Direction des Études et Synthèses Économiques

G2018/05

Financial constraints of innovative firms and sectoral growth

Charles-Marie CHEVALIER

Document de travail

Institut National de la Statistique et des Études Économiques

INSTITUT NATIONAL DE LA STATISTIQUE ET DES ÉTUDES ÉCONOMIQUES

Série des documents de travail
de la Direction des Études et Synthèses Économiques

G2018/05

Financial constraints of innovative firms and sectoral growth

Charles-Marie CHEVALIER*

OCTOBRE 2018

For their useful comments related to the current and previous versions of this work, and insightful discussions, I would like to thank Pierre CAHUC, Johan HOMBERT, Jacques MAIRESSE, Julien PRAT, Romain RANCIÈRE, Sébastien ROUX, Olivier SIMON as well as various participants at the Insee Department of Economic Studies and Crest seminars, the 2017 AFSE conference and the 2017 OECD / European Commission CONCORDi conference.

* Insee - Dese - Département des Études Économiques - Division « études macroéconomiques »

Département des Études Économiques - Timbre G201 - 88, avenue Verdier - CS 70058 - 92541 MONTROUGE CEDEX - France - Tél. : 33 (1) 87 69 59 54 - E-mail : d3e-dg@insee.fr - Site Web Insee : http://www.insee.fr

Contraintes financières des entreprises innovantes et croissance sectorielle

Résumé

Les politiques d'innovation peuvent consister en des mesures visant à soulager directement les contraintes financières des entreprises innovantes, au-delà des incitations fiscales plus usuelles pour stimuler la dépense privée de R&D. Pour explorer les interactions entre innovation et contraintes financières au niveau sectoriel, et évaluer des variantes politiques stylisées, cette étude rassemble deux cadres analytiques issus des littératures en matière de croissance endogène et de finance d'entreprise. Au sein de ce modèle dynamique, les entreprises innovent et se concurrencent en termes de produits selon un principe de création destructrice, et accumulent des fonds internes en rapport avec des obstacles financiers survenant lorsqu'elles sont créées, se développent ou disparaissent. En présence notamment d'asymétries d'information entre investisseurs et dirigeants d'une entreprise concernant des bénéfices incertains, ce modèle vérifie d'abord le fait que les entreprises tendent à dépenser plus en R&D quand leurs fonds internes sont plus élevés. Il se prête ensuite à des variantes pour analyser la croissance et la détention globale de liquidités dans différents contextes sectoriels. Dans ce cadre spécifique, faciliter la levée initiale de fonds internes, comme les incitations fiscales, peut avoir des effets notables. En outre, alors qu'un secteur high-tech stylisé est associé à une croissance et une détention globale de liquidités plus élevées, ces deux grandeurs dépendent largement de diverses caractéristiques sectorielles, comme l'efficactié de la recherche, les coûts d'entrée, le montant moyen des bénéfices, ou encore l'incertitude sur ces derniers.

Mots-clés : croissance endogène, gestion de liquidités, innovation de produit, distribution d'entreprises, contrats dynamiques

---

Financial constraints of innovative firms and sectoral growth

Abstract

Innovation policies can consist in measures aimed at directly alleviating financial constraints of innovative firms, beyond more traditional fiscal incentives to foster private R&D spendings. To explore the interaction between innovation and financial constraints at the sector level, and evaluate stylized policy scenarios, this paper brings together two analytical frameworks from the endogenous growth and corporate finance literatures. Within this dynamic model, firms innovate and compete for products through destructive creation and accumulate internal funds in relation to financial hindrances occurring when they enter, develop or exit. Including notably asymmetric information between investors and managers of firms with respect to uncertain cash flows, this model is first consistent with the fact that firms tend to spend more on R&D when their internal funds are higher. It then allows for experiments addressing growth and overall liquidity holdings for various sectoral contexts. In this specific framework, easing access to initial funding, as fiscal incentives, can have substantial effects. Moreover, while a stylized high-tech sector is associated with higher growth and overall liquidity holdings, both variables depend to a large extent on many sectoral characteristics, such as R&D efficiency, entry costs, and cash flow mean and volatility.

Keywords: endogenous growth, liquidity management, product innovation, firm distribution, dynamic contracts

Classification JEL : C61, D21, E22, G32, L11, O31

Introduction

Innovation being the major engine of growth, public policies intervene to stimulate firm research and development efforts. These policies broadly take the form of fiscal incentives, especially in France by international standards (OECD, 2018). In fact, difficulties in raising financing can be a deterring impediment and call for complementary measures addressing them directly, such as grants.[1] One could even wonder whether alleviating financial constraints is sometimes more efficient than direct subsidies in fostering innovation, and whether the current policy mix is appropriate for growth.[2] For instance in France, public spendings devoted to innovation policy amounted to 0.39 percent of GDP in 2015, including 70.2% to increase private R&D capacity and 16.4% to support the development of innovative firms (France Stratégie, 2016, and Table 1).

Bringing together toolboxes from the endogenous growth and corporate finance literatures, this paper provides a comprehensive and dynamic model for stylized policy analysis including firms which (i) innovate and compete for products through destructive creation and (ii) accumulate internal funds in relation with financial imperfections when they enter, exit and develop. Indeed, product innovation and equity availability are currently macroeconomic stakes.[3] While including microfunded channels, the model tractability allows for a large set of stylized experiments with respect to structural sectoral characteristics, with various implications in terms of growth and overall internal funds. Following the spirit of recent quantitative advances discussing U.S. innovation policy[4], this approach is also in line with the logic of traditional institutional models for economic policy evaluation.[5]

[1] Howell (2017) shows that an early-stage public grant approximately doubles the probability that a firm receives subsequent venture capital and has large, positive impacts on patenting and revenue. These effects are stronger for more financially constrained firms.

[2] Brown, Martinsson and Petersen (2017) provide recent comparative cross-country evidence on the effectiveness of alternative policies and institutions at spurring innovation using OECD's STAN database. They focus on tax incentives for R&D investment, the strength of intellectual property protections, and financial market rules that affect the availability of external financing and nature of financial intermediary development.

[3] In France, between 2010 and 2012, 24% of firms reported product innovation activity, and up to 55% among those with more than 250 employees (Insee, 2014). Moreover, according to Villeroy de Galhau (2015), there is a general lack of equity, especially for innovative small and medium firms, while investments "have to become more 'schumpeterian', and relatedly provided funds less guaranteed".

[4] For example, Acemoglu, Akcigit, Alp, Bloom and Kerr (2017) develop a model of endogenous reallocation and innovation with heterogeneous firms to investigate the implications of different types of industrial policies. Product creation and competition is at the core of several analyses of innovation policy though their impact on productivity gains attributable to incumbents or entrants (see Aghion, Akcigit and Howitt, 2014).

[5] At the French national institute of statistics and economic studies (Insee), the macroeconometric model Mésange and the DSGE model Mélèze are used for alternative policy experiments with respect to fiscal and monetary policies (Insee and French Treasury, 2017; Campagne and Poissonnier, 2016).

Table 1 – Budget of the French State and operating agencies devoted to innovation, by main objective categories, 2014-2015

objective category	*€ millions*	*%*	*GDP%*
1) increasing private R&D capacity	6,002	70.2	0.27
2) amplifying economic benefits of public research	226	2.6	0.01
3) developing collaborative projects	613	7.2	0.03
4) promoting innovative entrepreneurship	305	3.6	0.01
5) supporting the development of innovative firms	1,406	16.4	0.06
total	8,552	100.0	0.39

Source: *Commission nationale d'évaluation des politiques d'innovation*, Table 9 of France Stratégie (2016), author's calculations. Note: These main policy objectives addressing different types of market failures include respectively: (1) taking advantage of knowledge positive externalities; (2) improving the management of intellectual property rights; (3) avoiding the unnecessary duplication of some R&D efforts; (4) mitigating entry and exit barriers, and favoring appropriate competition intensity; (5) reducing the rationing of innovation financing (high asymmetry between lenders and borrowers due to collateral absence and future cash flow uncertainty), and encouraging venture capital and private equity.

More precisely, the model for firms consists of two main blocks. First, firms are made up by a set of product lines (as in Klette and Kortum, 2004). Successful R&D efforts bring about a new product which overtakes and destroys an existing one thanks to a marginal productivity improvement. Relatedly, each firm loses one product line with a probability equal to the creative destruction rate in the economy. Then, production on each product line is carried out with a linear technology with respect to labor. Cash flows bear firm level idiosyncratic risks, which can be interpreted as operational unexpected outcomes. Second, firms are subject to several precise financial imperfections (as in DeMarzo, Fishman, He and Wang, 2012). At entry, firms start with initial internal funds below their needs. During their development, decision making, shared between an operational manager and an outside investor, is affected by asymmetric information about cash flow realization.[6] When firms exit, liquidation costs drive down the remaining firm value for the investor. Given these constraints, internal funds are accumulated to cope with adverse cash flow shocks and avoid early liquidation.[7]

Under this framework, financial and investment strategies at the firm level have the

[6]To theoretically explain why external finance for R&D might be more expensive that internal finance, moral hazard is a standard argument (Hall and Lerner, 2010). Moral hazard in R&D investing can arise as modern industrial firms normally have separation of ownership and management. This leads to a principal-agent problem when the goals of the two conflict, which can result in investment strategies that do not maximize the share value.

[7]In this paper, the terms 'internal funds' and 'cash holdings' will be used interchangeably. In the empirical literature, cash holdings can be thought as a better proxy of financial constraints than cash flows. As advocated by Brown, Martinson and Petersen (2012), they more accurately incorporate R&D smoothing behavior in response to high adjustment costs (Hall, Moncada-Paterno-Castello, Montresor and Vezzani, 2016).

following properties. Internal funds are hoarded (resp. depleted) when cash flows are unexpectedly high (resp. low) or when a product line is created (resp. destroyed). Until internal funds are high enough, the manager receives no compensation, and a proportion of cash flows otherwise. Mostly, firms step up R&D investment when counting on more comforting internal funds, in line with empirical evidence (Bates, Kahle and Stulz, 2009; He and Wintoki, 2016; Pinkowitz, Stulz and Williamson, 2016). In addition, when internal funds are sufficient, R&D investment stabilizes at the level without financial imperfections.[8]

Then, quantitative experiments derive firm dynamics and general equilibrium outcomes for diverse sectoral contexts.[9] The aggregate outcomes of the structural shocks go beyond the mere composition of individual direct reactions, which also participate in altering innovation and competition conditions and shaping the distribution of firms in terms of age, size and relative proportions of entrants and incumbents. On the one hand, the financial shocks include ruling out information asymmetry, withdrawing liquidation losses, and freezing initial internal funding. On the other hand, costlier R&D for incumbents, harder entry for new firms, more rewarding innovation but also higher industrial risks are considered as alternative industrial contexts.

From these experiments, two main points can be derived (see Table 2 for details). First, initial internal funds are a major hedging lever for firms to adjust to any changing financial or industrial environment, helping to compensate financial imperfections and maintain growth with liquidity.[10] Thus, in comparison to innovation subsidies, financial policies, and especially access to initial funding, may be far from having negligible effects within a Schumpeterian perspective. And second, while the simulation of a stylized high-tech sector brings about both higher growth and higher liquidity, liquidity depends to a large extent on the many characteristics of a sector.[11]

[8]These results can be related to Brown, Fazzari and Petersen (2009) who find significant effects of cash flow and external equity for young but not mature firms. For France, Aghion, Berman, Eymard, Askenazy and Cette (2012) analyze the relationship between credit constraints and firm's R&D behavior and find that R&D is positively related to sales growth for financially constrained firms.

[9]By varying structural parameters affecting financial imperfections and the industrial environment, these experiments can be thought as diverse and stylized policy scenarios involving management monitoring, financial regulation, equity participation, innovation subsidies, innovation grants or corporate taxes for instance. These kinds of experiments are common with Schumpeterian growth models, but have additional implications from a financial point of view here. Moreover, if the model were not microfunded, disentangling different financial channels would be infeasible.

[10]In the rest of the paper, the term 'liquidity' will correspond to aggregate internal funds at the sector level, referring to the notion of 'inside liquidity' by Holström and Tirole (2011).

[11]An argument for the accumulation of cash by multinational goes beyond industrial aspects and reflect tax issues, which can retain cash earned abroad because earning repatriation would imply substantial tax payments. Yet, the relation between R&D and cash hoarding is not concentrated in these specific multina-

Table 2 – Summary of experimental outcomes for growth and liquidity

experiments w.r.t. ...	*growth*	*liquidity*
... the financial imperfections		
lower agency problem	+	0
lower liquidation losses	≃	≃
lower and fixed initial internal funds	−−	≃
... the innovation environment		
higher R&D costs for incumbents	−	−
higher entry costs for new firms	−−	++
higher cash flow mean	++	−−
higher cash flow volatility	≃	++

Note: This Table qualitatively summarizes results in Section 3 for variables g and C in Tables 5 and 6. These results are relative to a baseline case with existing financial imperfections and liquidity. For experiments w.r.t. financial imperfections, the parameters for the agency problem intensity and liquidation losses are set at almost zero to depict an unconstrained economy, and in the third scenario, initial internal funds are divided by two and cannot adjust. For experiments w.r.t. the innovation environment, parameters are increased by 50 percent. The calibration for the baseline scenario closely follows Acemoglu et al. (2017) for innovation parameters and DeMarzo et al. (2012) for financial ones.

This paper is first related to the Schumpeterian growth literature which abstracts from financial constraints but includes firm dynamics allowing for distributional analysis. For instance, Atkeson and Burnstein (2018) theoretically nest several of the corresponding canonical models, and Garcia-Macia, Hsieh and Klenow (2016) empirically investigate the contributions to aggregate productivity of product innovation by entrants and incumbents. In recent developments, the impact on growth and welfare of specific innovation policies are discussed and are confronted to firm-level data: in particular, the design of uniform R&D tax credit is criticized as it could oversubsidize inefficient incumbents or applied research (Acemoglu et al., 2017; Akcigit, Hanley and Serrano-Velarde, 2016).[12] The corresponding literature achieves the replication of many stylized facts in terms of dynamics and distributions of firms and reallocation of resources, prolonging the seminal work by Klette and Kortum (2004).[13] Yet,

tionals. (Bates et al., 2009) show that “there is no evidence that cash holdings increase more for firms with foreign pretax income [and in] particular, while the average cash ratio of firms without foreign taxable income increases from 14.3% in 1990 to 25.3% in 2006, the cash ratio of firms with foreign taxable income is 10.8% in 1990 and increases to 20.2% in 2006”. And cash hoarding at the global level is also not driven only by large firms as “the average cash ratio has a significantly positive time trend for all size quintiles.”

[12] In particular, Akcigit et al. (2016) estimate their structural parameters for the period 2000-2006 using French firm-level data from the R&D Survey conducted by the French Ministry of Research, and the datasets "Enquête Liaisons Financieres" (LIFI) and "Enquête Annuelle des Entreprises" (EAE),

[13] As reported by Aghion et al. (2014), this model is able to produce the following stylized facts: (i) the firm size distribution is highly skewed; (ii) firm size and firm age are highly correlated; (iii) small firms exit more frequently, but the ones that survive tend to grow faster than average growth rate; (iv) a large fraction of R&D in the US is done by incumbents; (v) reallocation of inputs between entrants and incumbents is an important source of productivity growth.

Schumpeterian approaches generally abstract from corporate financial constraints, which are especially relevant for young innovative firms.

This paper is also related to the literature on optimal security design, which studies how the resolution of durable governance problems affects corporate financial decisions. Ownership and management being often separated, these agency problems take the form of repeated moral hazard or asymmetric information, whose treatment in discrete-time earlier (for instance Clementi and Hopenhayn, 2006) has been dramatically simplified by continuous-time methods (Sannikov, 2013). Affecting corporate financing, these problems particularly prevail for R&D investments, which bear high uncertainty and may necessitate higher management involvement compared to alternative investments with better short-term outcomes (Kerr and Nanda, 2015).[14] Relatedly, while a large literature analyses corporate financial structures and capital investment through firm models with exogenous funding costs (Strebulaev and Whited, 2012; Falato, Kadyrzhanova and Sim, 2013; Bolton, Chen and Wang; 2011), the microfunded agency framework here enables endogenous financial constraints varying with firm innovative characteristics. This framework follows DeMarzo et al. (2012) and adapts their optimal security design model of dynamic capital investment to lumpy product line accumulation.

Finally, the closest papers to this mixed approach are Malamud and Zucchi (2017) and Aghion, Bergeaud, Cette, Lecat and Maghin (2018), which include *ad hoc* financial constraints into an endogenous growth setup. Malamud and Zucchi (2017) differs in that innovation relies on single product firms (as in Acemoglu and Cao, 2010) and financial constraints arise from exogenous funding costs (as in Bolton et al., 2011).[15] Here, based on Klette and Kortum (2004) and DeMarzo et al. (2012), destructive creation is at the product line level and financial constraints are microfunded. Aghion et al. (2018) also rely on Klette and Kortum (2004), assume that firms cannot invest in R&D more than a fixed fraction of firm value, and stress that lower financial constraints can favor innovation by entrants but also by incumbents, which can hamper entry.[16] Here, these opposite mechanisms are present and

[14]For example, Aghion, Van Reenen and Zingales (2013) find that greater institutional ownership improves innovation, which would be consistent managerial career concerns: by increasing monitoring, institutional ownership might protect them from being fired for bad outcomes unrelated to their decisions.

[15]Deriving original firm behaviors, they conclude that "stronger financing constraints may spur economic growth because they both reduce entry (creative destruction) and stimulate R&D by young and constrained firms" and that "applying this reasoning to the current lack of growth in Europe might indicate that firms hoard too much cash", and "policies reducing cash holdings may stimulate growth."

[16]This model is used to derive predictions before estimating the effect of credit rating measures on firm-level total factor productivity with the French Bank of France FiBEn database.

shape firm distributions and alternative scenarios outcomes, but internal fund accumulation also helps to alleviate the effect of financial imperfections on innovation effort.

The rest of the paper is organized as follows. Section 1 describes the model of the firm. Section 2 derives partial and general equilibrium properties. Finally, Section 3 presents the experiments.

1 Model of the firm

In this section, the model is described in details. The first part is devoted to the production and innovation technology of firms (Figure 1). In a nutshell, firms are made up by a set of product lines. When R&D is successful, a new product is created, randomly destroys an existing one belonging to another firm and improves its productivity, while the total number of products remains fixed. In the second part of the model (Figure 2), cash flows are affected by shocks which are observed by the firm manager, but not the firm investor. Hence, the investor designs a contract for the manager in order to make him reveal the true results rather than concealing part of them for personal benefits. This will be achieved by conditional remunerations and the dynamic management of internal funds.

1.1 Production and innovation technology

This subsection precises how firms produce and innovate.[17] The model being in continuous time, the current period is denoted by t and dt is a small time increment. A final good is produced using combined intermediary goods following:

$$\ln Y_t = \int_0^1 \ln Y_{jt} dj, \tag{1}$$

where Y_{jt} is the quantity produced by intermediate j.[18] There is a fixed measure l_s of individuals who can work in three different activities: as production worker (l_0), as R&D scientists in incumbent firms (h_i), or as R&D scientists for entrants (h_e).

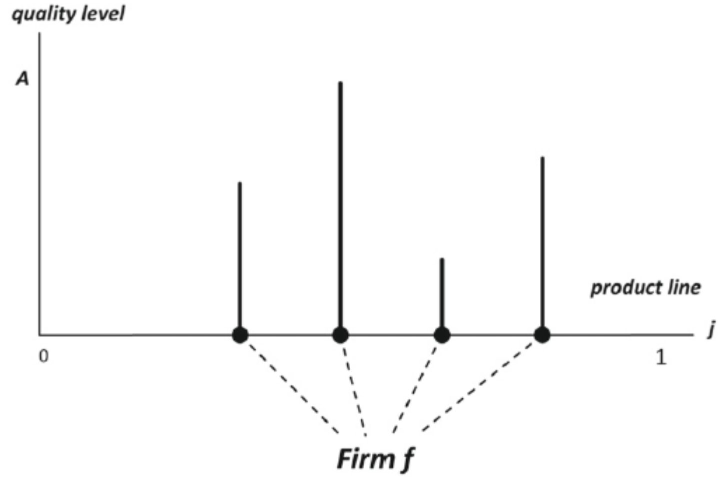
Intermediates are produced monopolistically by the last innovator within that product line j, according to the following linear technology, and omitting subscript t:

$$Y_j = A_j l_{0j}, \tag{2}$$

[17] It generally follows the model by Klette and Kortum (2004) as reported by Aghion et al. (2014), and Acemoglu et al. (2017) for the R&D cost function.

[18] A more general CES form $x^{(\epsilon-1)/\epsilon}$ rather than $\ln x$ in Equation (1) would change the product demand below to $Y_j = Y/p_j^{\epsilon}$ and the mark-up to $\Omega_j/Y = [A_j/(\gamma v)]^{\epsilon-1}(\gamma-1)/\gamma$. Depending on current productivity, such mark-ups would necessitate more complex quantitative methods as in Acemoglu et al. (2017). Here, constant mark-ups allow to include a substantial financial block and to preserve readability and tractability.

Figure 1 – Structure of the firm: product lines and productivities



Source: Aghion et al. (2014).

where A_j is the product line-specific labor productivity and l_{0j} is the labor employed for production. This implies that the marginal cost of production in j is simply V/A_j, where V is the wage rate in the economy at time t. Each time an innovation is made, productivity increases by a factor $\gamma > 1$ so that $A_{jt} = \gamma A_{j(t-dt)}$.

The final good consumer spends the same amount on each variety j. As a result, the final good production function generates a unit-elastic demand with respect to each variety, with price p_j: $Y_j = Y/p_j$. As firms in a single-product line compete *à la* Bertrand, this implies that a new innovator with marginal cost V/A_j can set his price up to the marginal cost of the previous innovator and still become the new monopolist, so that: $p_j = V/(A_j/\gamma)$. The resulting "winner-takes-all" equilibrium quantity and profit in product line j are:

$$Y_j = Y/p_j = Y\frac{A_j}{\gamma V} \text{ and } \Omega_j = (p_j - v/A_j)Y_j = \mu Y, \text{ where } \mu \equiv \frac{\gamma - 1}{\gamma}, \tag{3}$$

where Ω_j corresponds to profits after optimization of production labor. From now on, values corresponding to product lines will be considered as ratios over GDP, and notably wages: $v = V/Y$, and subscript j will be omitted. Optimal production labor so is: $l_0 = (\gamma v)^{-1}$.

Each firm is made up by n_t product lines where n_t is a Poisson process subject to innovation and creative destruction. The firm can invest in R&D in order to obtain another product line with a number of R&D scientists $H(x_t, n_t; \theta, \alpha)$, where x_t is the per product innovation success probability, θ an innovation capacity parameter and $1 - \alpha$ an innovation success elasticity with respect to R&D scientists.[19] The function H is smooth, convex, and homogeneous of degree one in the number of products n. In practice, the function will have the following form:

$$H(x_t, n_t; \theta) = n_t \theta^{-\alpha/(1-\alpha)} x_t^{1/(1-\alpha)}. \tag{4}$$

When a firm is successful in its current R&D investment with probability x_t, it innovates over a random product line $j' \in [0, 1]$. Then, as previously mentioned, the productivity in line j' increases from $A_{j'}$ to $\gamma A_{j'}$. The firm becomes the new monopoly producer in line j' and increases the number of its production lines to $n_t + 1$. At the same time, each of its n_t current product lines is subject to the creative destruction τ by entrants and other incumbents. Between t and $t + dt$, a product of the firm is destroyed with a probability τdt. A firm that loses all of its product lines exits the economy.[20]

1.2 Asymmetric information between investors and managers

In this subsection, the financial context of a firm is defined.[21] Assume that after sales, the product line is subject to a cash flow shock. Denote by $d\mu_t$ cash flows per GDP unit after its realization and for a small interval dt. The shocks are assumed to affect all product lines of a firm similarly. They are normally distributed with variance σ, and aggregate cumulated profits $d\Pi_t$ over a period dt have the following form:

$$d\mu_t \sim \mathcal{N}(\mu dt, \sigma dt) \text{ and } d\Pi_t = n_t[d\mu_t - vh(x_t)dt], \tag{5}$$

where $h(x_t) \equiv \theta^{-\alpha/(1-\alpha)} x_t^{1/(1-\alpha)}$ is the per product line number of R&D scientists paid at the general wage rate v.

The uncertainty about cash flows generates an agency conflict due to the separation of firm ownership and control. The manager who is hired by the investor has private information concerning the current cash flows, and can declare false cash flows by understating their mean with an intensity $a_t \in [0, 1]$:

$$d\hat{\mu}_t = a_t \mu dt + \sigma dS_t.$$

where dS_t is a standard normalized Brownian motion corresponding to (5).[22] For each dollar that the manager conceals, he can consume $\lambda \in [0, 1]$ and enjoys a private benefit

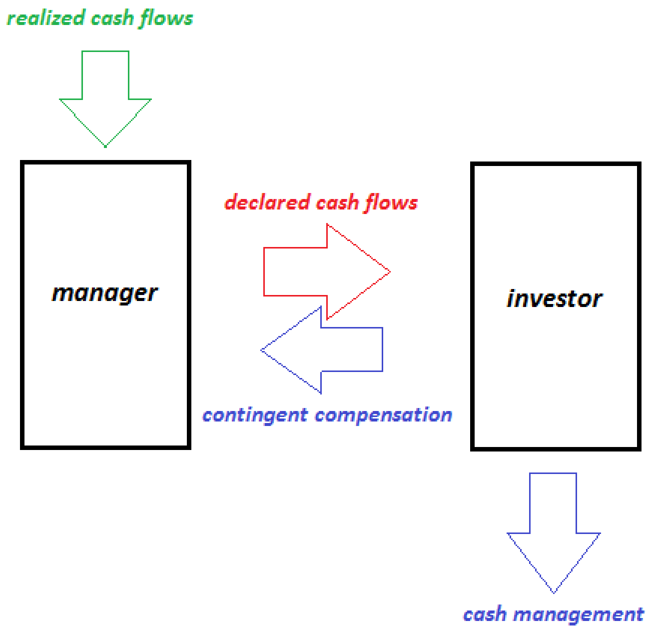
[19] This functional form is used by Acemoglu et al. (2017). The term $1 - \alpha$ can be interpreted as an elasticity of patents with respect to R&D which is empirically documented and set at 0.67 by Acemoglu et al. (2017).

[20] As described below, another source of firm exit will be the depletion of its internal funds.

[21] The model by DeMarzo et al. (2012) is closely followed. The main difference is the substitution of capital by product lines, of depreciation by creative destruction, and of a continuous by a lumpy accumulation process.

[22] This agency problem can alternatively be interpreted as a situation in which mean cash flows are affected by an agent's unobserved and costly effort.

Figure 2 – Relations between investor and manager: information and flows



$b_t = \lambda(d\mu_t - d\hat{\mu}_t)$ for $a_t = 0$.[23] λ thus corresponds to the stringency of the agency problem.[24] Investors have unlimited wealth, are risk-neutral and their discount rate is lower than the managers' one: $r < \rho$.[25] The contract with the manager can be terminated at any time, in which case the firm is liquidated and investors recover a value $l \cdot n_t$, where $l > 0$.

To maximize the value of the firm, the investor offers a contract that specifies the firm's investment policy x_t, the manager's cumulative compensation U_t, and a termination time T, all of which depend on the history of the manager's performance, which is given by the profit process Π_t. The manager's limited liability requires the compensation process U_t to be non-decreasing. Let $\Phi = (x_t, U_t, T)$ represent the contract. Then, the expected value for the manager at time t is:

$$W_t(\Phi) = \max_{a_s} \mathbb{E}\left\{\int_0^T e^{-\rho s}[dU_s + b_s(a_s)ds]\right\}. \tag{6}$$

In the rest of the paper, the term 'internal funds' will be used for the variable W_t. Simply put, this amount can be seen as reserves on a cash account provisioning for all future manager

[23]The fact that λ is below 1 reflects the agent's net consumption per dollar diverted or an effort cost.

[24]When there is no agency problem, the intertemporal value of a product line is given by: $q = \max_x[\mu - h(x)]/(r + \delta - x)$. Parameters are restricted in order to insure the definition of this value: $\mu < h(r + \delta)$.

[25]This assumption is common in this type of models. Managers can be seen as more impatient as they may have other attractive investment opportunities.

compensations.[26] These internal funds will be handled by the investor to align the manager's incentives, i.e. favoring $a_s = 1$ for all s. At the time the contract is initiated, the firm has a single product line. Given initial internal funds W_0, the investor's optimization problem is:

$$P_1(W_0) = \max_{\Phi} \mathbb{E}\left\{\int_0^T e^{-rs} d\Pi_s + e^{-rT} l \cdot n_T - \int_0^T e^{-rs} dU_s\right\},$$

under the constraints that Φ is incentive compatible and that W_0 verifies (6) for $t = 0$.

Entrants produce one unit of innovation by hiring ψ scientists. When a new entrant is successful, it innovates over a random product line by improving its productivity by $\gamma > 1$ as incumbents. It then starts out as a single-product firm. The free-entry condition equates the total value of a new entry with the cost of innovation:

$$P_1(W_0) + W_0 = v\psi. \tag{7}$$

$P_1(W_0)$ and W_0 are the initial values for the investor and the manager respectively, and their sum is the total firm initial value.[27] This equation implies that the wage cost is determined by benefits and costs in the arbitrage of entrants.

W_0 is chosen to maximize the value for investors when starting the firm, thus assuming negotiation power is fully on the side of investors. This model extension is suggested but not directly addressed by DeMarzo et al. (2012) in their partial equilibrium context. There are also hindrances to initial internal funds injection. It notably takes into account the possibility that a venture capital market is undersized and that a rationing of innovation financing exists (see innovation market failure (5) in the note of Table 1). This exogenous constraint could be related to risks and information asymmetries not included in the model, and in particular with respect to product line creation uncertainty.[28] Only a part $1 - \zeta$ of optimal initial internal funds can be provided to the firm, so that:

$$W_0^* = (1 - \zeta) \times \arg\max_{W_0 > 0} P_1(W_0). \tag{8}$$

Finally, the liquidation value l is endogenized. As many sectoral contexts will be considered, this hypothesis allows to remain neutral with respect to this financial friction parameter.

[26] To explicit this interpretation, an implementation of the optimal contract with internal funds is depicted in DeMarzo et al. (2012) in Section IV. For a survey on corporate liquidity management and the role of cash, see Almeida, Campello, Cunha and Weisbach (2014).

[27] The initial internal funds are not necessarily at the threshold value (see partial equilibrium below), which is different from Malamud and Zucchi (2017). Yet, the distance between initial internal funds and the threshold value can participate to internal funds dynamics at the firm and industry levels.

[28] See for example Hugonnier, Malamud and Morellec (2014) or He (2012) for such approaches. Including them within this framework might provide interesting further research.

Notably, if l were exogenous, the distance between the liquidation value and the first best intertemporal value of the product line might change with respect to μ for instance. Here again, this suggestion by DeMarzo et al. (2012) is adopted, and adapted to the current context:

$$l = (1 - \kappa) \times P_1(W_0^*). \tag{9}$$

In any industry, the remaining value of a product line is a fixed proportion of the initial value when starting the firm with a single product.[29] For example, high values of κ could reflect firms whose remaining value is largely made up by intangible assets.[30]

To sum up, the behavior of the firm will be determined by parameters intended to grasp different dimensions of the innovation environment. The sets $\{\theta, \mu, \psi, \sigma\}$ and $\{\lambda, \kappa, \zeta\}$ summarize the constraints of the firm either in the way they innovate and benefit from it, or in the way they deal with their own financial resources to run the firm over its life cycle. A very stylized view could be to interpret these two sets of parameters as attributes of the manager and the investor considered as the respective CEO and CFO of the firm arbitrating together investment and financial decisions. A major intent of the model is to be balanced with respect to these two parts constituting innovative firms.

2 Partial and general equilibria

In this section, the equilibrium is derived at the firm level, and the traditional Schumpeterian general equilibrium dynamics are depicted. Under this framework, optimal investment and financial policies at the firm level have the following properties. Internal funds are accumulated over time to insulate the firm from liquidation losses. Then, each time innovation is successful, the ratio between internal funds and the number of product lines is maintained. Each time competition implies the destruction of a product line, internal funds per product line are also kept at the same level. With respect to the manager's compensation, there exists a threshold of internal funds below which it is set at zero and above which it corresponds to the difference between the current internal funds and the threshold. Mostly, optimal R&D expenditures rise with internal funds, consistently with empirical evidence. They also reach

[29] According to the liquidation equation (9), liquidation is always inefficient, that is $q > l$, as $q > P_1(W_0^*)$ in any circumstances (see footnote 24 for the definition of q).

[30] See for instance Chen (2014) who exactly adjusts liquidation values with respect to relative proportions of tangible and intangible capitals.

values close to the case without financial imperfections when internal funds approach the threshold.

2.1 Optimal firm policy

The internal funds policy can be simply followed. W_t is a state variable depending on all optimal decisions. While the problem resolution is complex, it is possible to represent in a very simple form the evolution of internal funds as a function of decision parameters and random variables.[31] Let $n_t = n_t^+ - n_t^-$, and n_t^+ (resp. n_t^-) be the cumulated number of created (destroyed) product lines over the firm life cycle. Then, the evolution of internal funds is given by:

$$dW_t = \rho dt W_t - dU_t + \beta_t n_t \sigma dS_t + \beta_t^+ (dn_t^+ - x_t dt) + \beta_t^- (dn_t^- - \tau dt), \tag{10}$$

where β_t, β_t^+ and β_t^- are three decision parameters to be set optimally by the investor.[32] Intuitively, this equation states that a change in internal funds is always a linear combination of the current shocks affecting the firm.

The manager is given a promised information rent. The manager can hide information about the current entry of cash flows, which are affected by dS_t. To make the manager report the true value of cash flows, he must be given an information rent proportional to the private benefit he can take otherwise. Remind that W_t corresponds to all future compensations of the manager in the form of internal funds. As in DeMarzo et al. (2012), the incentive compatibility constraint requires that $\beta_t \geq \lambda$ for all t, so that:

$$\beta_t = \lambda. \tag{11}$$

Intuitively, internal funds dynamics are set in order to align the manager's incentives to the investor's interests. When the firm is profitable following positive cash flow shocks, the promised value of expected compensations is higher. Thus, the manager is given some

[31] Actually, this is one of the major contributions of Yuliy Sannikov who brought these stochastic calculus techniques into economics: "Using calculus in the context of continuous-time games allows him to overcome tractability problems that had long hindered research in a number of areas. Previous models often abstracted from crucial economic forces in the name of tractability, but Sannikov's methods allow models to include the most important forces and thus deliver results that are much more relevant and intuitive." (Athey and Skrzypacz, 2017)

[32] This is obtained by adjusting profits by their mean and using the martingale representation theorem, derived from the extended Ito representation theorem in Oksendal and Sulem (2011, p.33) for processes including Brownian motions and jumps (such as compensated Poisson processes used here) with time depending intensities. This equation is similar to the extension developed by DeMarzo et al. (2012) including persistent profitability shocks in addition to cash flow ones. Martingale representation is also used for a technology including jumps by He (2012).

information rent to compensate for his private benefit when diverting cash flows. In addition, internal funds accumulation in good times protects against termination risks in bad times.[33]

The manager is compensated only when internal funds are sufficient. Intuitively, when there is not enough internal funds, the firm has little room in the case of bad cash flow shocks. In this situation, it is not optimal to waste internal funds by providing the manager a compensation dU_t. On the contrary, with a high level of internal funds, the firm is protected against strong negative shocks, so that the manager can be given a substantial compensation. In this setup, there exists a fixed internal funds threshold delimiting a simple binary compensation policy.[34] This trade-off implies that there is a level of internal funds $\bar{W}$ such that it is optimal to pay the agent with cash if $W_t > \bar{W}$ and to defer compensation otherwise:

$$dU_t = \max\{W_t - \bar{W}, 0\}.$$

Each time internal funds are above the threshold, the manager is given a lumpy compensation so that internal funds get back to the threshold.

The problem of the firm can be simply restated and solved. With these different elements, the problem of the firm can be restated in a recursive form. Indeed, the law of motion for W_t is simplified, and optimal decision parameters have only to be settled for value of W_t below the threshold $\bar{W}$. The following proposition shows that the problem can actually be restated in per product line terms. Rather than considering the firm entirely, one only has to focus on every single product line.[35]

Proposition. *Let $\omega = W/n$ and $p = P_n/n$. The solution of the firm problem can be restated in per product line terms:*

$$rp(\omega) = \max_x \; \mu - wh(x) + [\rho - (x - \tau)]\omega p'(\omega) + \frac{1}{2}(\lambda\sigma)^2 p''(\omega) + (x - \tau)p(\omega), \tag{12}$$

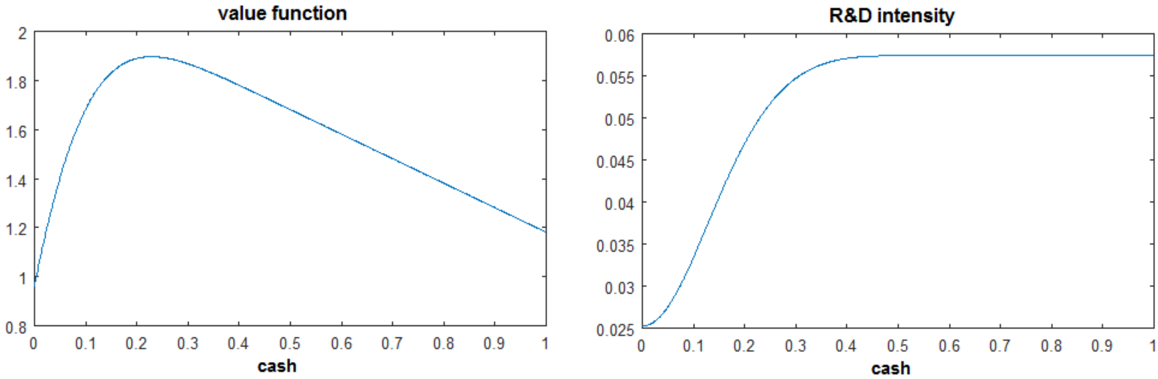
and defines a unique function $p(\omega)$ for the given conditions $p(0) = l$ and $p'(\bar{\omega}) = -1$. The behavior of p is shown in Figure 3 (left).

[33] There is no agency problem related to product line noises. β_t^+ and β_t^- are undetermined at this stage.

[34] The demonstration is as in DeMarzo et al. (2012): "Because investors can always compensate the agent with cash, it will cost investors at most one euro to increase W by one euro. Therefore, $P_n' > -1$, which implies that the total value of the firm $P_n(W) + W$ is weakly increasing in W. Because there is a benefit in deferring the agent's compensation, the optimal contract will set cash compensation dU to zero when W is small, so that W will rise as quickly as possible. However, because the agent has a higher discount rate, there is a cost in deferring the agent's compensation."

[35] This property is key in conferring tractability to the model, as this is the case in Acemoglu et al. (2017) and DeMarzo et al. (2012). It also allows for interpreting results intuitively without any restriction on the parameter space.

Figure 3 – Value function $p(\omega)$ and R&D intensity $x(\omega)$



Note: Graphics are derived with standard calibration depicted in simulations below, which remains close to those used in DeMarzo et al. (2012) and appearing in the model *à la* Klette and Kortum (2004) used by Acemoglu et al. (2017). The innovation efficiency parameter is set at $\theta = 0.60$.

Proof. See Appendix. □

This proposition has properties which differ from the approach with *ad hoc* financial constraints by Malamud and Zucchi (2017). First, this result brings notably a micro-foundation for internal funds policy when the firm has only one remaining product line. Malamud and Zucchi (2017) assume that shareholders receive a lumpy liquidation dividend equal to the firm's remaining internal funds. Here, the same fact is obtained from optimal policy. Second, the increase in internal funds when innovation is successful is not equal to the threshold as in Malamud and Zucchi (2017). Here, optimal additional internal funds are the current per product line level. Yet, if the firm already is at the threshold, then the same conclusion is reached. Third, there is no optimality condition for the total production size of the firm as in Malamud and Zucchi (2017). This is the outcome of using product innovation without capital, implying that the size of the firm is associated to n_t, and of the optimization program. While there is not the rich dynamics of Malamud and Zucchi (2017) in that respect here, the model has tractability thanks to this stylized approach. The volatility of cash flows is also not affected here by optimal production size, which allows to analyze its effects independently. Fourth, the impact of financial constraints can be characterized independently from firm size, and beyond the neighborhood of the threshold.

Corollary. *The first order condition with respect to x is*

$$vh'(x) = p(\omega) - \omega p'(\omega), \tag{13}$$

which implies a positive correlation between internal funds and R&D expenditures – for that positive relationship, see Figure 3 (right).

This equation states that the marginal value of investing equals the current per unit value of the firm to investors, $p(\omega)$, plus the marginal effect of decreasing the manager's per product line promised value ω as the firm grows. The shape of this curve is consistent with the microeconomic literature relating R&D and internal funds at the firm level, for U.S. listed corporations during the last three decades in particular (Bates et al., 2009).

So, the approach by DeMarzo et al. (2012) can be adapted to a context where irregular product line creation is substituted for continuous capital accumulation. More precisely, the firm problem can be restated in a per product line form; the per product line value function with respect to per product line internal funds in this model and in DeMarzo et al. (2012) are identical; and the same investment and internal funds policies are derived. The intuition behind this property is that, while the Poisson processes used here for innovation and destructive creation complicates analytics in the first place, they add two additional controls to determine optimal internal funds policy when product lines are created or destroyed. First order conditions with respect to these controls restore homogeneity.

2.2 Aggregate equilibrium

In equilibrium, the distribution $dM(n,\omega)$ of firms across product line numbers n and levels of internal funds ω is fixed. The rate of destructive creation τ is the sum of the total innovation effort by incumbents z_i and entrants $z_e : \tau = z_i + z_e$. z_e corresponds to the mass of entrants which is directly linked to the equilibrium distribution $dM(n,\omega)$. There is also a mass ν of firms which are liquidated when internal funds become empty. The stability of the distribution is given by permanent flows of entrants (see algorithm in Appendix). Relying on the optimal investment and internal funds policies stated above, these flows generate after a high number of periods a distribution of firms $d\tilde{M}(n,\omega)$ and a total number of products $N > 1$. When normalizing the distribution so that $dM(n,\omega) = d\tilde{M}(n,\omega)/N$ as in Klette and Kortum (2004), the mass of entrants and the innovation effort by incumbents are:

$$z_e = 1/N \text{ and } z_i = \int_{n=1}^{+\infty} \int_{\omega=0}^{+\infty} nx(n,\omega)dM(n,\omega). \tag{14}$$

Labor is in fixed supply l_s and split between production, $(\gamma v)^{-1}$, and R&D scientists of entrants $h_e = \psi z_e$, and incumbents h_i.

The liquidity C of the sector is the mean value of per product line internal funds ω. The growth rate has the same simple form as in the case without corporate financial imperfections, that is:

$$g = \tau \ln \gamma. \tag{15}$$

The equilibrium outcomes for g and C are not clear-cut and interact. When there is no agency problem, z_i and z_e have closed form solutions, as the value function reduces to a proportional function of the product line number, and the innovation intensity of incumbents is homogeneous. Here, the destructive creation rate is lower as the investment rate is below the first best one for many firms. Inversely, growth and destructive creation are here equivalent and τ affects the optimal financial policy of firms in Equation (12).

Finally, the general equilibrium can be summarized as follows (see Table 3 for variables).

Definition. *A stationary equilibrium of this economy is a tuple*

$$\{Y_j, l_{0j}, p_j, x_j, \omega_j, z_e, h_e, M, \tau, v, C, g\},$$

such that [i] Y_j maximize profits as in (3) and the labor demand l_{0j} satisfies (2); [ii] p_j is given by the value function in (3); [iii] x_j is given by the R&D policy function in (13); [iv] ω_j follows the per product line motion law (10) and at optimality; [v] z_e solves the entry equilibrium in (14); [vi] the distribution M is stable; [vii] the growth rate is given by (15); [viii] the wage rate v is consistent with labor market clearing.

For given wage and destructive creation rates, the value function can be solved independently from the firm distribution, and the distribution be derived in a second step. The wage and the destructive creation rates can not be simply depicted by closed-form solutions, but they can be computed numerically (see algorithm in Appendix).

3 Quantitative analysis

In this section, provided firm optimal policies, quantitative experiments are carried out for various sectoral contexts. Beyond displaying the model behavior, these exercises intend to examine situations where public intervention might be relevant. First, different financial variants are considered: when information asymmetry is ruled out, when liquidation losses are withdrawn, or when initial internal funds injection is hindered. If the model was not microfounded, disentangling these various channels would be infeasible, while they indeed

Table 3 – List of main variables

innovation block

var.	*description*
Y_j	production on line j
A_j	productivity on line j
l_{0j}	production workers
p_j	product j price
x	innovation intensity
h	research workers
n	number of product lines

financial block

var.	*description*
$d\mu$	cash flows
W	firm internal funds
ω	line internal funds
$\bar{\omega}$	line funds threshold
P	investor firm value
p	investor line value
l	line liquidation value
dU	manager compensation

general block

var.	*description*
v	wage
ν	liquidation rate
τ	destruction rate
z_e	entry rate
z_i	incumbents innovation
g	growth rate
C	liquidity

have differing implications. Second, several innovation environments are also addressed: with respect to R&D costs, for incumbents and entrants, and to cash flow mean and volatility. These experiments can be thought as comparisons between sectors, or between equilibria of a single sector with or without stylized targeted public intervention. These experiments are common for Schumpeterian growth models, e.g. Acemoglu et al. (2017), but have additional implications from a financial point of view here.

3.1 Setup and baseline

In this subsection, all the elements of the quantitative experiments are presented, with first the calibration of the baseline case, and then an illustration of the firm distribution at equilibrium, derived from an algorithm following Atkeson and Burstein (2010) (see Appendix).

Calibration is as follows (Table 4). Values are mainly taken from DeMarzo et al. (2012). The interest rate is exogenously set at $r = 0.06$. The discount rate of the manager follows $\rho = r + 0.004$. Mean cash flows are $\mu = 0.20$, which equivalently corresponds to an innovation step of $\ln\gamma = 0.223$. The agency problem parameter is $\lambda = 0.20$ and the cash flow risk is $\sigma = 0.13$. Further, the liquidation value loss of a product line is set at 25 percent: $\kappa = 0.25$. And the distance to optimal initial funds verifies: $\zeta = 0.25$. With respect to the general equilibrium, the measure of labor supply is $l_s = 0.078$. The fixed cost of entrants is $\psi = 0.15$. Finally, the innovation intensity with respect to the knowledge stock is $\alpha = 0.5$, which is close to 0.637 used in Acemoglu et al. (2017) and allows for a quadratic R&D cost function as in DeMarzo et al. (2012). With respect to the computation algorithm, the time interval is

Table 4 – Calibration

param.	*description*	*value*
l_s	measure of workers	0.078
r	interest rate of investors	0.060
ρ	interest rate of managers	0.064
λ	agency problem stringency	0.200
κ	liquidation losses share	0.250
ζ	initial distance to optimal internal funds	0.250
μ	product line mean cash flow	0.200
σ	cash flow shock volatility	0.130
γ	innovation step	1.258
θ	incumbent innovation capacity	0.400
ψ	entrant innovation cost	0.150
α	innovation intensity w.r.t. knowledge stock	0.500

$dt = 0.25$ to correspond to a quarter, and the number of periods is $Q = 1000$. The maximum number of products is $N = 15$ (Figure 4). Finally, cash values ω are between 0 and 1 on a grid with 1,000 points.[36]

As the outcome of the algorithm, the distribution of firms is similar to those traditionally observed with Schumpeterian models, but with a slight difference with respect to the internal funds dimension. In Figure 4, Panel (a) shows the overall distribution over internal funds and the number of products. An important mass of firms achieves the internal fund threshold. A second part of the distribution can be distinguished around the entry point. Its shape directly reflects cash flow shocks.[37] In the end, abstracting from internal funds in Panel (b), the distribution with respect to the product line number follows a classic pattern.

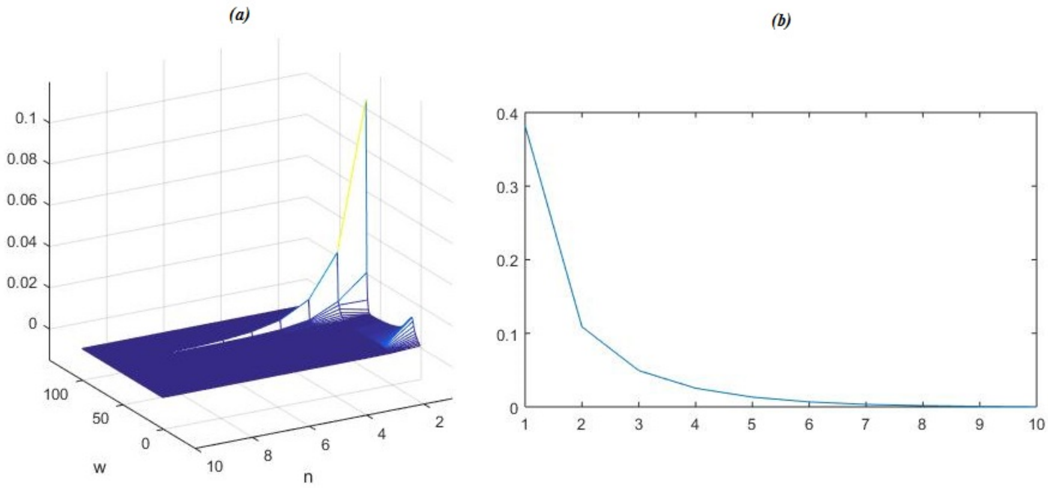
3.2 Experiments related to financial parameters

Financial constraints can be exacerbated by different factors. The need to avoid inefficient liquidation is reinforced in three situations: when the agency problem is more intense, when liquidation losses are higher, or when initial internal funds injections are hindered. In three experiments, a single parameter corresponding to each of these financial imperfections is adjusted. Generally, optimal financial policy, through internal funds accumulation and initial internal funds injection, allows to compensate higher risks to liquidate the firm in more

[36] The maximum value 1 could be higher but is never reached in all the considered simulations.

[37] Note there are two ways for firms to exit. On the one hand, they can have only a single remaining product line and experience a product line destruction. On the other hand, whatever their number of product lines, they are liquidated if they are running out of internal funds. This second source of exit is not due to creative destruction.

Figure 4 – Example of firm distribution



Note: On panel (a), the overall distribution is represented on the (ω, n) grid. The number of points for cash values is 1000. On panel (b), the masses of firm are calculated for each level of product number n. The pattern is similar to the one in Aghion et al. (2014) (Figure 1.4 p. 538).

constrained setups. However, if initial internal funds injection cannot reach the optimal level, firm development and sectoral growth can be altered to a large extent.[38]

First, unconstrained economies are considered by setting λ and then ζ close to zero. When the agency problem is lower, the risk to reach inefficient liquidation is reduced. There is indeed a decrease in the liquidation rate ν in the economy (Table 5 Panel B). The industry mean level of internal funds, denoted by C, collapses. The slight positive effect on growth is mainly due to initial internal funds ω_0 close to the threshold $\bar{\omega}$ allowing for optimal R&D expenditures. This property is consistent with the fact that industries with higher information asymmetry can have higher cash ratios. Growth differs by 0.05 point between the baseline economy and this scenario. When liquidation losses are withdrawn, the need to build more financial room to avoid this outcome is soften. When firms are created, initial internal funds are lower (Table 5 Panel C compared to Panel A). Liquidity C is divided by

[38] All these shocks where finance development favors growth are also related to a very large literature addressing the nexus between finance and growth. For instance, Philippon (2015) measures the cost and the size of financial intermediation with the key motivation to provide means to quantify the consequences of financial development for economic growth. Another key paper is Rajan and Zingales (1998) which uses firm level data and finds that when financial markets are more developed industrial sectors with higher needs of external finance grow faster. Benhabib and Spiegel (2000) finds with a cross-country panel that the potential effect of finance on growth goes mainly through improvements of total factor productivity. For a recent general review of the literature between finance and growth (and crisis), see Loayza, Ouazas and Rancière (2018).

Table 5 – Financial friction experiments

τ	v	l	$\bar{\omega}$	ω_0	z_i	z_e	ν	C	g
Panel A - Baseline									
6.77	11.52	1.25	21.0	7.3	2.95	3.82	0.40	15.5	1.51
Panel B - Without agency problem (λ = 0.05)									
6.99	11.51	1.28	5.8	2.5	2.80	4.19	0.13	2.8	1.56
Panel C - Without liquidation losses (κ = 0.03)									
6.73	11.58	1.64	18.8	4.3	2.95	3.79	0.74	8.2	1.50
Panel D - Without hindrance to internal funds (ζ = 0.03)									
6.90	11.51	1.22	21.0	9.7	2.91	3.99	0.26	14.2	1.54
Panel E - Exogenous initial internal funds (ζ = 1, ω_0 = 4.3)									
5.89	11.42	1.25	22.7	4.3	3.10	2.81	0.87	14.2	1.32

two while growth is barely modified. In the baseline case, higher initial internal funds allow to dampen higher liquidation costs. So, internal funds can reduce to effects of this specific financial imperfection.

Second, two scenarios consist in modifying access to initial internal funds. In the baseline scenario, just a part of optimal initial cash can be reached, i.e. 75 percent (Table 5 Panel D). If this constraint is ruled out (with a 93 percent capacity), initial internal funds rise and more firms enter, contributing to increase destructive creation and growth (by 0.03 point). On the contrary, if initial internal funds are fixed at a value almost twice lower than in the baseline case (Table 5 Panel D), entry z_e is deterred, the exit rate ν doubles and growth is affected by around 0.2 point, compared to a growth rate of 1.5 percent in the baseline case. While the shock is sizeable and would correspond to a major financial malfunctioning, the impact on growth is noticeable.

3.3 Experiments related to firm technology

The behavior of a sector depends on the structural properties of its innovation capacity. In this section, experiments consider changes with respect to R&D return and costs, for incumbents and entrants, and with respect to cash flow mean and volatility. In all these experiments, parameters are increased by 50 percent. In particular, higher entry costs and higher cash flow volatility generate a stringent reliance on internal funds to alleviate increased liquidation risks. In contrast, higher mean returns reduce the precautionary stock of internal funds and sectoral liquidity, while spurring innovation and growth. In the end, growth and

Table 6 – Innovation capacity experiments

τ	v	l	$\bar{\omega}$	ω_0	z_i	z_e	ν	C	g
Panel A - Baseline									
6.77	11.52	1.25	21.0	7.3	2.95	3.82	0.40	15.5	1.51
'*Panel B - Lower R&D subsidy for incumbents (θ = 0.30)*									
6.41	11.50	1.25	20.8	7.3	2.21	4.20	0.29	14.9	1.43
Panel C - Lower entry subsidy for entrants (ψ = 0.20)									
4.62	11.33	1.62	24.9	9.1	3.97	0.75	0.99	19.6	1.05
Panel D - Improved product line returns (μ = 0.266)									
10.57	11.50	1.26	18.7	6.5	2.89	7.68	0.37	11.7	3.27
Panel E - Increased cash flow volatility (σ = 0.173)									
6.67	11.52	1.24	27.6	9.1	2.95	3.73	0.51	19.5	1.49

liquidity crucially depend on the mix of many innovation features of a specific sector.[39]

Considering higher costs of R&D is a stylized way to address a lowering of R&D government subsidies directed to incumbent firms. Compared to the baseline case, there are compensating effects (Table 6 Panel B). First, the incumbent innovation rate is reduced. This implies a fall in the rate of destructive creation, a lower overall demand for R&D labor and falling wages, which stimulates entry. Liquidity is only slightly reduced. While optimal initial internal funds do not change substantially, the effect is purely due to the higher share of entrants in the distribution of firms. So, there is an adjustment between entrants and incumbents in line with Acemoglu et al. (2017) and generally with this kind of product line endogenous growth models. With higher entry costs, the outcomes are symmetric (Table 6 Panel C). The innovation rate by entrants is substantially reduced, which favors innovation by incumbents through reduced wages. Lower wages are a direct effect of higher entry costs through the free entry condition corresponding to Equation (7). This explains why the change in wages is sharper here than in any other experiment. The impact on growth is lower than what is due to the fall of innovation from entrants because of fostered innovation by incumbents. In this experiment, distributional aspects also lead to a sharp increase in sectoral liquidity.

Changes with respect to mean returns, or equivalently to the innovation step size, lead

[39] While there are many motives for internal funds accumulation in the theoretical and empirical literature (costs for financial transactions, taxes avoidance related to foreign earnings, agency costs for firms with poor investment opportunities), the model can address the main motive emphasized by Bates et al. (2009), that is the precautionary one by which firms hold cash to be in a better position to cope with adverse shocks when access to capital market, and by which "firms with better investment opportunities hold more cash because adverse shocks and financial distress are more costly for them". Graham and Leary (2017) find also some evidence of a precautionary motive to explain the run-up in cash in the U.S. in the 1930s.

Table 7 – High-technology experiments

τ	v	l	$\bar{\omega}$	ω_0	z_i	z_e	ν	C	g
Panel A - Baseline									
6.77	11.52	1.25	21.0	7.3	2.95	3.82	0.40	15.5	1.51
Panel B - High-tech sector (50% increase in θ, ψ, μ and σ)									
7.14	11.12	1.59	27.7	9.7	2.94	4.21	0.43	19.6	2.21
Panel C - High-tech sector at first best (λ, κ and ζ close to zero)									
7.39	11.14	2.12	6.7	2.8	2.97	4.42	0.22	3.8	2.29

Note: In Panel B, the coefficients are $\theta = 0.30$, $\psi = 0.20$, $\mu = 0.266$ and $\sigma = 0.173$. In Panel C, the coefficient for the financial constraints are $\lambda = 0.05$, $\kappa = 0.03$ and $\zeta = 0.03$.

to a sharp rise of innovation by entrants and to a corresponding increase in the destructive creation rate (Table 6 Panel D). The growth rate is more than doubled thanks to both the initial exogenous increase in the innovation step size and the accompanying rise in destructive creation. If the destructive creation rate was fixed, a higher product line mean profitability would increase the inefficiency of liquidation and make the internal funds threshold jump. Yet, the creative destruction rate increases considerably and affects product line profitability downwards. If the volatility of cash flows increases, there is a higher risk to reach early inefficient liquidation and internal funds accumulation is accelerated (Table 6 Panel E). As this initial internal funds vary endogenously, the increased volatility does not affect much innovation and growth. On the contrary, liquidity is far higher. This scenario reflects at the sectoral level the result that firms with higher cash flow volatility accumulate more internal funds (Bates et al., 2009).

Finally, to simulate a stylized high-tech sector, and following a similar exercise by Klette and Kortum (2004), an additional experiment is carried out by increasing by 50 percent all parameters affecting profits, for entrants and incumbents: R&D costs, entry costs, mean returns and volatility. Here, higher innovation opportunities are associated with better returns but also higher cash uncertainty and costlier R&D. In this scenario, initial internal funds rises (Table 7 Panel B).[40] Liquidity also increases substantially. This general pattern is the sum of effects in Table 6. Increases in ψ and σ foster internal fund accumulation while the increase in μ dampens it, the increase in θ being neutral. In this case, higher liquidity is

[40] Begenau and Palazzo (2017) and Graham and Leary (2017) document that the cash-run up in the U.S. in the 1980s and 1990s is not due to changing within firm characteristics but to a change in the sample composition of firms. The simulations here are thus interesting to think about the rise of a specific sector with different attributes in the whole economy.

associated with higher growth. Yet, another experiment mix could provide differing results.

Conclusion

This paper develops a micro-funded model of firm innovation, internal funds management, growth and liquidity. It mixes a seminal framework of Schumpeterian growth relying on product innovation, with standard information asymmetries about cash flows between managers and investors using continuous-time methods. The model displays tractable properties, notably for solving the firm problem at the product line scale, and is consistent with evidence on the relation between internal funds and R&D spendings at the firm level. It allows for experiments for a large set of parameters. In particular, various factors increasing liquidation risks are disentangled, and initial internal funds happens to be crucial for dynamics. In addition, many dimensions related to innovation capacity affect liquidity.

This paper did not address several limits and possible extensions. First, the agency problem could rely on uncertainty affecting R&D success on top of uncertainty related to cash flows. This could provide a direct explanation for hindered initial internal funds due to insufficient visibility on projects. The framework could also be enriched with tangible capital providing safer returns. Second, a financial intermediation block could be added, as this paper abstracts from considerations in terms of liquidity equilibrium. Internal funds accumulated by firms may affect the overall balance in the economy if safe assets are scarce.

Appendix

Proof of the Proposition

Applying an extended version of Ito's lemma for diffusion and jump processes (Oksendal and Sulem, 2011, p.6), the Hamilton-Jacobi-Bellman equation is:

$$\begin{aligned} rP_n(W) = \max_{x,\beta_t^+,\beta_t^-} \; & n[\mu - wh(x)] + (\rho W - \beta_t^+ nx + \beta_t^- n\tau)P_n'(W) + \frac{1}{2}(\lambda\sigma n)^2 P_n''(W) \\ & + nx[P_{n+1}(W+\beta_t^+) - P_n(W)] + n\tau[P_{n-1}(W-\beta_t^-) - P_n(W)], \end{aligned} \tag{16}$$

where $\frac{dP_n(W)}{dt}$ has been substituted for $rP_n(W)$ and the time subscript t is omitted. This equation is very similar to Brémaud (1981, chap. VII, P. 203) addressing dynamic programming for intensity control, without Brownian motions. Let us verify that $P_n = np$ is a solution to (16). With the per product line variable $p_n = P_n/n$ and $\omega = W/n$, the right hand side term of this equation becomes:

$$\max_{x,\beta_t^+,\beta_t^-} \; [\mu - wh(x)] + (\rho\omega - \beta_t^+ x + \beta_t^- \tau)p'(\omega) + \frac{1}{2}(\lambda\sigma)^2 p''(\omega)$$
$$+ x\left[(n+1)p\left(\frac{n\omega+\beta_t^+}{n+1}\right) - np(\omega)\right] + \tau\left[(n-1)p\left(\frac{n\omega-\beta_t^-}{n-1}\right) - np(\omega)\right]. \tag{17}$$

The first order condition with respect to β_t^+ is: $p'(\omega) = p'\left(\frac{n\omega+\beta_t^+}{n+1}\right)$. Following DeMarzo et al. (2012), the function p' associated with (16) is strictly monotone for $\omega < \bar{\omega}$ so that $\omega = \frac{n\omega+\beta_t^+}{n+1}$ and $\beta_t^+ = \omega$. Similarly, $\beta_t^- = \omega$. Then $x\left[(n+1)p\left(\frac{n\omega+\beta_t^+}{n+1}\right) - np(\omega)\right]$ simplifies to $xp(\omega)$, another term $-\tau p(\omega)$ also appears, and $(\rho\omega - \beta_t^+ x + \beta_t^- \tau)p'(\omega)$ becomes $[\rho - (x-\tau)]\omega p'(\omega)$. So, (17) corresponds to the right hand side of (12). Thus, as p is solution to (12), it is also a solution to (16).

Algorithm

The algorithm is made up by the following steps. First, after having chosen an initial value for the destructive creation rate, there is a partial equilibrium loop (all loops have a convergence criteria at 10^{-2}). Arbitrary initial values are given to w and l. Value functions are calculated: an initial value is chosen for the internal funds threshold $\bar{\omega}$. Then, the value function is calculated following (12) between 0 and $\bar{\omega}$. Finally, a new value for $\bar{\omega}$ is chosen if $p'(\bar{\omega})$ is above or below -1 (see Proposition) until convergence. New values are derived for w using the free entry condition (7) and for the liquidation value l using (9) and compared to the previous ones until convergence. Optimal initial cash ω_0 is also derived in this loop using (8) and optimal R&D spendings x using (13).

Second, there is general equilibrium loop (the procedure by Atkeson and Burstein, 2010, is followed as a core setup for firm dynamics and is adapted to the current context, notably with cash flow shocks). The distribution starts with a unit mass of entrants and then, at each period, a new distribution is calculated. Random shocks σdS_t are applied to every firm and the corresponding cash dynamics is derived with (10) and (11) using optimal decision parameters from the Proposition. The new number of products for each firm is derived using optimal R&D investment for each couple (ω, n) with the corresponding probability of success. A new unit mass of entrants is introduced and the loop is run Q times (the chosen value for Q allows for stability of aggregates and the firm distribution). Aggregates are normalized and innovation efforts by incumbents and entrants are summed up and compared to the chosen initial value of the destructive creation rate. New simulations are run until convergence for τ and clearing of the labor market (if the simulated τ_{out} is above the initial chosen value τ_{in}, total labor demand is also too high, and new simulations are run with a lower τ_{in}).

References

Acemoglu, D., Akcigit, U., Alp, H., Bloom, N. and Kerr, W. (2017). Innovation, reallocation and liquidity. *American Economics Review, forthcoming.*

Acemoglu, D. and Cao, D. (2010). Innovation by entrants and incumbents. *NBER Working Paper Series*, n°16411.

Aghion, P., Akcigit, U. and Howitt, P. (2014). What do we learn from schumpeterian growth theory? *Handbook of Economic Growth*, *2*(B), 515–563.

Aghion, P., Bergeaud, A., Cette, G., Lecat, R. and Maghin, H. (2018). Credit constraints and productivity. *mimeo.*

Aghion, P., Berman, N., Eymard, L., Askenazy, P. and Cette, G. (2012). Credit constraints and the cyclicality of R&D investment: evidence from France. *Journal of the European Economic Association*, *10*(5), 1001–1024.

Aghion, P., Van Reenen, J. and Zingales, L. (2013). Innovation and institutional ownership. *American Economic Review*, *103*(1), 277–304.

Akcigit, U., Hanley, D. and Serrano-Velarde, N. (2016). Back to basics: basic research spillovers, innovation policy and growth. *CEPR Discussion Papers*, n°11707.

Almeida, H., Campello, M., Cunha, I. and Weisbach, M. (2014). Corporate liquidity management: a conceptual framework and survey. *Annual Review of Financial Economics*, *6*, 135–162.

Athey, S. and Skrzypacz, A. (2017). Yuliy Sannikov: winner of the 2016 Clark Medal. *Journal of Economic Perspectives*, *31*(2), 237–256.

Atkeson, A. and Burnstein, A. (2018). Aggregate implications of innovation policy. *Journal of Political Economy*, forthcoming.

Atkeson, A. and Burstein, A. (2010). Innovation, firm dynamics and international trade. *Journal of Political Economy*, *118*(3), 53–63.

Bates, T., Kahle, K. and Stulz, R. (2009). Why do U.S. firms hold so much cash than they used to? *Journal of Finance*, *64*(5), 1985–2021.

Begenau, J. and Palazzo, B. (2017). Firm selection and corporate cash holdings. *NBER Working Papers*, n°23249.

Benhabib, J. and Spiegel, M. (2000). The role of financial development in growth and investment. *Journal of Economic Growth*, *5*(4), 341–360.

Bolton, P., Chen, H. and Wang, N. (2011). A unified theory of tobin's q, corporate investment, financing, and risk management. *Journal of Finance*, *66*, 1545–1578.

Brown, J., Fazzari, S. and Petersen, B. (2009). Financing innovation and growth: cash flows, external equity, and the 1990s R&D boom. *Journal of Finance*, *64*(1), 151–185.

Brown, J., Martinson, G. and Petersen, B. (2012). Do financing constraints matter for R&D? *European Economic Review*, *56*, 1512–1529.

Brown, J., Martinsson, G. and Petersen, B. (2017). What promotes R&D? Comparative evidence from around the world. *Research Policy*, *46*, 447–462.

Brémaud, P. (1981). *Point processes and queues: martingale dynamics.* Springer.

Campagne, B. and Poissonnier, A. (2016). Méleze, a DSGE model for France within the Euro Area. *Insee Working Papers*, G2016/05.

Chen, S. (2014). Financial constraints, intangible assets, and firm dynamics: theory and evidence. *IMF Working Papers*, n°14/88.

Clementi, G. and Hopenhayn, H. (2006). A theory of financing contraints and firm dynamics. *Quarterly Journal of Economics*, *121*(1), 229–265.

DeMarzo, P., Fishman, M., He, Z. and Wang, N. (2012). Dynamic agency and the q theory of investment. *Journal of Finance*, *68*(6), 2295–2340.

Falato, A., Kadyrzhanova, D. and Sim, J. (2013). Rising intangible capital, shrinking debt capacity, and the U.S. corporate saving glut. *Federal Reserve Board Finance and Economics Discussion Series*, n°67.

France Stratégie (2016). Quinze ans de politiques de l'innovation en France. *Commission nationale d'évaluation des politiques d'innovation.*

Garcia-Macia, D., Hsieh, C. and Klenow, P. (2016). How destructive is innovation? *NBER Working Papers*, n°22953.

Graham, J. and Leary, M. (2017). The evolution of corporate cash. *NBER Working Papers*, n°23767.

Hall, B. and Lerner, J. (2010). The financing of R&D and innovation. *Handbooks of Economics*, *46*, 609–639.

Hall, B., Moncada-Paterno-Castello, P., Montresor, S. and Vezzani, A. (2016). Financing constraints, R&D investments and innovative performance: new empirical evidence at the firm level for europe. *Economics of Innovation and New Technology*, *23*(3), 183–196.

He, Z. (2012). Dynamic compensation contracts with private savings. *Review of Financial Studies*, *25*(5), 1494–1549.

He, Z. and Wintoki, M. (2016). The cost of innovation: R&D and high cash holdings in U.S. firms. *Journal of Corporate Finance*, *41*, 280–303.

Holström, B. and Tirole, J. (2011). *Inside and outside liquidity.* MIT Press.

Howell, S. (2017). Financing innovation: evidence from R&D grants. *American Economic Review*, *107(4)*, 1136–1164.

Hugonnier, J., Malamud, S. and Morellec, E. (2014). Capital supply uncertainty, cash holdings and investment. *Review of Financial Studies*, *28*(2), 391–445.

Insee (2014). Les sociétés exportatrices sont plus innovantes que les autres. *Insee Première*, n°1521.

Insee and French Treasury (2017). Le modèle macroéconomique Mésange : réestimation et nouveautés. *Insee Working Papers*, G2017/04.

Kerr, W. and Nanda, R. (2015). Financing innovation. *Annual Review of Financial Economics*, *7*, 445–462.

Klette, T. and Kortum, S. (2004). Innovating firms and aggregate innovation. *Journal of Political Economy*, *112*(5), 986–1018.

Loayza, N., Ouazas, A. and Rancière, R. (2018). Financial development, growth, and crisis: is there a trade-off? *NBER Working Papers*, n°24474.

Malamud, S. and Zucchi, F. (2017). Liquidity, innovation and endogenous growth. *Journal of Financial Economics*, forthcoming.

OECD (2018). R&D tax incentives: France, 2017. *Directorate for Science and Technology.*

Oksendal, B. and Sulem, A. (2011). *Applied Stochastic control of jump diffusion.* Springer.

Philippon, T. (2015). Has the U.S. finance industry become less efficient? on the theory and measurement of financial intermediation. *American Economic Review*, *105*(4), 1408–1438.

Pinkowitz, L., Stulz, R. and Williamson, R. (2016). Do U.S. firms hold more cash than foreign firms do? *Review of Financial Studies*, *29*(2), 309–348.

Rajan, R. and Zingales, L. (1998). Financial dependence and growth. *American Economic Review*, *88*(3), 559–586.

Sannikov, Y. (2013). Dynamic security design and corporate financing. *Handbook of the Economics of Finance*, *2*(A), 71–122.

Strebulaev, I. and Whited, T. (2012). Dynamic models and structural estimation in corporate finance. *Foundations and Trends in Finance.*

Villeroy de Galhau, F. (2015). Le financement de l'investissement des entreprises. *Rapport au Premier Ministre.*

Liste des documents de travail de la Direction des Études et Synthèses Économiques

G 9001 J. FAYOLLE et M. FLEURBAEY
Accumulation, profitabilité et endettement des entreprises

G 9002 H. ROUSSE
Détection et effets de la multicolinéarité dans les modèles linéaires ordinaires - Un prolongement de la réflexion de BELSLEY, KUH et WELSCH

G 9003 P. RALLE et J. TOUJAS-BERNATE
Indexation des salaires : la rupture de 1983

G 9004 D. GUELLEC et P. RALLE
Compétitivité, croissance et innovation de produit

G 9005 P. RALLE et J. TOUJAS-BERNATE
Les conséquences de la désindexation. Analyse dans une maquette prix-salaires

G 9101 Équipe AMADEUS
Le modèle AMADEUS - Première partie - Présentation générale

G 9102 J.L. BRILLET
Le modèle AMADEUS - Deuxième partie - Propriétés variantielles

G 9103 D. GUELLEC et P. RALLE
Endogenous growth and product innovation

G 9104 H. ROUSSE
Le modèle AMADEUS - Troisième partie - Le commerce extérieur et l'environnement international

G 9105 H. ROUSSE
Effets de demande et d'offre dans les résultats du commerce extérieur manufacturé de la France au cours des deux dernières décennies

G 9106 B. CREPON
Innovation, taille et concentration : causalités et dynamiques

G 9107 B. AMABLE et D. GUELLEC
Un panorama des théories de la croissance endogène

G 9108 M. GLAUDE et M. MOUTARDIER
Une évaluation du coût direct de l'enfant de 1979 à 1989

G 9109 P. RALLE et alii
France - Allemagne : performances économiques comparées

G 9110 J.L. BRILLET
Micro-DMS ***NON PARU***

G 9111 A. MAGNIER
Effets accélérateur et multiplicateur en France depuis 1970 : quelques résultats empiriques

G 9112 B. CREPON et G. DUREAU
Investissement en recherche-développement : analyse de causalités dans un modèle d'accélérateur généralisé

G 9113 J.L. BRILLET, H. ERKEL-ROUSSE, J. TOUJAS-BERNATE
"France-Allemagne Couplées" - Deux économies vues par une maquette macro-économétrique

G 9201 W.J. ADAMS, B. CREPON, D. ENCAOUA
Choix technologiques et stratégies de dissuasion d'entrée

G 9202 J. OLIVEIRA-MARTINS, J. TOUJAS-BERNATE
Macro-economic import functions with imperfect competition - An application to the E.C. Trade

G 9203 I. STAPIC
Les échanges internationaux de services de la France dans le cadre des négociations multilatérales du GATT
Juin 1992 (1ère version)
Novembre 1992 (version finale)

G 9204 P. SEVESTRE
L'économétrie sur données individuelles-temporelles. Une note introductive

G 9205 H. ERKEL-ROUSSE
Le commerce extérieur et l'environnement international dans le modèle AMADEUS (réestimation 1992)

G 9206 N. GREENAN et D. GUELLEC
Coordination within the firm and endogenous growth

G 9207 A. MAGNIER et J. TOUJAS-BERNATE
Technology and trade: empirical evidences for the major five industrialized countries

G 9208 B. CREPON, E. DUGUET, D. ENCAOUA et P. MOHNEN
Cooperative, non cooperative R & D and optimal patent life

G 9209 B. CREPON et E. DUGUET
Research and development, competition and innovation: an application of pseudo maximum likelihood methods to Poisson models with heterogeneity

G 9301 J. TOUJAS-BERNATE
Commerce international et concurrence imparfaite : développements récents et implications pour la politique commerciale

G 9302 Ch. CASES
Durées de chômage et comportements d'offre de travail : une revue de la littérature

G 9303 H. ERKEL-ROUSSE
Union économique et monétaire : le débat économique

G 9304 N. GREENAN - D. GUELLEC / G. BROUSSAUDIER - L. MIOTTI
Innovation organisationnelle, dynamisme technologique et performances des entreprises

G 9305 P. JAILLARD
Le traité de Maastricht : présentation juridique et historique

G 9306 J.L. BRILLET
Micro-DMS : présentation et propriétés

G 9307 J.L. BRILLET
Micro-DMS - variantes : les tableaux

G 9308 S. JACOBZONE
Les grands réseaux publics français dans une perspective européenne

G 9309 L. BLOCH - B. CŒURE
Profitabilité de l'investissement productif et transmission des chocs financiers

G 9310 J. BOURDIEU - B. COLIN-SEDILLOT
Les théories sur la structure optimale du capital : quelques points de repère

G 9311 J. BOURDIEU - B. COLIN-SEDILLOT
Les décisions de financement des entreprises françaises : une évaluation empirique des théories de la structure optimale du capital

G 9312 L. BLOCH - B. CŒURÉ
Q de Tobin marginal et transmission des chocs financiers

G 9313 Équipes Amadeus (INSEE), Banque de France, Métric (DP)
Présentation des propriétés des principaux modèles macroéconomiques du Service Public

G 9314 B. CREPON - E. DUGUET
Research & Development, competition and innovation

G 9315 B. DORMONT
Quelle est l'influence du coût du travail sur l'emploi ?

G 9316 D. BLANCHET - C. BROUSSE
Deux études sur l'âge de la retraite

G 9317 D. BLANCHET
Répartition du travail dans une population hétérogène : deux notes

G 9318 D. EYSSARTIER - N. PONTY
AMADEUS - an annual macro-economic model for the medium and long term

G 9319 G. CETTE - Ph. CUNÉO - D. EYSSARTIER - J. GAUTIÉ
Les effets sur l'emploi d'un abaissement du coût du travail des jeunes

G 9401 D. BLANCHET
Les structures par âge importent-elles ?

G 9402 J. GAUTIÉ
Le chômage des jeunes en France : problème de formation ou phénomène de file d'attente ? Quelques éléments du débat

G 9403 P. QUIRION
Les déchets en France : éléments statistiques et économiques

G 9404 D. LADIRAY - M. GRUN-REHOMME
Lissage par moyennes mobiles - Le problème des extrémités de série

G 9405 V. MAILLARD
Théorie et pratique de la correction des effets de jours ouvrables

G 9406 F. ROSENWALD
La décision d'investir

G 9407 S. JACOBZONE
Les apports de l'économie industrielle pour définir la stratégie économique de l'hôpital public

G 9408 L. BLOCH, J. BOURDIEU, B. COLIN-SEDILLOT, G. LONGUEVILLE
Du défaut de paiement au dépôt de bilan : les banquiers face aux PME en difficulté

G 9409 D. EYSSARTIER, P. MAIRE
Impacts macro-économiques de mesures d'aide au logement - quelques éléments d'évaluation

G 9410 F. ROSENWALD
Suivi conjoncturel de l'investissement

G 9411 C. DEFEUILLEY - Ph. QUIRION
Les déchets d'emballages ménagers : une analyse économique des politiques française et allemande

G 9412 J. BOURDIEU - B. CŒURÉ - B. COLIN-SEDILLOT
Investissement, incertitude et irréversibilité
Quelques développements récents de la théorie de l'investissement

G 9413 B. DORMONT - M. PAUCHET
L'évaluation de l'élasticité emploi-salaire dépend-elle des structures de qualification ?

G 9414 I. KABLA
Le Choix de breveter une invention

G 9501 J. BOURDIEU - B. CŒURÉ - B. SEDILLOT
Irreversible Investment and Uncertainty:
When is there a Value of Waiting?

G 9502 L. BLOCH - B. CŒURÉ
Imperfections du marché du crédit, investissement des entreprises et cycle économique

G 9503 D. GOUX - E. MAURIN
Les transformations de la demande de travail par qualification en France
Une étude sur la période 1970-1993

G 9504 N. GREENAN
Technologie, changement organisationnel, qualifications et emploi : une étude empirique sur l'industrie manufacturière

G 9505 D. GOUX - E. MAURIN
Persistance des hiérarchies sectorielles de salaires: un réexamen sur données françaises

G 9505 Bis D. GOUX - E. MAURIN
Persistence of inter-industry wages differentials: a reexamination on matched worker-firm panel data

G 9506 S. JACOBZONE
Les liens entre RMI et chômage, une mise en perspective
NON PARU - article sorti dans Économie et Prévision n° 122 (1996) - pages 95 à 113

G 9507 G. CETTE - S. MAHFOUZ
Le partage primaire du revenu
Constat descriptif sur longue période

G 9601 Banque de France - CEPREMAP - Direction de la Prévision - Érasme - INSEE - OFCE
Structures et propriétés de cinq modèles macro-économiques français

G 9602 Rapport d'activité de la DESE de l'année 1995

G 9603 J. BOURDIEU - A. DRAZNIEKS
L'octroi de crédit aux PME : une analyse à partir d'informations bancaires

G 9604 A. TOPIOL-BENSAÏD
Les implantations japonaises en France

G 9605 P. GENIER - S. JACOBZONE
Comportements de prévention, consommation d'alcool et tabagie : peut-on parler d'une gestion globale du capital santé ?
Une modélisation microéconométrique empirique

G 9606 C. DOZ - F. LENGLART
Factor analysis and unobserved component models: an application to the study of French business surveys

G 9607 N. GREENAN - D. GUELLEC
La théorie coopérative de la firme

G 9608 N. GREENAN - D. GUELLEC
Technological innovation and employment reallocation

G 9609 Ph. COUR - F. RUPPRECHT
L'intégration asymétrique au sein du continent américain : un essai de modélisation

G 9610 S. DUCHENE - G. FORGEOT - A. JACQUOT
Analyse des évolutions récentes de la productivité apparente du travail

G 9611 X. BONNET - S. MAHFOUZ
The influence of different specifications of wages-prices spirals on the measure of the NAIRU: the case of France

G 9612 PH. COUR - E. DUBOIS, S. MAHFOUZ, J. PISANI-FERRY
The cost of fiscal retrenchment revisited: how strong is the evidence?

G 9613 A. JACQUOT
Les flexions des taux d'activité sont-elles seulement conjoncturelles ?

G 9614 ZHANG Yingxiang - SONG Xueqing
Lexique macroéconomique Français-Chinois

G 9701 J.L. SCHNEIDER
La taxe professionnelle : éléments de cadrage économique

G 9702 J.L. SCHNEIDER
Transition et stabilité politique d'un système redistributif

G 9703 D. GOUX - E. MAURIN
Train or Pay: Does it Reduce Inequalities to Encourage Firms to Train their Workers?

G 9704 P. GENIER
Deux contributions sur dépendance et équité

G 9705 E. DUGUET - N. IUNG
R & D Investment, Patent Life and Patent Value
An Econometric Analysis at the Firm Level

G 9706 M. HOUDEBINE - A. TOPIOL-BENSAÏD
Les entreprises internationales en France : une analyse à partir de données individuelles

G 9707 M. HOUDEBINE
Polarisation des activités et spécialisation des départements en France

G 9708 E. DUGUET - N. GREENAN
Le biais technologique : une analyse sur données individuelles

G 9709 J.L. BRILLET
Analyzing a small French ECM Model

G 9710 J.L. BRILLET
Formalizing the transition process: scenarios for capital accumulation

G 9711 G. FORGEOT - J. GAUTIÉ
Insertion professionnelle des jeunes et processus de déclassement

G 9712 E. DUBOIS
High Real Interest Rates: the Consequence of a Saving Investment Disequilibrium or of an insufficient Credibility of Monetary Authorities?

G 9713 Bilan des activités de la Direction des Études et Synthèses Économiques - 1996

G 9714 F. LEQUILLER
Does the French Consumer Price Index Overstate Inflation?

G 9715 X. BONNET
Peut-on mettre en évidence les rigidités à la baisse des salaires nominaux ?
Une étude sur quelques grands pays de l'OCDE

G 9716 N. IUNG - F. RUPPRECHT
Productivité de la recherche et rendements d'échelle dans le secteur pharmaceutique français

G 9717 E. DUGUET - I. KABLA
Appropriation strategy and the motivations to use the patent system in France - An econometric analysis at the firm level

G 9718 L.P. PELÉ - P. RALLE
Âge de la retraite : les aspects incitatifs du régime général

G 9719 ZHANG Yingxiang - SONG Xueqing
Lexique macroéconomique français-chinois, chinois-français

G 9720 M. HOUDEBINE - J.L. SCHNEIDER
Mesurer l'influence de la fiscalité sur la localisation des entreprises

G 9721 A. MOUROUGANE
Crédibilité, indépendance et politique monétaire
Une revue de la littérature

G 9722 P. AUGERAUD - L. BRIOT
Les données comptables d'entreprises
Le système intermédiaire d'entreprises
Passage des données individuelles aux données sectorielles

G 9723 P. AUGERAUD - J.E. CHAPRON
Using Business Accounts for Compiling National Accounts: the French Experience

G 9724 P. AUGERAUD
Les comptes d'entreprise par activités - Le passage aux comptes - De la comptabilité d'entreprise à la comptabilité nationale - *A paraître*

G 9801 H. MICHAUDON - C. PRIGENT
Présentation du modèle AMADEUS

G 9802 J. ACCARDO
Une étude de comptabilité générationnelle pour la France en 1996

G 9803 X. BONNET - S. DUCHÊNE
Apports et limites de la modélisation « Real Business Cycles »

G 9804 C. BARLET - C. DUGUET - D. ENCAOUA - J. PRADEL
The Commercial Success of Innovations
An econometric analysis at the firm level in French manufacturing

G 9805 P. CAHUC - Ch. GIANELLA - D. GOUX - A. ZILBERBERG
Equalizing Wage Differences and Bargaining Power - Evidence form a Panel of French Firms

G 9806 J. ACCARDO - M. JLASSI
La productivité globale des facteurs entre 1975 et 1996

G 9807 Bilan des activités de la Direction des Études et Synthèses Économiques - 1997

G 9808 A. MOUROUGANE
Can a Conservative Governor Conduct an Accomodative Monetary Policy?

G 9809 X. BONNET - E. DUBOIS - L. FAUVET
Asymétrie des inflations relatives et menus costs : tests sur l'inflation française

G 9810 E. DUGUET - N. IUNG
Sales and Advertising with Spillovers at the firm level: Estimation of a Dynamic Structural Model on Panel Data

G 9811 J.P. BERTHIER
Congestion urbaine : un modèle de trafic de pointe à courbe débit-vitesse et demande élastique

G 9812 C. PRIGENT
La part des salaires dans la valeur ajoutée : une approche macroéconomique

G 9813 A.Th. AERTS
L'évolution de la part des salaires dans la valeur ajoutée en France reflète-t-elle les évolutions individuelles sur la période 1979-1994 ?

G 9814 B. SALANIÉ
Guide pratique des séries non-stationnaires

G 9901 S. DUCHÊNE - A. JACQUOT
Une croissance plus riche en emplois depuis le début de la décennie ? Une analyse en comparaison internationale

G 9902 Ch. COLIN
Modélisation des carrières dans Destinie

G 9903 Ch. COLIN
Évolution de la dispersion des salaires : un essai de prospective par microsimulation

G 9904 B. CREPON - N. IUNG
Innovation, emploi et performances

G 9905 B. CREPON - Ch. GIANELLA
Wages inequalities in France 1969-1992
An application of quantile regression techniques

G 9906 C. BONNET - R. MAHIEU
Microsimulation techniques applied to intergenerational transfers - Pensions in a dynamic framework: the case of France

G 9907 F. ROSENWALD
L'impact des contraintes financières dans la décision d'investissement

G 9908 Bilan des activités de la DESE - 1998

G 9909 J.P. ZOYEM
Contrat d'insertion et sortie du RMI
Évaluation des effets d'une politique sociale

G 9910 Ch. COLIN - Fl. LEGROS - R. MAHIEU
Bilans contributifs comparés des régimes de retraite du secteur privé et de la fonction publique

G 9911 G. LAROQUE - B. SALANIÉ
Une décomposition du non-emploi en France

G 9912 B. SALANIÉ
Une maquette analytique de long terme du marché du travail

G 9912 Ch. GIANELLA
Bis Une estimation de l'élasticité de l'emploi peu qualifié à son coût

G 9913 Division « Redistribution et Politiques Sociales »
Le modèle de microsimulation dynamique DESTINIE

G 9914 E. DUGUET
Macro-commandes SAS pour l'économétrie des panels et des variables qualitatives

G 9915 R. DUHAUTOIS
Évolution des flux d'emplois en France entre 1990 et 1996 : une étude empirique à partir du fichier des bénéfices réels normaux (BRN)

G 9916 J.Y. FOURNIER
Extraction du cycle des affaires : la méthode de Baxter et King

G 9917 B. CRÉPON - R. DESPLATZ - J. MAIRESSE
Estimating price cost margins, scale economies and workers' bargaining power at the firm level

G 9918 Ch. GIANELLA - Ph. LAGARDE
Productivity of hours in the aggregate production function: an evaluation on a panel of French firms from the manufacturing sector

G 9919 S. AUDRIC - P. GIVORD - C. PROST
Évolution de l'emploi et des coûts par qualification entre 1982 et 1996

G 2000/01 R. MAHIEU
Les déterminants des dépenses de santé : une approche macroéconomique

G 2000/02 C. ALLARD-PRIGENT - H. GUILMEAU - A. QUINET
The real exchange rate as the relative price of nontrables in terms of tradables: theoretical investigation and empirical study on French data

G 2000/03 J.-Y. FOURNIER
L'approximation du filtre passe-bande proposée par Christiano et Fitzgerald

G 2000/04 Bilan des activités de la DESE - 1999

G 2000/05 B. CREPON - F. ROSENWALD
Investissement et contraintes de financement : le poids du cycle
Une estimation sur données françaises

G 2000/06 A. FLIPO
Les comportements matrimoniaux de fait

G 2000/07 R. MAHIEU - B. SÉDILLOT
Microsimulations of the retirement decision: a supply side approach

G 2000/08 C. AUDENIS - C. PROST
Déficit conjoncturel : une prise en compte des conjonctures passées

G 2000/09 R. MAHIEU - B. SÉDILLOT
Équivalent patrimonial de la rente et souscription de retraite complémentaire

G 2000/10 R. DUHAUTOIS
Ralentissement de l'investissement : petites ou grandes entreprises ? industrie ou tertiaire ?

G 2000/11 G. LAROQUE - B. SALANIÉ
Temps partiel féminin et incitations financières à l'emploi

G2000/12 Ch. GIANELLA
Local unemployment and wages

G2000/13 B. CREPON - Th. HECKEL
- Informatisation en France : une évaluation à partir de données individuelles
- Computerization in France: an evaluation based on individual company data

G2001/01 F. LEQUILLER
- La nouvelle économie et la mesure de la croissance du PIB
- The new economy and the measure ment of GDP growth

G2001/02 S. AUDRIC
La reprise de la croissance de l'emploi profite-t-elle aussi aux non-diplômés ?

G2001/03 I. BRAUN-LEMAIRE
Évolution et répartition du surplus de productivité

G2001/04 A. BEAUDU - Th. HECKEL
Le canal du crédit fonctionne-t-il en Europe ? Une étude de l'hétérogénéité des comportements d'investissement à partir de données de bilan agrégées

G2001/05 C. AUDENIS - P. BISCOURP - N. FOURCADE - O. LOISEL
Testing the augmented Solow growth model: An empirical reassessment using panel data

G2001/06 R. MAHIEU - B. SÉDILLOT
Départ à la retraite, irréversibilité et incertitude

G2001/07 Bilan des activités de la DESE - 2000

G2001/08 J. Ph. GAUDEMET
Les dispositifs d'acquisition à titre facultatif d'annuités viagères de retraite

G2001/09 B. CRÉPON - Ch. GIANELLA
Fiscalité, coût d'usage du capital et demande de facteurs : une analyse sur données individuelles

G2001/10 B. CRÉPON - R. DESPLATZ
Évaluation des effets des dispositifs d'allégements
de charges sociales sur les bas salaires

G2001/11 J.-Y. FOURNIER
Comparaison des salaires des secteurs public et privé

G2001/12 J.-P. BERTHIER - C. JAULENT
R. CONVENEVOLE - S. PISANI
Une méthodologie de comparaison entre consommations intermédiaires de source fiscale et de comptabilité nationale

G2001/13 P. BISCOURP - Ch. GIANELLA
Substitution and complementarity between capital, skilled and less skilled workers: an analysis at the firm level in the French manufacturing industry

G2001/14 I. ROBERT-BOBEE
Modelling demographic behaviours in the French microsimulation model Destinie: An analysis of future change in completed fertility

G2001/15 J.-P. ZOYEM
Diagnostic sur la pauvreté et calendrier de revenus : le cas du "Panel européen des ménages »

G2001/16 J.-Y. FOURNIER - P. GIVORD
La réduction des taux d'activité aux âges extrêmes, une spécificité française ?

G2001/17 C. AUDENIS - P. BISCOURP - N. RIEDINGER
Existe-t-il une asymétrie dans la transmission du prix du brut aux prix des carburants ?

G2002/01 F. MAGNIEN - J.-L. TAVERNIER - D. THESMAR
Les statistiques internationales de PIB par habitant en standard de pouvoir d'achat : une analyse des résultats

G2002/02 Bilan des activités de la DESE - 2001

G2002/03 B. SÉDILLOT - E. WALRAET
La cessation d'activité au sein des couples : y a-t-il interdépendance des choix ?

G2002/04 G. BRILHAULT
- Rétropolation des séries de FBCF et calcul du capital fixe en SEC-95 dans les comptes nationaux français
- Retropolation of the investment series (GFCF) and estimation of fixed capital stocks on the ESA-95 basis for the French balance sheets

G2002/05 P. BISCOURP - B. CRÉPON - T. HECKEL - N. RIEDINGER
How do firms respond to cheaper computers? Microeconometric evidence for France based on a production function approach

G2002/06 C. AUDENIS - J. DEROYON - N. FOURCADE
L'impact des nouvelles technologies de l'information et de la communication sur l'économie française - un bouclage macro-économique

G2002/07 J. BARDAJI - B. SÉDILLOT - E. WALRAET
Évaluation de trois réformes du Régime Général d'assurance vieillesse à l'aide du modèle de microsimulation DESTINIE

G2002/08 J.-P. BERTHIER
Réflexions sur les différentes notions de volume dans les comptes nationaux : comptes aux prix d'une année fixe ou aux prix de l'année précédente, séries chaînées

G2002/09 F. HILD
Les soldes d'opinion résument-ils au mieux les réponses des entreprises aux enquêtes de conjoncture ?

G2002/10 I. ROBERT-BOBÉE
Les comportements démographiques dans le modèle de microsimulation Destinie - Une comparaison des estimations issues des enquêtes Jeunes et Carrières 1997 et Histoire Familiale 1999

G2002/11 J.-P. ZOYEM
La dynamique des bas revenus : une analyse des entrées-sorties de pauvreté

G2002/12 F. HILD
Prévisions d'inflation pour la France

G2002/13 M. LECLAIR
Réduction du temps de travail et tensions sur les facteurs de production

G2002/14 E. WALRAET - A. VINCENT
- Analyse de la redistribution intragénérationnelle dans le système de retraite des salariés du privé - Une approche par microsimulation
- Intragenerational distributional analysis in the french private sector pension scheme - A microsimulation approach

G2002/15 P. CHONE - D. LE BLANC - I. ROBERT-BOBEE
Offre de travail féminine et garde des jeunes enfants

G2002/16 F. MAUREL - S. GREGOIR
Les indices de compétitivité des pays : interprétation et limites

G2003/01 N. RIEDINGER - E.HAUVY
Le coût de dépollution atmosphérique pour les entreprises françaises : Une estimation à partir de données individuelles

G2003/02 P. BISCOURP et F. KRAMARZ
Création d'emplois, destruction d'emplois et internationalisation des entreprises industrielles françaises : une analyse sur la période 1986-1992

G2003/03 Bilan des activités de la DESE - 2002

G2003/04 P.-O. BEFFY - J. DEROYON -
N. FOURCADE - S. GREGOIR - N. LAÏB -
B. MONFORT
Évolutions démographiques et croissance : une projection macro-économique à l'horizon 2020

G2003/05 P. AUBERT
La situation des salariés de plus de cinquante ans dans le secteur privé

G2003/06 P. AUBERT - B. CRÉPON
Age, salaire et productivité
La productivité des salariés décline-t-elle en fin de carrière ?

G2003/07 H. BARON - P.O. BEFFY - N. FOURCADE - R. MAHIEU
Le ralentissement de la productivité du travail au cours des années 1990

G2003/08 P.-O. BEFFY - B. MONFORT
Patrimoine des ménages, dynamique d'allocation et comportement de consommation

G2003/09 P. BISCOURP - N. FOURCADE
Peut-on mettre en évidence l'existence de rigidités à la baisse des salaires à partir de données individuelles ? Le cas de la France à la fin des années 90

G2003/10 M. LECLAIR - P. PETIT
Présence syndicale dans les firmes : quel impact sur les inégalités salariales entre les hommes et les femmes ?

G2003/11 P.-O. BEFFY - X. BONNET - M. DARRACQ-PARIES - B. MONFORT
MZE: a small macro-model for the euro area

G2004/01 P. AUBERT - M. LECLAIR
La compétitivité exprimée dans les enquêtes trimestrielles sur la situation et les perspectives dans l'industrie

G2004/02 M. DUÉE - C. REBILLARD
La dépendance des personnes âgées : une projection à long terme

G2004/03 S. RASPILLER - N. RIEDINGER
Régulation environnementale et choix de localisation des groupes français

G2004/04 A. NABOULET - S. RASPILLER
Les déterminants de la décision d'investir : une approche par les perceptions subjectives des firmes

G2004/05 N. RAGACHE
La déclaration des enfants par les couples non mariés est-elle fiscalement optimale ?

G2004/06 M. DUÉE
L'impact du chômage des parents sur le devenir scolaire des enfants

G2004/07 P. AUBERT - E. CAROLI - M. ROGER
New Technologies, Workplace Organisation and the Age Structure of the Workforce: Firm-Level Evidence

G2004/08 E. DUGUET - C. LELARGE
Les brevets accroissent-ils les incitations privées à innover ? Un examen microéconométrique

G2004/09 S. RASPILLER - P. SILLARD
Affiliating versus Subcontracting:
the Case of Multinationals

G2004/10 J. BOISSINOT - C. L'ANGEVIN - B. MONFORT
Public Debt Sustainability: Some Results on the French Case

G2004/11 S. ANANIAN - P. AUBERT
Travailleurs âgés, nouvelles technologies et changements organisationnels : un réexamen à partir de l'enquête « REPONSE »

G2004/12 X. BONNET - H. PONCET
Structures de revenus et propensions différentes à consommer - Vers une équation de consommation des ménages plus robuste en prévision pour la France

G2004/13 C. PICART
Évaluer la rentabilité des sociétés non financières

G2004/14 J. BARDAJI - B. SÉDILLOT - E. WALRAET
Les retraites du secteur public : projections à l'horizon 2040 à l'aide du modèle de microsimulation DESTINIE

G2005/01 S. BUFFETEAU - P. GODEFROY
Conditions de départ en retraite selon l'âge de fin d'études : analyse prospective pour les générations 1945 à1974

G2005/02 C. AFSA - S. BUFFETEAU
L'évolution de l'activité féminine en France :
une approche par pseudo-panel

G2005/03 P. AUBERT - P. SILLARD
Délocalisations et réductions d'effectifs
dans l'industrie française

G2005/04 M. LECLAIR - S. ROUX
Mesure et utilisation des emplois instables
dans les entreprises

G2005/05 C. L'ANGEVIN - S. SERRAVALLE
Performances à l'exportation de la France
et de l'Allemagne - Une analyse par secteur et destination géographique

G2005/06 Bilan des activités de la Direction des Études et Synthèses Économiques - 2004

G2005/07 S. RASPILLER
La concurrence fiscale : principaux enseignements de l'analyse économique

G2005/08 C. L'ANGEVIN - N. LAÏB
Éducation et croissance en France et dans un panel de 21 pays de l'OCDE

G2005/09 N. FERRARI
Prévoir l'investissement des entreprises
Un indicateur des révisions dans l'enquête de conjoncture sur les investissements dans l'industrie.

G2005/10 P.-O. BEFFY - C. L'ANGEVIN
Chômage et boucle prix-salaires :
apport d'un modèle « qualifiés/peu qualifiés »

G2005/11 B. HEITZ
A two-states Markov-switching model of inflation in France and the USA: credible target VS inflation spiral

G2005/12 O. BIAU - H. ERKEL-ROUSSE - N. FERRARI
Réponses individuelles aux enquêtes de conjoncture et prévision macroéconomiques :
Exemple de la prévision de la production manufacturière

G2005/13 P. AUBERT - D. BLANCHET - D. BLAU
The labour market after age 50: some elements of a Franco-American comparison

G2005/14 D. BLANCHET - T. DEBRAND -
P. DOURGNON - P. POLLET
L'enquête SHARE : présentation et premiers résultats de l'édition française

G2005/15 M. DUÉE
La modélisation des comportements démographiques dans le modèle de microsimulation DESTINIE

G2005/16 H. RAOUI - S. ROUX
Étude de simulation sur la participation versée aux salariés par les entreprises

G2006/01 C. BONNET - S. BUFFETEAU - P. GODEFROY
Disparités de retraite de droit direct entre hommes et femmes : quelles évolutions ?

G2006/02 C. PICART
Les gazelles en France

G2006/03 P. AUBERT - B. CRÉPON -P. ZAMORA
Le rendement apparent de la formation continue dans les entreprises : effets sur la productivité et les salaires

G2006/04 J.-F. OUVRARD - R. RATHELOT
Demographic change and unemployment:
what do macroeconometric models predict?

G2006/05 D. BLANCHET - J.-F. OUVRARD
Indicateurs d'engagements implicites des systèmes de retraite : chiffrages, propriétés analytiques et réactions à des chocs démographiques types

G2006/06 G. BIAU - O. BIAU - L. ROUVIERE
Nonparametric Forecasting of the Manufacturing Output Growth with Firm-level Survey Data

G2006/07 C. AFSA - P. GIVORD
Le rôle des conditions de travail dans les absences pour maladie

G2006/08 P. SILLARD - C. L'ANGEVIN - S. SERRAVALLE
Performances comparées à l'exportation de la France et de ses principaux partenaires
Une analyse structurelle sur 12 ans

G2006/09 X. BOUTIN - S. QUANTIN
Une méthodologie d'évaluation comptable du coût du capital des entreprises françaises : 1984-2002

G2006/10 C. AFSA
L'estimation d'un coût implicite de la pénibilité du travail chez les travailleurs âgés

G2006/11 C. LELARGE
Les entreprises (industrielles) françaises sont-elles à la frontière technologique ?

G2006/12 O. BIAU - N. FERRARI
Théorie de l'opinion
Faut-il pondérer les réponses individuelles ?

G2006/13 A. KOUBI - S. ROUX
Une réinterprétation de la relation entre productivité et inégalités salariales dans les entreprises

G2006/14 R. RATHELOT - P. SILLARD
The impact of local taxes on plants location decision

G2006/15 L. GONZALEZ - C. PICART
Diversification, recentrage et poids des activités de support dans les groupes (1993-2000)

G2007/01 D. SRAER
Allègements de cotisations patronales et dynamique salariale

G2007/02 V. ALBOUY - L. LEQUIEN
Les rendements non monétaires de l'éducation : le cas de la santé

G2007/03 D. BLANCHET - T. DEBRAND
Aspiration à la retraite, santé et satisfaction au travail : une comparaison européenne

G2007/04 M. BARLET - L. CRUSSON
Quel impact des variations du prix du pétrole sur la croissance française ?

G2007/05 C. PICART
Flux d'emploi et de main-d'œuvre en France : un réexamen

G2007/06 V. ALBOUY - C. TAVAN
Massification et démocratisation de l'enseignement supérieur en France

G2007/07 T. LE BARBANCHON
The Changing response to oil price shocks in France: a DSGE type approach

G2007/08 T. CHANEY - D. SRAER - D. THESMAR
Collateral Value and Corporate Investment
Evidence from the French Real Estate Market

G2007/09 J. BOISSINOT
Consumption over the Life Cycle: Facts for France

G2007/10 C. AFSA
Interpréter les variables de satisfaction : l'exemple de la durée du travail

G2007/11 R. RATHELOT - P. SILLARD
Zones Franches Urbaines : quels effets sur l'emploi salarié et les créations d'établissements ?

G2007/12 V. ALBOUY - B. CRÉPON
Aléa moral en santé : une évaluation dans le cadre du modèle causal de Rubin

G2008/01 C. PICART
Les PME françaises : rentables mais peu dynamiques

G2008/02 P. BISCOURP - X. BOUTIN - T. VERGÉ
The Effects of Retail Regulations on Prices
Evidence form the Loi Galland

G2008/03 Y. BARBESOL - A. BRIANT
Économies d'agglomération et productivité des entreprises : estimation sur données individuelles françaises

G2008/04 D. BLANCHET - F. LE GALLO
Les projections démographiques : principaux mécanismes et retour sur l'expérience française

G2008/05 D. BLANCHET - F. TOUTLEMONDE
Évolutions démographiques et déformation du cycle de vie active : quelles relations ?

G2008/06 M. BARLET - D. BLANCHET - L. CRUSSON
Internationalisation et flux d'emplois : que dit une approche comptable ?

G2008/07 C. LELARGE - D. SRAER - D. THESMAR
Entrepreneurship and Credit Constraints - Evidence from a French Loan Guarantee Program

G2008/08 X. BOUTIN - L. JANIN
Are Prices Really Affected by Mergers?

G2008/09 M. BARLET - A. BRIANT - L. CRUSSON
Concentration géographique dans l'industrie manufacturière et dans les services en France : une approche par un indicateur en continu

G2008/10 M. BEFFY - É. COUDIN - R. RATHELOT
Who is confronted to insecure labor market histories? Some evidence based on the French labor market transition

G2008/11 M. ROGER - E. WALRAET
Social Security and Well-Being of the Elderly: the Case of France

G2008/12 C. AFSA
Analyser les composantes du bien-être et de son évolution
Une approche empirique sur données individuelles

G2008/13 M. BARLET - D. BLANCHET -
T. LE BARBANCHON
Microsimuler le marché du travail : un prototype

G2009/01 P.-A. PIONNIER
Le partage de la valeur ajoutée en France, 1949-2007

G2009/02 Laurent CLAVEL - Christelle MINODIER
A Monthly Indicator of the French Business Climate

G2009/03 H. ERKEL-ROUSSE - C. MINODIER
Do Business Tendency Surveys in Industry and Services Help in Forecasting GDP Growth?
A Real-Time Analysis on French Data

G2009/04 P. GIVORD - L. WILNER
Les contrats temporaires : trappe ou marchepied vers l'emploi stable ?

G2009/05 G. LALANNE - P.-A. PIONNIER - O. SIMON
Le partage des fruits de la croissance de 1950 à 2008 : une approche par les comptes de surplus

G2009/06 L. DAVEZIES - X. D'HAULTFOEUILLE
Faut-il pondérer ?… Ou l'éternelle question de l'économètre confronté à des données d'enquête

G2009/07 S. QUANTIN - S. RASPILLER - S. SERRAVALLE
Commerce intragroupe, fiscalité et prix de transferts : une analyse sur données françaises

G2009/08 M. CLERC - V. MARCUS
Élasticités-prix des consommations énergétiques des ménages

G2009/09 G. LALANNE - E. POULIQUEN - O. SIMON
Prix du pétrole et croissance potentielle à long terme

G2009/10 D. BLANCHET - J. LE CACHEUX - V. MARCUS
Adjusted net savings and other approaches to sustainability: some theoretical background

G2009/11 V. BELLAMY - G. CONSALES - M. FESSEAU - S. LE LAIDIER - É. RAYNAUD
Une décomposition du compte des ménages de la comptabilité nationale par catégorie de ménage en 2003

G2009/12 J. BARDAJI - F. TALLET
Detecting Economic Regimes in France: a Qualitative Markov-Switching Indicator Using Mixed Frequency Data

G2009/13 R. AEBERHARDT - D. FOUGÈRE - R. RATHELOT
Discrimination à l'embauche : comment exploiter les procédures de *testing* ?

G2009/14 Y. BARBESOL - P. GIVORD - S. QUANTIN
Partage de la valeur ajoutée, approche par données microéconomiques

G2009/15 I. BUONO - G. LALANNE
The Effect of the Uruguay round on the Intensive and Extensive Margins of Trade

G2010/01 C. MINODIER
Avantages comparés des séries des premières valeurs publiées et des séries des valeurs révisées - Un exercice de prévision en temps réel de la croissance trimestrielle du PIB en France

G2010/02 V. ALBOUY - L. DAVEZIES - T. DEBRAND
Health Expenditure Models: a Comparison of Five Specifications using Panel Data

G2010/03 C. KLEIN - O. SIMON
Le modèle MÉSANGE réestimé en base 2000
Tome 1 – Version avec volumes à prix constants

G2010/04 M.-É. CLERC - É. COUDIN
L'IPC, miroir de l'évolution du coût de la vie en France ? Ce qu'apporte l'analyse des courbes d'Engel

G2010/05 N. CECI-RENAUD - P.-A. CHEVALIER
Les seuils de 10, 20 et 50 salariés : impact sur la taille des entreprises françaises

G2010/06 R. AEBERHARDT - J. POUGET
National Origin Differences in Wages and Hierarchical Positions - Evidence on French Full-Time Male Workers from a matched Employer-Employee Dataset

G2010/07 S. BLASCO - P. GIVORD
Les trajectoires professionnelles en début de vie active : quel impact des contrats temporaires ?

G2010/08 P. GIVORD
Méthodes économétriques pour l'évaluation de politiques publiques

G2010/09 P.-Y. CABANNES - V. LAPÈGUE - E. POULIQUEN - M. BEFFY - M. GAINI
Quelle croissance de moyen terme après la crise ?

G2010/10 I. BUONO - G. LALANNE
La réaction des entreprises françaises à la baisse des tarifs douaniers étrangers

G2010/11 R. RATHELOT - P. SILLARD
L'apport des méthodes à noyaux pour mesurer la concentration géographique - Application à la concentration des immigrés en France de 1968 à 1999

G2010/12 M. BARATON - M. BEFFY - D. FOUGÈRE
Une évaluation de l'effet de la réforme de 2003 sur les départs en retraite - Le cas des enseignants du second degré public

G2010/13 D. BLANCHET - S. BUFFETEAU - E. CRENNER S. LE MINEZ
Le modèle de microsimulation Destinie 2 : principales caractéristiques et premiers résultats

G2010/14 D. BLANCHET - E. CRENNER
Le bloc retraites du modèle Destinie 2 : guide de l'utilisateur

G2010/15 M. BARLET - L. CRUSSON - S. DUPUCH - F. PUECH
Des services échangés aux services échangeables : une application sur données françaises

G2010/16 M. BEFFY - T. KAMIONKA
Public-private wage gaps: is civil-servant human capital sector-specific?

G2010/17 P.-Y. CABANNES - H. ERKEL-ROUSSE - G. LALANNE - O. MONSO - E. POULIQUEN
Le modèle Mésange réestimé en base 2000
Tome 2 - Version avec volumes à prix chaînés

G2010/18 R. AEBERHARDT - L. DAVEZIES
Conditional Logit with one Binary Covariate: Link between the Static and Dynamic Cases

G2011/01 T. LE BARBANCHON - B. OURLIAC - O. SIMON
Les marchés du travail français et américain face aux chocs conjoncturels des années 1986 à 2007 : une modélisation DSGE

G2011/02 C. MARBOT
Une évaluation de la réduction d'impôt pour l'emploi de salariés à domicile

G2011/03 L. DAVEZIES
Modèles à effets fixes, à effets aléatoires, modèles mixtes ou multi-niveaux : propriétés et mises en œuvre des modélisations de l'hétérogénéité dans le cas de données groupées

G2011/04 M. ROGER - M. WASMER
Heterogeneity matters: labour productivity differentiated by age and skills

G2011/05 J.-C. BRICONGNE - J.-M. FOURNIER V. LAPÈGUE - O. MONSO
De la crise financière à la crise économique
L'impact des perturbations financières de 2007 et 2008 sur la croissance de sept pays industrialisés

G2011/06 P. CHARNOZ - É. COUDIN - M. GAINI
Wage inequalities in France 1976-2004: a quantile regression analysis

G2011/07 M. CLERC - M. GAINI - D. BLANCHET
Recommendations of the Stiglitz-Sen-Fitoussi Report: A few illustrations

G2011/08 M. BACHELET - M. BEFFY - D. BLANCHET
Projeter l'impact des réformes des retraites sur l'activité des 55 ans et plus : une comparaison de trois modèles

G2011/09 C. LOUVOT-RUNAVOT
L'évaluation de l'activité dissimulée des entreprises sur la base des contrôles fiscaux et son insertion dans les comptes nationaux

G2011/10 A. SCHREIBER - A. VICARD
La tertiarisation de l'économie française et le ralentissement de la productivité entre 1978 et 2008

G2011/11 M.-É. CLERC - O. MONSO - E. POULIQUEN
Les inégalités entre générations depuis le baby-boom

G2011/12 C. MARBOT - D. ROY
Évaluation de la transformation de la réduction d'impôt en crédit d'impôt pour l'emploi de salariés à domicile en 2007

G2011/13 P. GIVORD - R. RATHELOT - P. SILLARD
Place-based tax exemptions and displacement effects: An evaluation of the Zones Franches Urbaines program

G2011/14 X. D'HAULTFOEUILLE - P. GIVORD - X. BOUTIN
The Environmental Effect of Green Taxation: the Case of the French "Bonus/Malus"

G2011/15 M. BARLET - M. CLERC - M. GARNEO - V. LAPÈGUE - V. MARCUS
La nouvelle version du modèle MZE, modèle macroéconométrique pour la zone euro

G2011/16 R. AEBERHARDT - I. BUONO - H. FADINGER
Learning, Incomplete Contracts and Export Dynamics: Theory and Evidence form French Firms

G2011/17 C. KERDRAIN - V. LAPÈGUE
Restrictive Fiscal Policies in Europe: What are the Likely Effects?

G2012/01 P. GIVORD - S. QUANTIN - C. TREVIEN
A Long-Term Evaluation of the First Generation of the French Urban Enterprise Zones

G2012/02 N. CECI-RENAUD - V. COTTET
Politique salariale et performance des entreprises

G2012/03 P. FÉVRIER - L. WILNER
Do Consumers Correctly Expect Price Reductions? Testing Dynamic Behavior

G2012/04 M. GAINI - A. LEDUC - A. VICARD
School as a shelter? School leaving-age and the business cycle in France

G2012/05 M. GAINI - A. LEDUC - A. VICARD
A scarred generation? French evidence on young people entering into a tough labour market

G2012/06 P. AUBERT - M. BACHELET
Disparités de montant de pension et redistribution dans le système de retraite français

G2012/07 R. AEBERHARDT - P GIVORD - C. MARBOT
Spillover Effect of the Minimum Wage in France: An Unconditional Quantile Regression Approach

G2012/08 A. EIDELMAN - F. LANGUMIER - A. VICARD
Prélèvements obligatoires reposant sur les ménages : des canaux redistributifs différents en 1990 et 2010

G2012/09 O. BARGAIN - A. VICARD
Le RMI et son successeur le RSA découragent-ils certains jeunes de travailler ? Une analyse sur les jeunes autour de 25 ans

G2012/10 C. MARBOT - D. ROY
Projections du coût de l'APA et des caractéristiques de ses bénéficiaires à l'horizon 2040 à l'aide du modèle Destinie

G2012/11 A. MAUROUX
Le crédit d'impôt dédié au développement durable : une évaluation économétrique

G2012/12 V. COTTET - S. QUANTIN - V. RÉGNIER
Coût du travail et allègements de charges : une estimation au niveau établissement de 1996 à 2008

G2012/13 X. D'HAULTFOEUILLE - P. FÉVRIER - L. WILNER
Demand Estimation in the Presence of Revenue Management

G2012/14 D. BLANCHET - S. LE MINEZ
Joint macro/micro evaluations of accrued-to-date pension liabilities: an application to French reforms

G2013/01-F1301 T. DEROYON - A. MONTAUT - P-A PIONNIER
Utilisation rétrospective de l'enquête Emploi à une fréquence mensuelle : apport d'une modélisation espace-état

G2013/02-F1302 C. TREVIEN
Habiter en HLM : quel avantage monétaire et quel impact sur les conditions de logement ?

G2013/03 A. POISSONNIER
Temporal disaggregation of stock variables - The Chow-Lin method extended to dynamic models

G2013/04 P. GIVORD - C. MARBOT
Does the cost of child care affect female labor market participation? An evaluation of a French reform of childcare subsidies

G2013/05 G. LAME - M. LEQUIEN - P.-A. PIONNIER
Interpretation and limits of sustainability tests in public finance

G2013/06 C. BELLEGO - V. DORTET-BERNADET
La participation aux pôles de compétitivité : quelle incidence sur les dépenses de R&D et l'activité des PME et ETI ?

G2013/07 P.-Y. CABANNES - A. MONTAUT - P.-A. PIONNIER
Évaluer la productivité globale des facteurs en France : l'apport d'une mesure de la qualité du capital et du travail

G2013/08 R. AEBERHARDT - C. MARBOT
Evolution of Instability on the French Labour Market During the Last Thirty Years

G2013/09 J-B. BERNARD - G. CLÉAUD
Oil price: the nature of the shocks and the impact on the French economy

G2013/10 G. LAME
Was there a « Greenspan Conundrum » in the Euro area?

G2013/11 P. CHONÉ - F. EVAIN - L. WILNER - E. YILMAZ
Introducing activity-based payment in the hospital industry : Evidence from French data

G2013/12 C. GRISLAIN-LETRÉMY
Natural Disasters: Exposure and Underinsurance

G2013/13 P.-Y. CABANNES - V. COTTET - Y. DUBOIS - C. LELARGE - M. SICSIC
French Firms in the Face of the 2008/2009 Crisis

G2013/14 A. POISSONNIER - D. ROY
Households Satellite Account for France in 2010. Methodological issues on the assessment of domestic production

G2013/15 G. CLÉAUD - M. LEMOINE - P.-A. PIONNIER
Which size and evolution of the government expenditure multiplier in France (1980-2010)?

G2014/01 M. BACHELET - A. LEDUC - A. MARINO
Les biographies du modèle Destinie II : rebasage et projection

G2014/02 B. GARBINTI
L'achat de la résidence principale et la création d'entreprises sont-ils favorisés par les donations et héritages ?

G2014/03 N. CECI-RENAUD - P. CHARNOZ - M. GAINI
Évolution de la volatilité des revenus salariaux du secteur privé en France depuis 1968

G2014/04 P. AUBERT
Modalités d'application des réformes des retraites et prévisibilité du montant de pension

G2014/05 C. GRISLAIN-LETRÉMY - A. KATOSSKY
The Impact of Hazardous Industrial Facilities on Housing Prices: A Comparison of Parametric and Semiparametric Hedonic Price Models

G2014//06 J.-M. DAUSSIN-BENICHOU - A. MAUROUX
Turning the heat up. How sensitive are households to fiscal incentives on energy efficiency investments?

G2014/07 C. LABONNE - G. LAMÉ
Credit Growth and Capital Requirements: Binding or Not?

G2014/08 C. GRISLAIN-LETRÉMY et C. TREVIEN
The Impact of Housing Subsidies on the Rental Sector: the French Example

G2014/09 M. LEQUIEN et A. MONTAUT
Croissance potentielle en France et en zone euro : un tour d'horizon des méthodes d'estimation

G2014/10 B. GARBINTI - P. LAMARCHE
Les hauts revenus épargnent-ils davantage ?

G2014/11 D. AUDENAERT - J. BARDAJI - R. LARDEUX - M. ORAND - M. SICSIC
Wage Resilience in France since the Great Recession

G2014/12 F. ARNAUD - J. BOUSSARD - A. POISSONNIER - H. SOUAL
Computing additive contributions to growth and other issues for chain-linked quarterly aggregates

G2014/13 H. FRAISSE - F. KRAMARZ - C. PROST
Labor Disputes and Job Flows

G2014/14 P. GIVORD - C. GRISLAIN-LETRÉMY - H. NAEGELE
How does fuel taxation impact new car purchases? An evaluation using French consumer-level dataset

G2014/15 P. AUBERT - S. RABATÉ
Durée passée en carrière et durée de vie en retraite : quel partage des gains d'espérance de vie ?

G2015/01 A. POISSONNIER
The walking dead Euler equation
Addressing a challenge to monetary policy models

G2015/02 Y. DUBOIS - A. MARINO
Indicateurs de rendement du système de retraite français

G2015/03 T. MAYER - C. TREVIEN
The impacts of Urban Public Transportation: Evidence from the Paris Region

G2015/04 S.T. LY - A. RIEGERT
Measuring Social Environment Mobility

G2015/05 M. A. BEN HALIMA - V. HYAFIL-SOLELHAC
M. KOUBI - C. REGAERT
Quel est l'impact du système d'indemnisation maladie sur la durée des arrêts de travail pour maladie ?

G2015/06 Y. DUBOIS - A. MARINO
Disparités de rendement du système de retraite dans le secteur privé : approches intergénérationnelle et intragénérationnelle

G2015/07 B. CAMPAGNE - V. ALHENC-GELAS - J.-B. BERNARD
No evidence of financial accelerator in France

G2015/08 Q. LAFFÉTER - M. PAK
Élasticités des recettes fiscales au cycle économique : étude de trois impôts sur la période 1979-2013 en France

G2015/09 J.-M. DAUSSIN-BENICHOU, S. IDMACHICHE, A. LEDUC et E. POULIQUEN
Les déterminants de l'attractivité de la fonction publique de l'État

G2015/10 P. AUBERT
La modulation du montant de pension selon la durée de carrière et l'âge de la retraite : quelles disparités entre assurés ?

G2015/11 V. DORTET-BERNADET - M. SICSIC
Effet des aides publiques sur l'emploi en R&D dans les petites entreprises

G2015/12 S. GEORGES-KOT
Annual and lifetime incidence of the value-added tax in France

G2015/13 M. POULHÈS
Are Enterprise Zones Benefits Capitalized into Commercial Property Values? The French Case

G2015/14 J.-B. BERNARD - Q. LAFFÉTER
Effet de l'activité et des prix sur le revenu salarial des différentes catégories socioprofessionnelles

G2015/15 C. GEAY - M. KOUBI - G de LAGASNERIE
Projections des dépenses de soins de ville, construction d'un module pour Destinie

G2015/16 J. BARDAJI - J.-C. BRICONGNE - B. CAMPAGNE - G. GAULIER
Compared performances of French companies on the domestic and foreign markets

G2015/17 C. BELLÉGO - R. DE NIJS
The redistributive effect of online piracy on the box office performance of American movies in foreign markets

G2015/18 J.-B. BERNARD - L. BERTHET
French households financial wealth: which changes in 20 years?

G2015/19 M. POULHÈS
Fenêtre sur Cour ou *Chambre avec Vue* ?
Les prix hédoniques de l'immobilier parisien

G2016/01 B. GARBINTI - S. GEORGES-KOT
Time to smell the roses? Risk aversion, the timing of inheritance receipt, and retirement

G2016/02 P. CHARNOZ - C. LELARGE - C. TREVIEN
Communication Costs and the Internal Organization of Multi-Plant Businesses: Evidence from the Impact of the French High-Speed Rail

G2016/03 C. BONNET - B. GARBINTI - A. SOLAZ
Gender Inequality after Divorce: The Flip Side of Marital Specialization - Evidence from a French Administrative Database

G2016/04 D. BLANCHET - E. CAROLI - C. PROST - M. ROGER
Health capacity to work at older ages in France

G2016/05 B. CAMPAGNE - A. POISSONNIER
MELEZE: A DSGE model for France within the Euro Area

G2016/06 B. CAMPAGNE - A. POISSONNIER
Laffer curves and fiscal multipliers: lessons from Mélèze model

G2016/07 B. CAMPAGNE - A. POISSONNIER
Structural reforms in DSGE models: a case for sensitivity analyses

G2016/08 Y. DUBOIS et M. KOUBI
Relèvement de l'âge de départ à la retraite : quel impact sur l'activité des séniors de la réforme des retraites de 2010 ?

G2016/09 A. NAOUAS - M. ORAND - I. SLIMANI HOUTI
Les entreprises employant des salariés au Smic : quelles caractéristiques et quelle rentabilité ?

G2016/10 T. BLANCHET - Y. DUBOIS - A. MARINO - M. ROGER
Patrimoine privé et retraite en France

G2016/11 M. PAK - A. POISSONNIER
Accounting for technology, trade and final consumption in employment: an Input-Output decomposition

G2017/01 D. FOUGÈRE - E. GAUTIER - S. ROUX
Understanding Wage Floor Setting in Industry-Level Agreements: Evidence from France

G2017/02 Y. DUBOIS - M. KOUBI
Règles d'indexation des pensions et sensibilité des dépenses de retraites à la croissance économique et aux chocs démographiques

G2017/03 A. CAZENAVE-LACROUTZ - F. GODET
L'espérance de vie en retraite sans incapacité sévère des générations nées entre 1960 et 1990 : une projection à partir du modèle Destinie

G2017/04 J. BARDAJI - B. CAMPAGNE - M.-B. KHDER - Q. LAFFÉTER - O. SIMON (Insee)
A.-S. DUFERNEZ - C. ELEZAAR - P. LEBLANC - E. MASSON - H. PARTOUCHE (DG-Trésor)
Le modèle macroéconométrique Mésange : réestimation et nouveautés

G2017/05 J. BOUSSARD - B. CAMPAGNE
Fiscal Policy Coordination in a Monetary Union at the Zero-Lower-Bound

G2017/06 A. CAZENAVE-LACROUTZ - A. GODZINSKI
Effects of the one-day waiting period for sick leave on health-related absences in the French central civil service

G2017/07 P. CHARNOZ - M. ORAND
Qualification, progrès technique et marchés du travail locaux en France, 1990-2011

G2017/08 K. MILIN
Modélisation de l'inflation en France par une approche macrosectorielle

G2017/09 C.-M. CHEVALIER - R. LARDEUX
Homeownership and labor market outcomes: disentangling externality and composition effects

G2017/10 P. BEAUMONT
Time is Money: Cash-Flow Risk and Export Market Behavior

G2018/01 S. ROUX - F. SAVIGNAC
SMEs' financing: Divergence across Euro area countries?

G2018/02 C.-M. CHEVALIER - A. LUCIANI
Computerization, labor productivity and employment: impacts across industries vary with technological level

G2018/03 R.MONIN - M. SUAREZ CASTILLO
L'effet du CICE sur les prix : une double analyse sur données sectorielles et individuelles

G2018/04 R. LARDEUX
Who Understands The French Income Tax? Bunching Where Tax Liabilities Start

G2018/05 C.-M. CHEVALIER
Financial constraints of innovative firms and sectoral growth