{\omega})$, and the loan rate spread, $i^B - i$, defined as a "Cost spread," are exogenously set to match actual data. Leverage is set at 100%, which is close to actual average data taken from Eurostat. This level is also used by Bernanke *et al.* (1999) or Kumhof *et al.* (2010). The probability of default is in line with average exit rates computed by Mata *et al.* (2014), and close to the value used by Kumhof *et al.* (2010). The cost spread is set at 175 basis points, which is also close to average actual data. Tradable and non-tradable sectors are assumed to have identical calibrations.

The monitoring cost parameter, $\mu$, and the standard deviation, $\sigma$, are endogenously set by the model, standing at 0.111 and 0.32, respectively. The

| | | type | model | actual data | |
|---|---|---|---|---|---|
| | | | | *interval* | *average* |
| Leverage (%) | $B/N$ | exo. | 100.0 | 84.3–109.6 | 98.8 |
| Probability of default (%) | $\mathfrak{F}(\bar{\omega})$ | exo. | 8.5 | 7.9–11.1 | 9.3 |
| Cost spread (bp) | $i^B - i$ | exo. | 175 | 131–214 | 187 |
| Monitoring costs | $\mu$ | end. | 0.111 | n.a. | n.a. |
| Borrowers Riskiness | $\sigma$ | end. | 0.32 | n.a. | n.a. |

TABLE 1. Steady-state calibration and actual data

Source: Eurostat, Banco de Portugal, Mata *et al.* (2014), and authors' own calculations.

Notes: *bp* indicates basis points. Expressions "exo." and "end." refer to exogenously-matched and endogenously-determined values, respectively. Leverage is defined as corporate debt-to-equity ratio (average data over 2000-07). Debt includes debt securities issued by non-financial corporations, as well as loans (consolidated data). The non-default loan rate *spread* is approximated by the "cost spread", computed as the difference between a weighted average of bank loans and short-run comercial paper, and the three-month EURIBOR (average over 2000-08). Probability of default figures is computed with 2002-07 data.

former is similar to the "average unconditional loss" estimated by Bonfim *et al.* (2012) for the 2000–2008 period (11.1%), and close to benchmark values used by Bernanke *et al.* (1999) or Gertler *et al.* (2003). For the US, Levin *et al.* (2004) estimate a similar average result over the period 1997-1999. The standard deviation stands between benchmark figures used by Christiano *et al.* (2014) and Bernanke *et al.* (1999).

## 4. The financial fragmentation shock

### *4.1. A short discussion*

Parameter $\mu$ is typically interpreted as a simple "auditing cost" that lenders must pay to observe the idiosyncratic shock hitting the entrepreneur, and thus to observe the individual borrower's realized return. This cost determines the value of the firm that the lender is able to recover when a given entrepreneurs' project is not sufficiently productive to honour the debt contract, implying bankruptcy. Entrepreneurs observe the return for free.

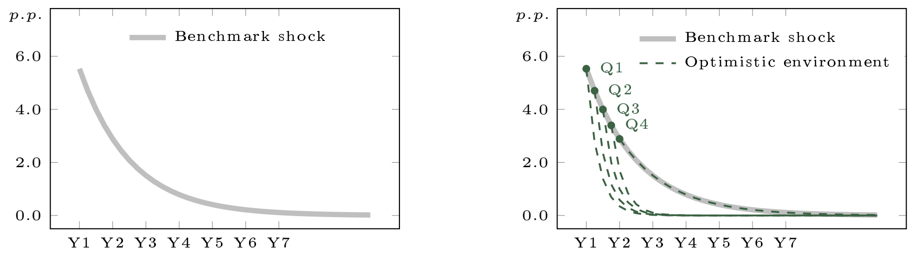
As discussed by Carlstrom and Fuerst (1997), a narrow perspective behind the computation of bankruptcy costs is to consider only direct costs. *Stricto sensu*, parameter $\mu$ is just a simple cost of bankruptcy, possibly including accounting and legal costs, as well as losses associated with asset liquidation and interruption of business. A broader perspective behind the computation of monitoring costs includes also indirect costs, namely associated with the overall efficiency of the financial sector in allocating resources between savers and borrowers. In distressed times, the lack of efficiency of the financial intermediation sector may imply significant losses, such as lost sales, lost profits, as well as deadweight losses from keeping capital idle. *Lato sensu*, parameter $\mu$ can thus be interpreted as an operational cost effectively capturing the financial markets' allocative inefficiency.

The most common approach behind the estimation of $\mu$ is to take it as a deep-rooted unknown constant, capturing the representative degree of financial market inefficiencies over a given sample period. Point estimates vary: Pinter *et al.* (2013) estimate 0.05 for the US; Christiano *et al.* (2014) estimate 0.21. Bernanke *et al.* (1999) use 0.12. Herein the steady-state $\mu = 0.11$ is endogenously set by the model (as clarified in Section 3), but over the business cycle is seen as the realization of a stochastic process, not a deep-rooted constant, reflecting the efficiency in which financial funds are allocated across agents in a particular moment in time—a *lato sensu* interpretation.

The assumption of a time-varying $\mu_t$—instead of a constant $\mu$—is not novel in the literature. Levin *et al.* (2004) estimated $\mu_t$ for the US and suggested that stable periods may be followed by significant jumps during turbulence episodes (*e.g.* the Russian financial crisis, or the collapse of the Long-term Capital Management in the late nineties). The authors also conclude that the null hypothesis of no financial market frictions (*i.e.* $\mu_t = 0$) is rejected by the data. The reaction of stock prices following an increase in the monitoring cost parameter is analysed by Ozdagli (2014).

Gilchrist, Hairault, and Kempf (2002) highlighted that distinct monitoring cost parameters across countries in a monetary union can be interpreted as heterogeneous financial markets. As clarified by these authors, the country with the higher parameter has also a higher required return on capital, a lower capital-labour ratio and will have to cope with a higher volatility owing to financial market constraints. For a small euro area economy, in which domestic developments have negligible international impacts, a increase in $\mu_t$ is thus effectively capturing a relative change in financial market inefficiencies against the euro area, and thus an environment akin to a financial fragmentation disturbance.

Parameter $\mu$ should also be distinguished from standard costs paid by common financial intermediaries, notably banks, who face additional restrictions in their operational environment and play a role in the economy that is not captured by the current framework. Equation (4) captures perfectly competitive lenders that are pure financial intermediaries, with the sole mission of borrowing funds from asset holders and lending to entrepreneurs. Christiano *et al.* (2014) names them mutual funds. As discussed by BGG, there would be a non-trial role in the current framework if financial intermediaries would also face frictions in raising funds themselves. In this case, the net worth of lenders, as well as the net worth of entrepreneurs, would matter for the models' dynamics.




(A) Perfect foresight (B) Optimistic environment

FIGURE 3: Financial fragmentation shocks ($\mu_t$)

Source: Own calculations.

Notes: Quarterly frequency. $Y_i$ highlights the first quarter of year $i$, where $i = 1, 2 \ldots, \infty$. Figure 3a represents the perfect foresight benchmark shock, computed as $\mu_t = \rho_\mu \mu_{t-1} + \varepsilon_t$, where $\rho_\mu = 0.90$, $\varepsilon_t = 5.5$ p.p. and $\varepsilon_{t+1} = \varepsilon_{t+2} = \ldots = \varepsilon_{t+\infty} = 0$. The optimistic environment in figure 3b corresponds to an initial sequence of four unexpected processes, between Q1 and Q4, with $\rho_\mu = 0.50$, followed in the beginning of the second year by a sequence with $\rho_\mu = 0.90$.

### *4.2. Alternative expectational environments*

This section introduces two distinct expectational environments. The benchmark conditions is depicted in Figure 3a. It correspond to a situation where the decision-making process is based on perfect foresight and where the shock representation takes the form

$$\mu_t = \rho_\mu \mu_{t-1} + \varepsilon_t. \tag{7}$$

The benchmark shock is parametrized in line with available empirical evidence. We set $\rho_\mu = 0.90$, which is below the parameter of the risk shock process estimated by Christiano *et al.* (2014)—another prominent disturbance that affects the financial wedge. These authors estimate a posterior mode of 0.97. We assume a 50% increase in the first quarter against the steady-state value—from 0.111 to 0.166—and thus a half-life of 6.6 quarters. After the shock, the first quarter level remains below the 0.20–0.36 relevant range suggested by Carlstrom and Fuerst (1997). During the US stock market bubble in mid-2000s, the $\mu_t$ estimates computed by Levin *et al.* (2004) more than doubled, reaching levels above 0.4.

Figure 3b depicts a distinct expectational environment. The actual $\mu_t$ levels that prevail in the economy in each quarter and throughout the entire horizon are exactly the same as in the benchmark case, as depicted by the gray bold line. Agents' expectations about its future evolution are however different. In this stylized example, agents are assumed to be rather optimistic. The environment corresponds to a situation where agents form expectations during the first year, based on equation (7), but with $\rho_\mu = 0.50$ (which implies an half-life of 1.0 quarter). More precisely, agents expect in the first quarter (Q1 in Figure 3b) that the shock will be halved by the second quarter and will vanish by the end of the first year. In the second quarter (Q2), they realize their mistake but take it as a temporary underestimation and therefore continue on computing expected values based on $\rho_\mu = 0.50$. It is only from the second year (Y2) onwards that agents incorporate the true underlying persistence, *i.e.* the benchmark shock. No more expectational errors occur from that moment on.

## 5. Macroeconomic impacts

This section evaluates the macroeconomic impacts of financial fragmentation shocks. Section 5.1 focuses on the importance of alternative structural features. Section 5.2 is centred on the effects of expectations. Finally, Section 5.3 compares the macroeconomic impacts of fragmentation and risk shocks.

All innovations take identical magnitudes across tradable and non-tradable goods sectors. The nominal risk-free interest rate remains unchanged in all experiments. There is a unique fiscal policy rule, with $d_1 = 0.07$ and $d_2 = 0.50$ in equation (6). The former ensures that the monitoring cost shock in the benchmark environment leads to muted fiscal policy responses in the short run. The latter is broadly in line with Kumhof *et al.* (2010). We choose labor taxes, which include the labor income tax paid by employees and the payroll tax paid by manufacturers, as the endogenous fiscal policy instrument—a common option in the literature (Harrison *et al.* 2005; Kilponen *et al.* 2006; Kumhof and Laxton 2007).

### *5.1. Alternative nominal rigidities and competition levels*

Figure 4 depicts macroeconomic impacts of a fragmentation shock over the short and medium run. The benchmark results (entitled "A. Benchmark environment"), reported in the bold gray line, take into account the standard calibration of the model. The shock is depicted in Figure 3a.

The first-order effect of an increase in credit market frictions is to augment operational costs of financial intermediation. In line with the contractual arrangement lenders satisfy the zero profit condition in all states of nature (equation (4)), and thus higher operational costs force entrepreneurs to look for higher returns on capital. As a result, entrepreneurs end up reducing their capital demand to honour their debt obligations, capital goods producer find it optimal to reduce investment levels, and the capital stock falls off. As initial steady-state lending rates became suddenly inadequate to cover all losses, financial intermediaries increase interest rates to break even.

The shock places some entrepreneurs in the bankruptcy region, as their projects ceased to be sufficiently productive. However, given that

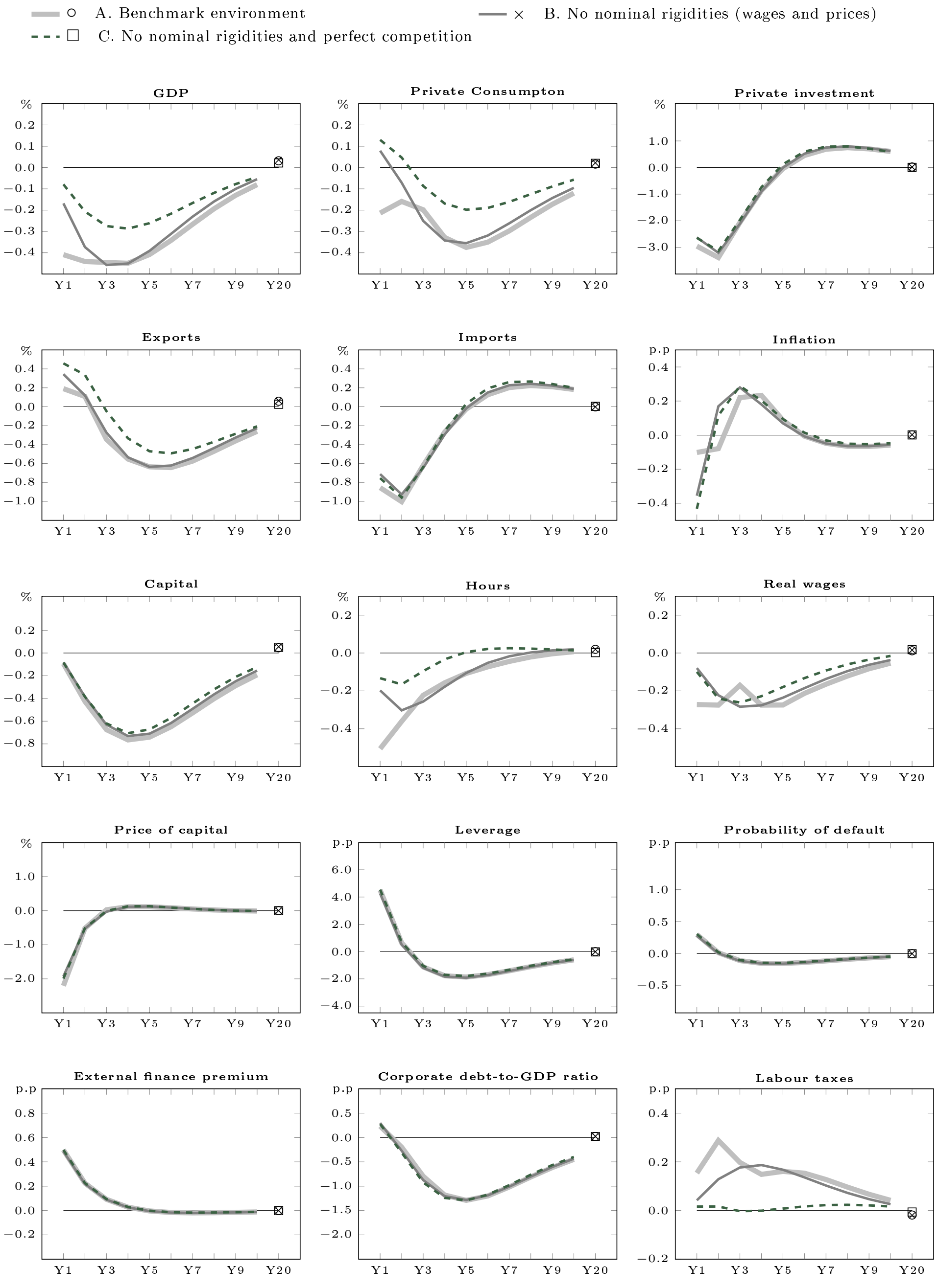



FIGURE 4: Fragmentation shocks in structurally different economies

Source: Own calculations.

Notes: Deviations from steady-state. The benchmark environment features *inter alia* monopolistic competition, real and nominal rigidities, including wage, intermediate and final price rigidities. The environment behind shock "B" changes the previous set-up by featuring close to nil adjustments costs in wages and prices during the adjustment process towards the steady sate; the environment behind shock "C" also features close to unitary mark-ups in labour and product markets in the steady state. All panels report annual data. Inflation refers to the annual average of quarterly year-on-year rates of change. The external finance premium is annualized. The first 10 years are shown by lines, the 20 year horizon by markers.

the risk structure of the economy remains unchanged, default probabilities remain relatively unaffected. It is therefore important to distinguish between bankruptcy costs and bankruptcy rates. The former are directly affected by the fragmentation shock, the latter only indirectly and marginally.

The increase in credit market frictions translates into higher operational costs per unit of debt—*i.e.* higher external finance premia (see equation (5)). With lower demand, the price of capital decreases, as well as net worth of entrepreneurs, which implies a deterioration of their balance sheet position.

The benchmark results on fiscal variables are also noteworthy. With the economy receding, fiscal revenues fall, while Government deficits and debt-to-GDP ratios rise. To guarantee the debt target level, the government is forced to implement a fiscal policy tightening, namely to increase labour taxes.

Private consumption falls, hindered among other factors by the reduction in hours worked and after-tax real wages, the latter conditioned by the increase in labour income taxes. As aggregate demand recedes, inflation falls marginally, though with a noticeable degree of persistence. Inflation remains below the initial steady-state figure over two years. With sluggish price adjustments and lower expected inflation, the nationwide real interest rate increases and acts as an additional contractionary force in the economy (it should be kept in mind that monetary policy remains irresponsive and nominal risk-free interest rates unchanged). Higher real interest rates induces households to postpone consumption expenditures, particularly due to a substitution effect, insofar as the return of savings increases. It also induces entrepreneurs to reduce capital expenditures, reflecting the reduction in their net worth. This contractionary force is partially offset by the depreciation of the real exchange rate (the nominal rate is irrevocably fixed), which imply higher exports and lower imports. The latter are also conditioned by lower production levels.

After the initial impact of the financial fragmentation shock, the economy initiates a deleveraging process. With lower capital needs, entrepreneurs reduce their indebtedness level, and regain access to external funds at lower interest rates. Lost net worth is rebuild, conditioned among other factors by the increase in the price of capital, and investment recovers.

The degree of nominal rigidities is an important conditioning factor behind the benchmark environment over the short run. The environment behind the thin grey line ("B. No nominal rigidities (wages and prices)") considers a structurally different economy. The shock remains the one presented in Panel A of Figure 3, but changing wages, intermediate and final prices in this economy entails virtually no costs for all relevant agents who have the market power to optimally determine them—in the case of price inflation of intermediate goods, this implies setting $\varphi_{PJ}$ close to zero in equation (2). All real rigidities remain in place.

Against the benchmark environment, the results show that a large bulk of the equilibrium outcomes changes from quantity to price adjustments (investment dynamics are an exception). GDP losses are more contained, as well as the fall in hours worked. Inflation falls more sharply, price competitiveness gains are amplified and exports expand more intensively, which supports labour demand. As a consequence, the fall in real wages (and hours worked) is attenuated. In addition, as prices become more volatile, so does the real interest rate. In contrast with the benchmark result, the real interest rate ends up unchanged in the first year (on average), and rapidly decreases in the second year[4]. The strain placed on fiscal authorities is mitigated and labour taxes do not increase as much as in the benchmark case.

The financial impacts without nominal rigidities are virtually indistinguishable from the benchmark case. Leverage starts by increasing in both cases, as well as the external finance premia, followed by similar movements back to initial steady-state values. Default probabilities remain largely unaffected. With indistinguishable financial impacts, capital demand and investment dynamics are also similar, in particular after the second year. The similarities are explained by the assumption that lenders, entrepreneurs and capital producers are not subject to nominal rigidities in the benchmark environment, and therefore their operational context remains unchanged.

The environment behind the dashed line (identified as "C. No nominal rigidities and perfect competition") considers an economy characterized not only by the absence of nominal rigidities, but also by perfect competition in both labour and product markets. In contrast with the previous simulations, this environment is based on an alternative steady state, now also featuring perfect competition. More precisely, this new steady state embodies a larger elasticity of substitution between both labour varieties and product varieties—in the case of consumption goods, this implies setting $\sigma_t^{\mathcal{C}}$ close to a large figure in equation (1).[5] Figure 4 reports percentage deviations against the new steady state (featuring perfect competition).

Results suggest that fragmentation shocks cause less severe recessions under an environment mimicking perfect competition. Exports rebound is larger, reflecting a stronger real exchange rate depreciation. This rather persistent outcome improves the net foreign asset position of the economy and is sufficient to bring about a significant wealth effect, with marked impacts on consumption.[6] In addition, the strain placed on fiscal authorities is virtually eliminated. In this economy, labour taxes remain practically unchanged after the shock, implying that distortionary taxation remains unaffected. Finally, it should be mentioned that the GDP contraction is not eliminated, as

4. The first quarter (not reported) is the only period where the real interest rate is significantly above the steady-state level

5. The transitional dynamics between the two steady states is fully ignored. The short and medium-run effects of a permanent reduction of 10% in the non-tradable sector markup and in the wage markup were analysed in Almeida *et al.* (2010).

6. The improvement in the net foreign asset position contrasts with the results obtained under both environment A and B.

higher consumption and exports are insufficient to counterbalance the fall in investment—conditioned by the impact of credit market frictions. The financial impacts are again virtually indistinguishable from the benchmark results.

In sum, a fragmentation shock triggers a financial distress and a slump in economic activity. Nominal rigidities and competition levels in labour and product markets do not change the financial sector, nor entrepreneurs' decisions, but affect the macro-financial linkages. Frictionless labour and goods markets imply lower output and employment volatility. Consumption and exports are highly conditioned by those features, with noticeable impacts on the strain placed on fiscal authorities.

### *5.2. Expectation effects*

This section evaluates the macroeconomic impacts of financial fragmentation shocks when entrepreneurs operate under the optimistic environment present in Figure 3b.

In the original BGG formulation, capital expenditures are decided at the end of period $t$, capital is used in the production process at period $t+1$ and throughout both periods the monitoring cost parameter is constant and known. In the current set up, with $\mu_t$ being the realization of a stochastic process, entrepreneurs need to incorporate the expected operational costs in their decision process. This creates a direct link between periods $t$ and $t+1$, more precisely between capital expenditures and the expected value of $\mu_{t+1}$, conditional on information up to the end of period $t$. Under perfect foresight—Figure 3a—entrepreneurs anticipate $\mu_{t+1}$ without error. Under less-than-perfect foresight, entrepreneurs fail to incorporate in their decision process the true underlying $\mu_{t+1}$. The results, based on the standard calibration of the model, are depicted in Figure 5.

Agents' perceptions of the shock persistence are a non-negligible conditioning factor behind a financial fragmentation disturbance. Under perfect foresight, all agents know the true persistence and incorporate a protracted fragmentation period. Capital demand falls persistently, as well as investment, with protracted impacts on output and hours worked.

When agents underpredict the duration of the fragmentation period, the initial steady-state lending rate level remains insufficient to cover lenders' operational costs, as in the perfect foresight case, but the increase in this rate and in the external finance premia are now more contained. The reason lies on the expected decrease in financial frictions over the entire simulation horizon. Therefore, it is not only the actual level of $\mu_t$ that matters, but also how it is expected to evolve. Although actual $\mu_t$ levels are identical to the benchmark case over the first year, their expected evolution is not. Optimistic agents expect lower $\mu_t$ levels than in the perfect foresight case, implying that their capital acquisitions are adjusted downwards by a smaller amount. Accordingly, the price of capital and the leverage position of entrepreneurs are also less affected.

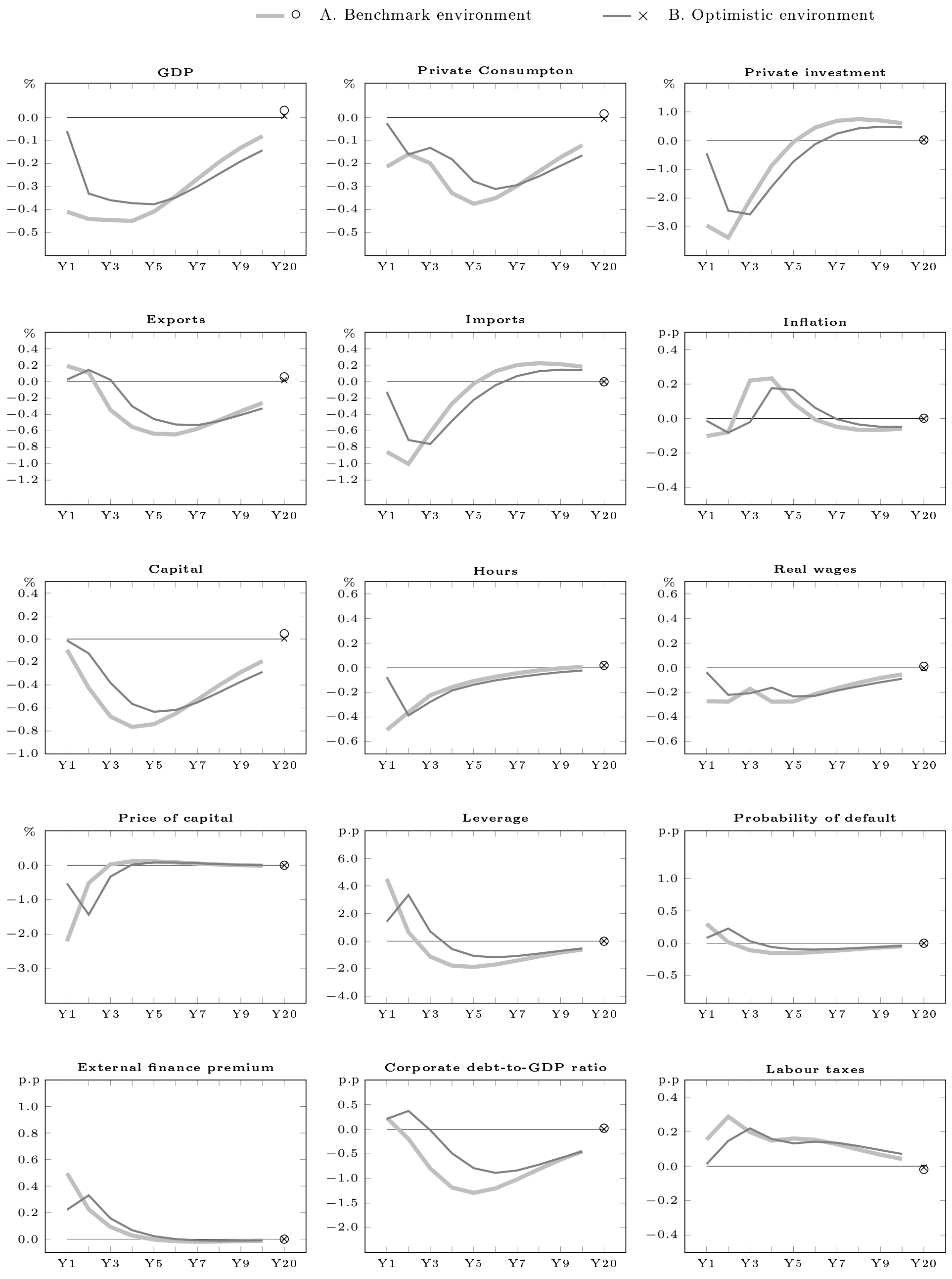



Figure 5: Fragmentation shocks under alternative expectation environments

Source: Own calculations.

Notes: Deviations from initial steady-state. The environment behind shock "A" is identical to the one presented in Figure 4. The environment behind shock "B. Optimistic environment" refers to the expectational context presented in panel 2 of Figure 3. See Figure 4 for details on the metric of all panels.

On the real side, the fall in investment is more contained, which supports aggregate demand. Results embody to some extent a self-fulfilling outcome: the higher the degree of optimism, the lower the output and employment losses.[7]

The impact on public accounts is also noteworthy. The increase in the debt-to-GDP ratio is smaller under optimistic expectations, which implies that the government does not increase taxes as much. When expectational errors vanish, namely from the first quarter of the second year onwards, all macroeconomic impacts, financial and real, approach those of the benchmark shock.

In short, the impact of fragmentation shocks on both financial and real variables depends on the expectational environment. Among the reasons why financial shocks seems to have heterogeneous impacts across countries, as reported by Hubrich *et al.* (2013), may lie not only in distinct key structural macroeconomic features, but also on heterogeneous agent's expectations, reflecting country- and time-specific perceptions of business climates.

### *5.3. Fragmentation and risk shocks*

Technology shocks have been considered one of the most important drivers of the business cycle.[8] The international financial crisis and the noticeable interaction between real and financial variables challenged this traditional view and paved the way for other disturbances, namely from financial intermediation. Among other prominent disturbances based on the BGG set up, a special mention should be placed on "risk shocks," especially after Christiano *et al.* (2014).[9]

Following the interpretation in Christiano *et al.* (2014), entrepreneurs buy $K$ units of "raw physical capital" at the end of period $t$. This capital is then transformed into $\omega K$ units of "effective capital" at the beginning of period $t+1$, where $\omega \geq 0$ is a random variable, not known at the end of period $t$, drawn independently by each entrepreneur.

The period $t$ cross-sectional standard deviation of $\omega$ is assumed to be the realization of a stochastic process. A risk shock is defined as a mean-preserving shift in distribution (3), and implemented herein as an increase in $\sigma_t$. Equation (4) clarifies that lenders' revenues at period $t+1$ depend on the realization of $\sigma_{t+1}$, which in the simulation below is known at

7. The inverse is also true. A pessimistic environment in which agents incorporate a more persistent shock than the "true shock", *i.e* $E_t\mu_{t+1} - \mu_{t+1} > 0$, leads to higher output and employment losses. The results are not reported but are available upon request.

8. Prescott (1986) claims that technology shocks account for more than half the US fluctuations in the postwar period, with a best point estimate near 75%.

9. The empirical importance of financial and technology shocks have been analysed by Kaihatsu and Kurozumi (2014). Shocks to net worth have also been suggest as potentially important. Gilchrist *et al.* (2009) or Christiano *et al.* (2014) clarified their impacts.

the end of period $t$.[10]

The macroeconomic impacts of risk and fragmentation shocks under perfect foresight are depicted in Figure 6, assuming no expectational errors. To ease the comparison, the risk shock is calibrated to deliver a similar investment outcome over the short run.

The first-order effect of a risk shock is to bring about higher probabilities of default, as a fatter left tail of entrepreneurial returns falls below the solvency threshold. This contrasts with fragmentation shocks, which leave the risk structure of the economy unaffected. Given that entrepreneur's return is idiosyncratic, lenders can always diversify its portfolio to regain immunity. However, by interacting with the zero-profit condition, the seemingly diversifiable source of risk becomes systemic (Christiano *et al.* 2010). In the presence of a risk shock lenders also raise interest rates to cover their insufficient revenues.

Although identifying the true shock hitting the economy is important to define adequate policy responses, this may prove to be a difficult task as financial fragmentation and risk disturbances have similar impacts—except on probabilities of default. The similarities are explained by the propagating mechanism embedded on the debt contract established between financial intermediaries and entrepreneurs, which is the same in both shocks.

In sum, risk shocks change the shape of entrepreneurial returns and imply sharp countercyclical bankruptcy rates, in contrast with fragmentation shocks. All remaining implications are relatively similar. This is explained by the shared transmission mechanism between capital demand and the debt contract.

10. In general, the entrepreneur information set at the end of period $t$ must include $E_t\sigma_{t+1}$, which represents the expected value conditional on information up to the end of period $t$. Under perfect foresight, $E_t\sigma_{t+1} - \sigma_{t+1} = 0$.

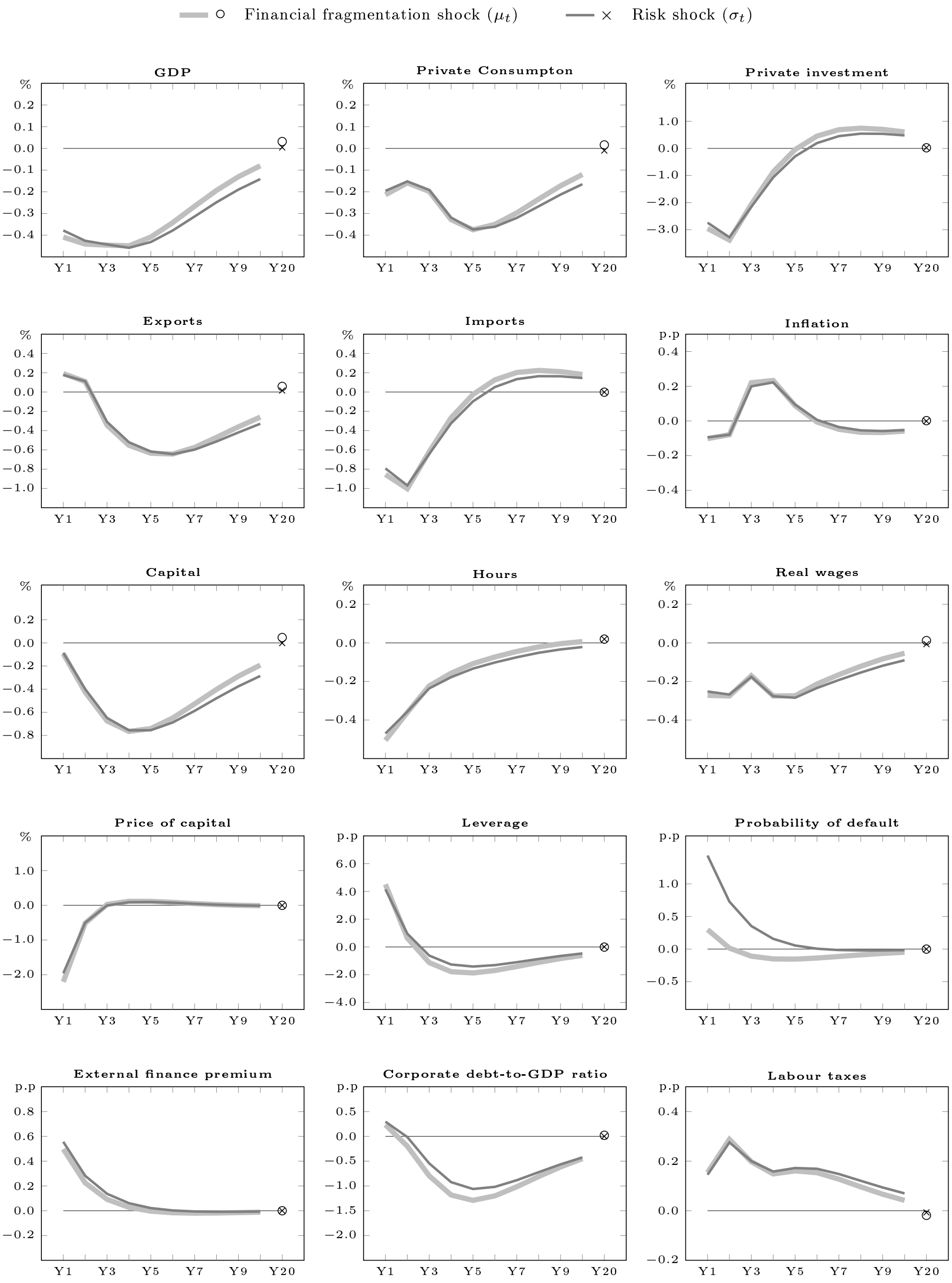



Figure 6: Financial fragmentation and risk shocks

Source: Own calculations.

Notes: Deviations from initial steady-state. The fragmentation ($\mu_t$) and risk ($\sigma_t$) shocks take the form $x_t = 0.90x_{t-1} + \varepsilon_t^x$, where $x = \{\mu, \sigma\}$, $\varepsilon_t^\mu = 5.5$ and $\varepsilon_t^\sigma = 0.10$. The macroeconomic impacts of an increase in $\sigma_t$ are derived under the assumption of an unchanged monitoring cost parameter, namely $\mu = 0.111$, whereas in $\mu_t$ are under $\sigma = 0.32$. The results assume perfect foresight and are based on the standard calibration of the model. See Figure 4 for details on the metric of all panels.

## 6. Conclusions

An increase of credit market frictions in a small euro area economy against the rest of the monetary union—the fragmentation shock—increases borrowing costs of non-financial corporations, as well as leverage, bringing along significant real effects. Investment decreases, as well as output and hours worked. The financial stress places a strain on fiscal authorities, who are forced to tighten the fiscal policy to comply with fiscal targets. The degree of financial integration changes because the small economy witnesses an increase in market frictions without any international spillover.

Nominal rigidities and competition levels in labor and product markets do not affect the financial intermediation sector, but contribute to insulate real variables from financial developments.

In competitive economies operating under optimistic business climates, namely under expectations of short-lived disturbances when the true shock depicts a high persistence, the impact of fragmentation shocks on output and hours worked is mitigated, reducing the need for an aggressive fiscal policy response.

Fragmentation and risk shocks embody an identification issue, as macroeconomic impacts are virtually identical. The results showed for instance that changes in actual NFC' borrowing rates may be due to fluctuations in credit market frictions and not in risk. The behaviour of bankrupcy rates is however a distinctive factor. These rates are counter-cyclical under risk shocks and largely acyclical under fragmentation shocks (for similar reductions in investment levels). The identification issue justifies monitoring a wide range of indicators to adequately assess the origin of the underlying disturbances.

Promoting efficiency levels across euro area countries that reduce undesirable idiosyncratic adjustments seems a desirable strategy. The harmonization goals behind a complete European Banking Union appears to be in this context an important step to reduce financial fragmentation.

Some caveats and omissions are noteworthy. The absence of liquidity channels, where the signs of fragmentation in the euro area are clear, or the role of international linkages are missing and represent possible directions for future work.

## References


Almeida, Vanda, Gabriela Castro, and Ricardo M. Félix (2010). "Improving competition in the non-tradable goods and labour markets: the Portuguese case." *Portuguese Economic Journal*, 9(3).

Almeida, Vanda, Gabriela Castro, Ricardo M. Félix, José R. Maria, and Paulo Júlio (2013a). "Inside PESSOA: A detailed description of the model." Working Paper 16, Banco de Portugal.

Almeida, Vanda, Gabriela Castro, Ricardo M. Félix, and José R. Maria (2013b). "Fiscal consolidation in a small euro area economy." *International Journal of Central Banking*, 9(4), 1–38.

Bernanke, B.S., M. Gertler, and S. Gilchrist (1999). "The financial accelerator in a quantitative business cycle framework." *Handbook of macroeconomics*, 1, 1341–1393.

Blanchard, Olivier (1985). "Debts, deficits and finite horizons." *Journal of Political Economy*, 93(2), 223–247.

Bonfim, Diana, Daniel A. Dias, and Christine Richmond (2012). "What happens after corporate default? Stylized facts on access to credit." *Journal of Banking and Finance*, 36(7), 2007 – 2025.

Carlstrom, Charles T. and Timothy S. Fuerst (1997). "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis." *American Economic Review*, 87(5), 893–910.

Castro, Gabriela, Ricardo M. Félix, José R. Maria, and Paulo Júlio (2015). "Unpleasant debt dynamics: Can Fiscal consolidations raise debt ratios?" *Journal of Macroeconomics*, 44, 276–294.

Christiano, Lawrence and Joshua Davis (2006). "Two Flaws In Business Cycle Accounting." NBER Working Paper Series 12647, National Bureau of Economic Research.

Christiano, Lawrence, Martin Eichenbaum, and Mathias Trabandt (2015). "Understanding the Great Recession." *American Economic Journal: Macroeconomics*, 7(1), 110–67.

Christiano, Lawrence, Roberto Motto, and Massimo Rostagno (2010). "Financial factors in economic fluctuations." Working Paper Series 1192, European Central Bank.

Christiano, Lawrence J., Roberto Motto, and Massimo Rostagno (2014). "Risk Shocks." *American Economic Review*, 104(1), 27–65.

Constâncio, Vítor (2014). "Banking Union: meaning and implications for the future of banking." Speech at the Banking Union Conference organised by the Navarra University, 24 april 2014, available at http://www.ecb.europa.eu/press/key/date/2014/html/sp140424_1.en.html, European Central Bank.

Dombret, A. (2013). "How to overcome fragmentation in the European financial market." Speech at the 23rd European Banking Congress, available at http://www.bundesbank.de/Redaktion/EN/Reden

/2013/2013_11_22_dombret.html, Deutsche Bundesbank.

Draghi, M. (2012). “Introductory statement to the press conference held in Frankfurt am Main, 2 August 2012.” Available at http://www.ecb.europa.eu/press/pressconf/2012/html/is120802.en.html, European Central Bank.

ECB (2012). “Financial Integration in Europe.” Annual report on financial integration in europe, European Central Bank.

ECB (2014). “Financial Integration in Europe.” Annual report on financial integration in europe, European Central Bank.

ECB (2015). “Financial Integration in Europe.” April, European Central Bank.

Fagan, Gabriel, Vítor Gaspar, and Alfredo Pereira (2004). “Macroeconomic Adjustment to Structural Change.” In *Monetary strategies for joining the euro*, edited by György Szapary and Jürgen von Hagen, pp. 168–217. Edward Elgar.

Galí, Jordi, J. David López-Salido, and Javier Vallés (2007). “Understanding the Effects of Government Spending on Consumption.” *Journal of the European Economic Association*, 5(1), 227–270.

Gertler, Mark, Simon Gilchrist, and Fabio Natalucci (2003). “External Constraints on Monetary Policy and the Financial Accelerator.” NBER Working Papers 10128, National Bureau of Economic Research.

Gilchrist, Simon, Jean-Olivier Hairault, and Hubert Kempf (2002). “Monetary policy and the financial accelerator in a monetary union.” Working Paper Series 175, European Central Bank.

Gilchrist, Simon, Alberto Ortiz, and Egon Zakrajšek (2009). “Credit Risk and the Macroeconomy: Evidence from an Estimated DSGE Model.” Presented at the FRB/JMCB conference “Financial Markets and Monetary Policy”, Board of Governors of the Federal Reserve System (U.S.).

Harrison, Richard, Kalin Nikolov, Meghan Quinn, Gareth Ramsay, Alasdaur Scott, and Ryland Thomas (2005). *The Bank of England Quarterly Model*. Bank of England.

Hoffmann, P., Manfred Kremer, and Sonia Zaharia (2015). “Financial integration in Europe through the lens of composite indicators.” Working paper, Mimeo.

Hubrich, Kirstin, Antonello D’Agostino, Marianna Červená, Matteo Ciccarelli, Paolo Guarda, Markus Haavio, Philippe Jeanfils, Caterina Mendicino, Eva Ortega, Maria Teresa Valderrama, and Marianna Valentinyiné Endrész (2013). “Financial shocks and the macroeconomy - Heterogeneity and non-linearities.” ECB Working Paper No. 143, European Central Bank.

Kaihatsu, Sohei and Takushi Kurozumi (2014). “Sources of business fluctuations: Financial or technology shocks?” *Review of Economic Dynamics*, 17(2), 224–242.

Keynes, John Maynard (1936). *General theory of employment, interest and money*. Macmillan and Co.

Kilponen, Juha, Helvi Kinnunen, and Antti Ripatti (2006). “Population ageing in a small open economy - some policy experiments with a tractable general equilibrium model.” Research Discussion Papers 28/2006, Bank of Finland.

Kumhof, Michael and Douglas Laxton (2007). “A party without a hangover? On the Effects of U.S. Government Deficits.” Working Paper No. 07/202, International Monetary Fund.

Kumhof, Michael, Dirk Muir, Susanna Mursula, and Douglas Laxton (2010). “The Global Integrated Monetary and Fiscal Model (GIMF) - Theoretical structure.” IMF Working Paper 10/34, International Monetary Fund.

Levin, Andrew T., Fabio M. Natalucci, and Egon Zakrajsek (2004). “The magnitude and cyclical behavior of financial market frictions.” Finance and Economics Discussion Series 2004-70, Board of Governors of the Federal Reserve System (U.S.).

Mata, José, António Antunes, and Pedro Portugal (2014). “Borrowing Patterns, Bankruptcy and Voluntary Liquidation.” Mimeo, Banco de Portugal.

Ozdagli, Ali (2014). “Financial Frictions and the Reaction of Stock Prices to Monetary Policy Shocks.” Working Paper No. 14-6, Federal Reserve Bank of Boston.

Pigou, Arthur Cecil (1927). *Industrial fluctuations*. Macmillan.

Pinter, Gabor, Konstantinos Theodoridis, and Tony Yates (2013). “Risk news shocks and the business cycle.” Working Paper No. 483, Bank of England.

Prescott, E (1986). “Response to a Skeptic.” *Federal Reserve Bank of Minneapolis Quarterly Review*, 10, 28–32.

Yaari, Menahem (1965). “Uncertain lifetime, life insurance and the theory of the consumer.” *The Review of Economic Studies*, 32(2), 137–150.

## Appendix A: The maximization problem of entrepreneurs

The maximization problem of entrepreneurs $l$ operating in sector $J$ can be presented as

$$\max_{\substack{\bar{\omega}^J_{t+1} \\ \bar{K}^J_{t+1}(l)}} \left[1-\Gamma(\bar{\omega}^J_{t+1})\right] Ret^{\mathcal{K}J}_t P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) \tag{A.1}$$

$$\text{s.t. } \left[\Gamma(\bar{\omega}^J_{t+1}) - \mu_{t+1} G(\bar{\omega}^J_{t+1})\right] Ret^{\mathcal{K}J}_t P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) = i_t B^J_t(l)\ .$$

Here,

$$\underbrace{\Gamma(\bar{\omega}^J_{t+1})}_{\substack{\text{Banks capital} \\ \text{earnings gross share}}} \equiv \underbrace{\int_0^{\bar{\omega}^J_{t+1}} \omega^J_{t+1} \mathfrak{f}(\omega^J_{t+1}) \mathrm{d}\omega^J_{t+1}}_{\text{If } \omega^J_{t+1} < \bar{\omega}^J_{t+1}} + \underbrace{\bar{\omega}^J_{t+1} \int_{\bar{\omega}^J_{t+1}}^{\infty} \mathfrak{f}(\omega^J_{t+1}) \mathrm{d}\omega^J_{t+1}}_{\text{If } \omega^J_{t+1} \geq \bar{\omega}^J_{t+1}},$$

$$\underbrace{1-\Gamma(\bar{\omega}^J_{t+1})}_{\substack{\text{Entrepreneurs capital} \\ \text{earnings net share}}} \equiv \underbrace{0}_{\text{If } \omega^J_{t+1} < \bar{\omega}^J_{t+1}} + \underbrace{\int_{\bar{\omega}^J_{t+1}}^{\infty} (\omega^J_{t+1} - \bar{\omega}^J_{t+1}) \mathfrak{f}(\omega^J_{t+1}) \mathrm{d}\omega^J_{t+1}}_{\text{If } \omega^J_{t+1} \geq \bar{\omega}^J_{t+1}},$$

$$G(\bar{\omega}^J_{t+1}) \equiv \int_0^{\bar{\omega}^J_{t+1}} \omega^J_{t+1} \mathfrak{f}(\omega^J_{t+1}) \mathrm{d}\omega^J_{t+1},$$

$$B^J_t(l) = P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) - N^J_t(l).$$

Variable $Ret^{\mathcal{K}J}_t$ is the nominal return on capital, $P^{\mathcal{K}J}_t$ is the price of capital, $\bar{K}^J_{t+1}(l)$ is the total capital stock that can be used in period $t+1$, $i_t$ is the risk-free interest rate, $N^J_t(l)$ is the net worth.

The cut-off level $\bar{\omega}^J_{t+1}$ satisfies the condition $\bar{\omega}^J_{t+1} Ret^{\mathcal{K}J}_t P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) = i^{BJ}_{t+1}(l) B^J_t(l)$, where the following mapping applies:

$$\text{If} \begin{cases} \omega_{t+1} < \bar{\omega}_{t+1} \Rightarrow \begin{cases} \text{the bank pays monitoring cost } \mu_{t+1}\omega^J_{t+1} Ret^{\mathcal{K}J}_t P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) \\ \quad \text{and receives } (1-\mu_{t+1})\omega^J_{t+1} Ret^{\mathcal{K}J}_t P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) \\ \\ \text{the entrepreneur receives 0 and goes bankrupt} \end{cases} \\ \\ \omega_{t+1} \geq \bar{\omega}_{t+1} \Rightarrow \begin{cases} \text{the bank receives } i^{BJ}_{t+1}(l) B^J_t(l) \text{ from the entrepreneur} \\ \\ \text{the entrepreneur receives } [\omega^J_{t+1} Ret^{\mathcal{K}J}_t P^{\mathcal{K}J}_t \bar{K}^J_{t+1}(l) \\ \qquad\qquad - i^{BJ}_{t+1}(l) B^J_t(l)] \geq 0 \end{cases} \end{cases}$$

The solution of problem (A.1) in the stationary form is given by

$$(1-\Gamma^J_{t+1})\frac{ret^{\mathcal{K}J}_t}{r_t}+\lambda_t\left[(\Gamma^J_{t+1}-\mu_{t+1}G^J_{t+1})\frac{ret^{\mathcal{K}J}_t}{r_t}-1\right]=0, \tag{A.2}$$

where $\lambda_t=\left(\Gamma^J_{t+1}\right)'/\left[\left(\Gamma^J_{t+1}\right)'-\mu_{t+1}\left(G^J_{t+1}\right)'\right]$, $\frac{ret^{\mathcal{K}J}_t}{r_t}=\frac{Ret^{\mathcal{K}J}_t}{r_t\pi_{t+1}}=\frac{Ret^{\mathcal{K}J}_t}{i_t}$, and

$$\Gamma^J_{t+1}\equiv\Gamma(\bar{\omega}^J_{t+1}) \qquad \text{with} \qquad \left(\Gamma^J_{t+1}\right)'\equiv\frac{\mathrm{d}\Gamma^J_{t+1}}{\mathrm{d}\bar{\omega}^J_{t+1}}=1-\mathfrak{F}(\bar{\omega}^J_{t+1}),$$

$$G^J_{t+1}\equiv G(\bar{\omega}^J_{t+1}) \qquad \text{with} \qquad \left(G^J_{t+1}\right)'\equiv\frac{\mathrm{d}G^J_{t+1}}{\mathrm{d}\bar{\omega}^J_{t+1}}=\bar{\omega}^J_{t+1}\mathfrak{f}(\bar{\omega}^J_{t+1}).$$

Variable $r_t=\frac{i_t}{\pi_{t+1}}$ is the real interest rate, and $\pi_t$ the inflation rate of consumption goods. Equation (A.2) is identical to the one reported in Kumhof *et al.* (2010). Almeida *et al.* (2013a) reports the complete derivation.

## Appendix B: Calibration

*PESSOA* is calibrated to match Portuguese and euro area data. Some parameters are exogenously set by taking into account common options in the literature, available historical data, or empirical evidence. Others are endogenously determined within the model, with the objective of matching desired features, for instance the consumption- or investment-to-GDP ratios. Key references behind the calibration can be found in Almeida *et al.* (2013a).

The annual growth rate of the labor-augmenting productivity is set to 2 percent, which is a plausible estimate for potential output growth in both Portugal and the euro area. Steady-state inflation stands at 2 percent per year and the euro area nominal interest rate at 4.5 percent.

Steady-state tax rates, transfers from the rest of the euro area, government consumption, and government transfers are calibrated to match actual data.

Households parameters are largely based on Fagan *et al.* (2004), Harrison *et al.* (2005), Kumhof and Laxton (2007) and Kumhof *et al.* (2010). Consumption shares are calibrated to ensure a unitary elasticity of labor supply to real wage. The instant probability of death and the productivity decay rate are assumed to be identical, implying an average lifetime and an expected working life of 25 years. The share of hand-to-mouth households is broadly in line with the estimates for Portugal.

The depreciation rate of capital is calibrated by taking into account actual data on the investment-to-GDP ratio. The unitary elasticity of substitution between capital and labor in the production function takes into account the actual labor income share. The steady-state price markup of tradable and non-tradable goods is calibrated using OECD product market regulation indicators, as well as the correlation between tradable and non-tradable goods markups and product market regulation indicators.

The elasticity of substitution between domestic tradable goods and imported goods is assumed to be identical across firms and set above unity. The degree of monopolistic competition amongst distributors is lower than among manufacturers.

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1|14 Autoregressive augmentation of MIDAS regressions
Cláudia Duarte

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Diana Bonfim | Carla Soares

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João Amador | Sónia Cabral

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Alessandro Sforza

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Daniel Carvalho

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Sandra Gomes

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John T. Addison | Pedro Portugal | José Varejão

10|14 Capital inflows and euro area long-term interest rates
Daniel Carvalho | Michael Fidora

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Daniel A. Dias | Carlos Robalo Marquesz | Christine Richmond

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João Amador | Rita Cappariello | Robert Stehrer

13|14 A dynamic quantitative macroeconomic model of bank runs
Elena Mattana | Ettore Panetti

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S. Gomes | P. Jacquinot | M. Pisani

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