From Flexibility to Insecurity: How Vertical Separation Amplifies Firm Level Uncertainty*

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Abstract

This paper presents a model where firms may endogenously externalize part of their production process. We start from the premise that adaptation to uncertainty cannot be contracted upon in the worker - employer relationship. Vertical separation then balances flexibility gains against hold-up costs of opportunistic behavior by outside contractors. In equilibrium, the degree of outsourcing is shown to depend on the degree of product market competition, contractor's bargaining power, and the volatility of demand shocks. Our main result is that an increase in the degree of outsourcing amplifies the volatility of firm sales and employment; it does not, however, amplify aggregate uncertainty. This theory is therefore a good candidate in explaining the rise in firm level uncertainty witnessed in many developed countries over the past 30 years. It also provides valuable insights on the relation between globalization, IT diffusion and competition on the one hand, and firm level uncertainty and job instability on the other. Finally, we bring our theory's implications to the test. Evidence from firm level data is shown to be largely consistent with the main implications of our theory.

1 Introduction

It is a common view among practitioners of the firm that vertical separation improves corporate flexibility. Because outside suppliers are given stronger incentives to adapt, vertical separation allows to follow demand shifts more closely. This paper starts from such premises, to assess the determinants of vertical separation and its links with firm level uncertainty. The main result of our theoretical and empirical investigations is that vertical separation amplifies demand shocks by increasing the firm-level volatility of sales and employment.

[figure 1 here]

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An emerging literature documents the recent rise in the uncertainty of corporate environment within industrialized economies (Comin [2000], Chaney, Gabaix and Philippon [2002]). Three stylized facts have been established: 1/ there are signs that firm level labor demand fluctuates nowadays more than in the past[1]; 2/ Firm-level volatility of sales and cash-flows has increased (see figure for evidence on US firms)[2]; 3/ This rise in uncertainty is not driven by larger aggregate shocks[3] but rather by what seems to be larger idiosyncratic shocks[4]. Our theory proposes a common explanation for all these facts: the trend toward "externalization", "fragmentation" or "outsourcing" of production processes.[5] As a consequence, our theory also suggests how trade openness, by making vertical separation easier, may have indirectly increased the degree of firm level uncertainty. In addition our theory may provide an explanation of how increased product market competition, or diffusion of IT , by promoting vertical separation, may also have contributed to the rise in firm level uncertainty.

Our view of vertical separation rests on two core assumptions. The first one is that firms face demand shocks which require adaptation efforts from the workforce. The second one is that these shocks are, at least partially, non contractible upon. It is therefore difficult for firms to enforce the ex-post efficient level of efforts from their workers. By reliquishing ownership of intermediate inputs to subcontractors, firms make these workers credible residual claimants on joint output, and provide them with the proper incentives to adapt. In sum, vertical separation increases flexibility as it enables firms to switch from ex-ante to ex-post production decisions. However, the bilateral nature of the subcontractor-final producer relation gives rise to a hold up problem (Grossman and Hart [1986]). In our model, firms therefore trade off the benefits of flexibility against its costs in term of opportunism.

[1]There has been an increase in the short run volatility of labor earnings (Gottschalk and Moffit [1994]) and some authors have documented an increase in job turnover, at least for some skill groups in the US (Neumark [2000]), and for all kinds of workers in France (Givord and Maurin [2001]). Consistently with this, workers now perceive their positions as more insecure than ever (OECD [1997]).

[2]Campbell et al [2001] documents an increase in stock returns volatility over the past four decades, which they interpret as a rising volatility in firm-level cash flows. Chaney et al. [2002] confirm this evidence by looking at firm-level data using Compustat: They show that standard deviations of sales and employment growth rates at the firm level have simultaneously increased during the last 3 decades, even after controlling for entry and size effects

[3]Several recent empirical studies even show that there has been a decline in the aggregate volatility in the US since the mid-80s (for example see Stock and Watson [2002])

[4]A striking illustration of this fact is provided by Campbell and al. [2001], who decompose the volatility of stocks return in three parts: a market, an industry, and a firm specific component. Their analysis shows that the increase in stocks returns volatility they witness is fully accounted for by the changes in the last component. To explain this, they end up exploring various hypotheses: a rise in idiosyncratic uncertainty of firm level cash flows seems the most plausible.

With respect to labor market evidence, Gottshalk and Moffit [1994] conclude their analysis by stating that most of the increase in transitory variance of earnings appears to have incurred at the individual level and cannot be linked to any macroeconomic or industry-level changes. More broadly, the literature on US wage inequality documents that a large share (some two thirds) of the recent spread of the wage distribution is accounted for by the so-called "within-group" part (see e.g. June et al [1993]). In other words, wage inequality has risen, even among very similar workers.

[5]This trend has been widely documented in the international trade literature (Feenstra [1998] for example).

The equilibrium level of vertical separation is shown to depend on the degree of product market competition, final demand uncertainty, and contractor opportunism. Competition matters because, when final demand becomes very sensitive to the price policy of the firm, any ex-post productive inefficiency is very costly: Competition therefore exacerbates the desire for flexibility and vertical separation.

In turn, the degree of vertical separation is shown to amplify firm level uncertainty. The intuition is that both parts of the production process are to some extent complement, such that increased flexibility on the subcontractor's side has to be matched with a similar increase on the other (ie. in house production).[6] In addition, an interesting side product of the model is the positive relation between product market competition and firm level uncertainty. Competition promotes vertical separation, which in turn amplifies uncertainty. Without vertical separation, the model would predict the opposite relation.

We then ask whether our theory of outsourcing also predicts amplification of aggregate uncertainty. We thus embed our microeconomic theory in a simple general equilibrium model. First, we show that aggregate shocks are not a motive for outsourcing: since aggregate shocks cause comovements in the price of intermediate inputs, the flexibility gain of outsourcing is fully counteracted by the equilibrium swings in tensions on the input market. Second, we show aggregate shocks to the economy are *not* amplified by the degree of vertical separation - only idiosyncratic shocks are. Hence, our theory is a good candidate to explain the parallel increase in outsourcing and firm level uncertainty, *while* aggregate uncertainty remains more or less constant.

As it turns out, our model has opposite predictions to Carlton [1979]'s model of the relation between outsourcing and firm level uncertainty; in his model, firms want to secure steady supply of inputs when the upstream market is subject to uncertainty. Hence, vertical integration reduces firm level uncertainty, while we predict, albeit for different reasons, the contrary. We thus bring our model to the data. We find a robust positive correlation between various measure of uncertainty and our measure of vertical separation. In line with our result about amplification, we also show that firms adapt more their sales to industry-wide demand shocks when they outsource a larger part of their production process with respect to the industry average. Such evidence is robust to various estimation techniques, and extends to measures of labor demand.[7]

[6] The intuition closest to ours can be found in early work by Hartman [1976], who looks at the relation between the firm's ability to adapt to shocks and the degree of substitutability between labor - the adjustable input - and capital, the fixed input.

[7] This evidence is consistent with recent results of Mulhainathan and Scharfstein [2001] from the chemical industry. They find that non integrated firms tend to have production capacity that is more sensitive to demand shocks, though they interprete this piece of evidence differently.

This paper builds on two distinct research paths. First we build on Grossman and Hart [1986] to model the subcontractor - client relationship. But our emphasis on flexibility and adaptation takes us closer to a somewhat older literature on outside contracting, starting with Arrow [1975], and Carlton [1979]. This literature's concern however is more on uncertainty in the upstream part of the production process, rather than in final demand volatility. Closest to our microeconomic model is a recent paper by Matouschek and Ramezzana [2002], who study the relation between vertical integration and market frictions. Albeit for different reasons, we share the same causal relation from uncertainty to vertical separation, but our theory has the additionnal implication that vertical separation has itself an impact on uncertainty. Given our macroeconomic approach, our model may also be related to various contributions that tried to investigate the macroeconomic consequences of vertical separation. Just as we do, Grossman and Helpman [2001,2002] provide a general equilibrium framework with endogenous vertical separation to understand the relation between vertical separation, the extent of competition and trade barriers. Their models rest upon very different microeconomic foundations for the choice of vertical separation, as they do not look at the relation between vertical separation and uncertainty, which is focus of the present paper. Closer to this issue, following intuitions of Means [1932], Basu [1995] proposed a model where firms are clients of each other for their intermediate inputs. With fixed prices of intermediate inputs, macroeconomic shocks are propagated and amplified to all firms through these vertical separation relations. However in Basu's model vertical separation is fully exogenous, and the analysis focuses on aggregate fluctuations rather than firm level one.

Secondly, this paper contributes to the growing debate on the causes and consequences of the rise in corporate uncertainty. This research builds on intuitions expressed two decades ago by Piore and Sabel [1984]. Increased product market uncertainty has compelled firms to reorganize and to adopt more flexible production technologies. Comìn [2000] investigates the consequences of this evolution on the productivity slowdown, while Thesmar and Thoenig [2000], Mobius [2000] and Aghion et al. [2001] emphasize both product and labor market issues. Compared to these contributions, the twin novelty of our paper is both to highlight the key role of vertical separation and to provide plausible foundations for the rise in uncertainty. Our theory also has interesting implications on international trade. In this vein, a related contribution is Rodrik [1997,1998]'s analysis of the relation between globalization and volatility. Rodrik's concern, however, is on focused the political economy of globalization, while the way globalization increases uncertainty is left not modelled. We believe nonetheless that our theory usefully allows to confirm some of his intuitions.

The roadmap of this paper is fairly simple. The next section highlights the key features of the model. Section III exhibits the most important predictions of our theory. Section IV brings the results to the test, using French firm level data over the 1984-1999 period. Section V concludes and provides leads for further research.

2 The Baseline Story

This section lays out the theoretical framework on this paper in two stages. First, we look at the microeconomic mechanism we focus on, that is, the relation between volatility and vertical separation. We show that uncertainty promotes vertical separation. In this partial model, we also show that vertical integration in turn ampilifies uncertainty.

In a second stage, we introduce two sources of uncertainty: microeconomic and macroeconomic. We ask whether outsourcing amplifies differentially macro- and microeconomic uncertainty. To properly answer this question, we embed the microeconomic model into a simple general equilibrium framework. As it turns out, macroeconomic uncertainty is less amplified by vertical separation than micro shocks: in fact, in the model we look at, macro uncertainty is *not amplified at all.*

2.1 Set-Up

We start by looking at a single firm managed by its owner. Production of y units of output is assumed to need two types of inputs: l units of labor and one productive asset of quality q. The production possibility frontier is given by a standard Cobb Douglas production function:

$$y = q^{\alpha} l^{1-\alpha} \tag{1}$$

The *entrepreneur*'s job consists in combining the asset and the laborforce. The production of the asset q has however to be delegated to another worker, which we call the *manager*. It is convenient to view the production as having two stages. First, the manager produces the asset and chooses its quality q. The manager has to bear privately the costs $C(q)$ of achieving a quality level q. Secondly, the entrepreneur hires l units of labor and combines them with the asset to produce y. It is convenient to think of this asset as the combination of a tangible (easily observable) capital good and non tangible (less easily observable) managerial decisions such as team management, market adaptation, reactivity, initiative in product design etc.

This entrepreneur's firm is a monopolist facing an uncertain demand curve:

$$p \equiv \widetilde{T}^{\frac{1}{\sigma}}.y^{-\frac{1}{\sigma}} \tag{2}$$

were y is the quantity of output sold and $\widetilde{T}$ is a random variable of mean T and variance σ_T^2. $\sigma > 1$ is the price elasticity of demand. This demand function can, for example, be derived from Dixit Stiglitz preferences as in the next section.

Under uncertainty, the first best level of output, $\tilde{y}^*$, and quality level, $\tilde{q}^*$, depend on $\widetilde{T}$. It could be achieved through writing, before the revelation of uncertainty a contract specifying a payment to the manager contingent on (1) the level of quality q delivered and (2) the demand shock $\widetilde{T}$. Another solution would be to sign the contract contingent on q only, but after the shock $\widetilde{T}$ is revealed. We rule out these possibilities by assuming contractual incompleteness in a fashion very similar to Battigalli and Maggi [2002]:

i/ the demand shock $\tilde{T}$ (ie. contingencies), the quality level q (ie. the actions) are observable and verifiable.

ii/ contracts are signed *ex-ante* (before information disclosure) and there is no renegotiation.[8]

iii/ there are costs of describing contingencies and quality levels when writing down the contract.

For the sake of simplicity we restrict the set of contracts to the two polar forms highlighted by Battigalli and Maggi [2002]: a rigid contract $(\bar{q}, W)$ specifies the level of quality $\bar{q}$ and the associated payment and a discrete contract $(\emptyset, W)$ does not specify the quality.

Aside from contracting decisions, the entrepreneur chooses the degree of vertical integration of his firm. We take here a standard property rights approach to vertical integration (Grossman Hart [1986]). Under vertical integration, the entrepreneur owns the asset q which is produced by the manager at a linear cost $C^{in}(q) = c.q$. Under separation the manager owns the asset which gives him ex-post bargaining power when he brings his productive assets to the entrepreneur for production. However the manager faces an extra cost of coordination (or transportation) such that the production of the asset costs him $C^{sep}(q) = \gamma.c.q$ with $\gamma > 1$. This last assumption is *ad hoc* and will serve only for comparative statics.

The timing of actions is the following:

- *0/ Ownership structure and contracting issue:*

  -the entrepreneur chooses the ownership structure. In case of separation she auctions the license to supply to an infinity of potential managers: this ensures that the winner of the auction pays her the expected profits of producing and selling the productive asset.

  -the entrepreneur signs either a discrete or a rigid contract with the manager.

- *1/ Information*: the demand shock $\widetilde{T}$ is revealed to both parties.

- *2/ Production of the asset:* the manager produces the quality level q and brings it to the

[8] A justification for this would be that production has to take place very soon after the shock is revealed, and that writing a contract is very time consuming.

manager. The payment to the manager depends on (a) the contract signed ex ante and (b) possible bargaining if the manager owns the asset.

- *3/ Production of the good:* the entrepreneur uses the asset, hires labor and produces. The firm's profit with respect to demand shock and asset quality is given by

$$\pi\left(q,\widetilde{T}\right) = \max_{l}\left[\widetilde{T}^{\frac{1}{\sigma}}.\left(q^{\alpha}l^{1-\alpha}\right)^{1-\frac{1}{\sigma}} - wl\right] \tag{3}$$

$$= \frac{1}{\sigma\varepsilon}.\widetilde{T}^{\varepsilon}.q^{1-\varepsilon}.\left(\frac{(\sigma-1)(1-\alpha)}{\sigma w}\right)^{\sigma\varepsilon-1} \tag{4}$$

where w is labor's price and $\varepsilon = \frac{1}{1+\alpha(\sigma-1)} < 1$.

In the following, we study the unconstrained first best solution to provide a benchmark. We then look at the four organizational structures: integration under discrete/rigid contract and separation under discrete/rigid contract.

2.1.1 Unconstrained First Best

The unconstrained first-best corresponds to the case where an ex ante complete contract contingent on q and $\widetilde{T}$ can be written, or when contracts contingent on q *can* be signed after the realisation of $\widetilde{T}$. In this case, integration is always chosen because of the additional costs γ of coordination under vertical separation. Hence, the first best level of quality is given by maximising entrepreneur's surplus $\pi(\tilde{q}^*,\widetilde{T}) - \tilde{W}^*$ under manager's participation constraint $\tilde{W}^* - c.\tilde{q}^* \geq 0$. This is equivalent to maximizing total surplus:

$$\Pi^{\mathrm{FB}} = E\left\{\max_{q}\left[\pi\left(q,\widetilde{T}\right) - c.q\right]\right\} \tag{5}$$

one sees easily that, in this unconstrained case:

$$\widetilde{q}^{\mathrm{FB}} = \left(\frac{\alpha}{c}\right).\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.\left(\left(\frac{\alpha}{c}\right)^{\alpha}.\left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1}.\widetilde{T} \tag{6}$$

$$\Pi^{\mathrm{FB}} = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}.\left(\left(\frac{\alpha}{c}\right)^{\alpha}.\left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1}.E\left(\widetilde{T}\right) \tag{7}$$

so that optimal quality is an incresing function of the shock as both shock $\widetilde{T}$ and q are complements in π. The elasticity with respect to the shock $\widetilde{T}$ is 1: there is full adaptation.

2.1.2 The Case of Integration

Under integration the entrepreneur owns the asset. Assume first that the entrepreneur and manager write a discrete contract specifying a non contigent payment W to be made to the manager in case of production of the asset but where the quality is not written. In this case, once in period 2, the manager gets W whatever the level of quality: thus she chooses the lowest possible quality level $q = 0$. The entrepreneur cannot produce at all and gets zero surplus. Hence *under integration a discrete contract cannot sustain the production of an asset with non zero quality.*

Under a rigid contract $\left(\bar{q}, \bar{W}\right)$, the payment $\bar{W}$ is made only if an asset of quality $\overline{q}$ is delivered. When such a contract is signed in period 0, entrepreneur's expected payoffs and manager's participation constraint are given by $E\pi(\bar{q}, \widetilde{T}) - \bar{W}$ and $\bar{W} - c.\bar{q} \geq 0$. Given this, the entrepreneur chooses the level of quality that maximises the expected surplus:

$$\Pi^{\text{IN}} = \max_{q} E\left[\pi\left(\bar{q}, \widetilde{T}\right) - c.\bar{q}\right] \tag{8}$$

which gives the quality level and expected profit under integration:

$$\overline{q} = \left(\frac{\alpha}{c}\right) \cdot \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \cdot \left(\left(\frac{\alpha}{c}\right)^{\alpha} \cdot \left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1} \cdot \left[E\left(\widetilde{T}^{\varepsilon}\right)\right]^{\frac{1}{\varepsilon}} \tag{9}$$

$$\Pi^{\text{IN}} = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}} . \left(\left(\frac{\alpha}{c}\right)^{\alpha} \cdot \left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1} \cdot \left[E\left(\widetilde{T}^{\varepsilon}\right)\right]^{\frac{1}{\varepsilon}} \tag{10}$$

where $\overline{q}$ is by definition deterministic and fixed in advance. With respect to unconstrained first best, the fit with demand deteriorates and thus profits under (rigid) integration are lower than first best because of this absence of flexibility. The loss of flexibility due to the rigidity of contracts under integration appears in the last term of the profit expression:

$$\frac{\Pi^{\text{IN}}}{\Pi^{\text{FB}}} = \underbrace{\frac{\left[E\left(\widetilde{T}^{\varepsilon}\right)\right]^{\frac{1}{\varepsilon}}}{E\left(\widetilde{T}\right)}}_{\text{flexibility}}$$

which is smaller than 1 by virtue of Jensen's inequality. For the same reason, $\overline{q}$ is smaller than the average of $\widetilde{q}^{\text{FB}}$, the fully adapted quality.

2.1.3 The Case of Separation

Under separation the manager owns the asset. This potentially gives him ex-post bargaining power but at the cost of an extra cost of coordination γcq. We start with discrete contracts.

Consider first the case of a discrete contract specifying a payment W but not the quality. In period 2 the manager faces an alternative. (1) he decides to stick with the contract. In this case, he makes no effort, quality is zero and he gets W (2) the manager decides to produce a quality level $q > 0$. Since he owns the asset q, he may threaten the entrepreneur not to deliver anything. If this happens, we assume both parties get zero utility. Hence, both parties bargain over the cooperation surplus $\pi(q;\widetilde{T})$ and get respectively a share φ and $1-\varphi$ of it. All in all in period 2, the manager makes a positive effort if and only if $\varphi\pi(q;\widetilde{T}) - cq > W$. By setting initially $W > 0$, the entrepreneur thus reduces manager's incentives to nil when the demand shock is low and thus loses $(1-\varphi)\,\pi(q;\widetilde{T})$. As a consequence the optimal discrete contract under separation specifies $W = 0$.

Hence, under vertical separation the manager manages to get ex post a fraction φ of the overall surplus $\pi\left(q,\widetilde{T}\right)$. He therefore chooses, once uncertainty is revealed, the quality level q^{OUT} that solves the following maximum problem:

$$\max_{q}\left(\varphi\pi(q;\widetilde{T}) - \gamma cq\right)$$

Hence, the level of quality q^{OUT} is given by:

$$\widetilde{q}^{\text{OUT}} = \left(\frac{\varphi\alpha}{\gamma c}\right).\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.\left(\left(\frac{\varphi\alpha}{\gamma c}\right)^{\alpha}.\left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1}.\widetilde{T} \tag{11}$$

Now $\widetilde{q}^{\text{OUT}}$ covaries with the shock $\widetilde{T}$, with exactly the same elasticity than in the first best case: the adaptation goal is fulfilled. The problem is however that $\widetilde{q}^{\text{OUT}}$ is always smaller than $\widetilde{q}^{\text{FB}}$ by a factor $(\gamma/\varphi)^{1/\varepsilon}$. It represents two effects (1) compared to the first best, the manager under separation faces increased production costs because of lack of coordination - our *ad hoc* hypothesis - and (2) compared to first best, the manager only reaps a fraction φ of the overall profits and hence produces a lower quality level.

At date 0 the entrepreneur sells the production license to the manager at a price equal to the future profit $\varphi.E\left[\pi\left(q^{\text{OUT}};\widetilde{T}\right)\right] - c\gamma q^{\text{OUT}}$. This allows to compute the overall profit for the entrepreneur which is therefore the sum of his own expected profit $(1-\varphi)\,E\pi\left(q^{\text{OUT}};\widetilde{T}\right)$ and the expected profit of the manager $\varphi.E\left[\pi\left(q^{\text{OUT}};\widetilde{T}\right) - c\gamma q^{\text{OUT}}\right]$. Given the above expression of q^{OUT}, we get:

$$\Pi^{\text{OUT}} = \left(1+(1-\varphi)\,\alpha\,(\sigma-1)\right).\frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}.\left(\left(\frac{\varphi\alpha}{\gamma c}\right)^{\alpha}.\left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1}.E\left(\widetilde{T}\right)$$

The ratio of Π^{OUT} to Π^{FB} highlights the two costs of outsourcing:

$$\frac{\Pi^{\text{OUT}}}{\Pi^{\text{FB}}} = \underbrace{\left(1+(1-\varphi)\,\alpha\,(\sigma-1)\right).\varphi^{\alpha(\sigma-1)}}_{\text{hold up}}.\underbrace{\left(\frac{1}{\gamma}\right)^{\alpha(\sigma-1)}}_{\text{coordination}}$$

the first term is smaller than 1. It thus makes Π^{OUT} smaller than Π^{FB}: because he does not internalize the whole gains of increasing quality, the manager produces, on average, a lower quality than the fixed level of quality chosen in a rigid contract. Hence, hold up under vertical separation acts as if it increased unit costs of production. This first term tends toward 1 when φ tends toward 1: in this case, the hold up cost of separation disappears as the manager gets the entire product of his effort q. The second term also makes Π^{OUT} smaller than Π^{FB}. It stems from our *ad hoc* extra cost of vertical separation. We interpret it as summarizing the cost advantages of vertical integration in terms of transport costs or coordination.

From the previous discussion it should be clear that a rigid contract is not an appealing solution under separation. Indeed with such a contract, the manager has no ex-post bargaining power (because the quality and the price of the asset are fixed ex-ante by contract) and still faces the extra-cost of production due to coordination. This situation is similar to the one under integration with rigid contract except that now the total cost of production is larger. Clearly this means that rigid contracts under separation are always dominated by other organizational structures.

2.1.4 The Choice of Ownership structure: Determinants

The ratio of Π^{OUT} to Π^{IN} highlights the two major forces at work in the model (hold up versus flexibility):

$$\frac{\Pi^{\text{OUT}}}{\Pi^{\text{IN}}} = \underbrace{\left(1 + (1-\varphi)\,\alpha\,(\sigma-1)\right).\varphi^{\alpha(\sigma-1)}}_{\text{hold up}} . \underbrace{\left(\frac{1}{\gamma}\right)^{\alpha(\sigma-1)}}_{\text{coordination}} . \underbrace{\frac{E\left(\widetilde{T}\right)}{\left[E\left(\widetilde{T}^{\varepsilon}\right)\right]^{\frac{1}{\varepsilon}}}}_{\text{flexibility}} \tag{12}$$

the first term makes Π^{OUT} smaller than Π^{IN}: with respect to vertical integration, an outside supplier does not internalize the effect of quality on the entrepreneur's profit. This effect, which we label the *hold up effect*, makes average quality under vertical separation smaller than the fixed quality written in the rigid contract. This effect is further reinforced by our ad hoc coordination cost (second term). The third term represents the flexibility gains from outsourcing in this model and makes Π^{OUT} larger than Π^{IN}. Although the average quality level is lower under separation, it is more adapted to demand, which increases average profit. We label this second force the *flexibility effect*.

Our discussion on the *hold up* vs *flexibility* effects has two immediate consequences in terms of comparative statics: first, an increase in uncertainty increases the flexibility gain (term (II) in (12) rises) and therefore pushes the firm toward more vertical separation. The intuition is that uncertainty reduces the average fitness of the quality level $\overline{q}$ to demand and therefore reduces profits under vertical separation. The second important consequence is that an increase in the manager's bargaining power makes separation more likely as it reduces holp up inefficiencies under separation (term (I) in (12) gets larger), but does not affect flexibility.

The following proposition summarizes the predicted direction of the main determinants of vertical integration in this model:

Proposition 1 *The "likelihood" $\overline{\gamma}$ of vertical separation increases with:*

1. *the manager's ex post bargaining power φ*
2. *a mean preserving spread of the demand shock $\tilde{T}$*

The proof of this proposition is straightforward. The first result stems from the fact that the term (I) in (12) is an increasing function of φ. The second result comes from the fact that that $\varepsilon < 1$, such that $\widetilde{T}^{\varepsilon}$ is a concave, increasing function of $\widetilde{T}$. Hence, a mean preserving spread of $\widetilde{T}$ reduces the term (II) in (12).

The use of vertical separation or outsourcing to manage uncertainty is well known to businessmen (for the case of IT departments, see Lacity et al. [1995]). In the new economy, a well known example of this relation is given by the success of Dell in selling and shipping personal computers to its customers (Magretta [1998]). Dell corporation is the entity that coordinates a very tight network of part makers, that are kept very well informed about the quantities ordered and supposed dates of deliveries. Suppliers are not owned by Dell, but the relation that binds them to the PC assembler is tight and cooperative. To some extent, Dell managed, through a lower γ (better coordination with outside suppliers) and a larger φ (a commitment to leave a reasonable part of the surplus to suppliers) to outsource a large part of its production process. The main gain of such an organization, which Mr Dell calls "Virtual Integration", is a reduction in time to market, and therefore a better adaptation to demand changes.

Although some practioners view outsourcing as a way to adapt to uncertainty, it must be noted that the existing theory of outsourcing and uncertainty tend to predict the opposite. Following Chandler [1977]'s account of the history of vertical integration of large US business over the twentieth century, Carlton [1977] proposes a model where vertical integration allows to *reduce* uncertainty in the supply of inputs. Hence, in Carlton's model, a larger level of uncertainty promotes *integration*, not separation. As it turns out, however, Carlton looks at uncertainty in the *upstream* market, while we focus on the *downstream* market. As both may be related, our contribution would be worth little without an empirical test. We propose such a test in our empirical section below.

A last comparative static is competition. In this model, competition is what reduces mark-ups, i.e. price elasticity of demand σ. How does the outsourcing decision react to an increase in competition ?

Unfortunately, σ enters the choice equation (12) both in the holdup costs and in the flexibility gains terms. We thus need to specify the distribution of $\widetilde{T}$ if we want to proceed any further. A natural assumption in this framework is to assume $\widetilde{T}$ lognormal (assuming small shocks yields very similar intuitions). Under that assumption, the gain to outsource writes:

$$\frac{\Pi^{\text{OUT}}}{\Pi^{\text{IN}}}(\gamma) = \underbrace{\left(1+(1-\varphi)\,\alpha\,(\sigma-1)\right).\varphi^{\alpha(\sigma-1)}}_{(\text{I})}.\underbrace{\left(\frac{1}{\gamma}\right)^{\alpha(\sigma-1)}}_{(\text{II})}.\underbrace{e^{\frac{\alpha(\sigma-1)}{1+\alpha(\sigma-1)}\cdot\frac{\Sigma^2}{2}}}_{(\text{III})} \tag{13}$$

Equation (13) points out that competition has an ambiguous effect on outsourcing decisions. On the one hand, unit costs of outsourcing make it less attractive when competition is tougher (terms (I) and (II)), but on the other hand adaptation becomes more critical and outsourcing is more valuable (term (III). More precisely, the first term (I) gathers the hold up costs. It is a decreasing function of σ: as σ increases, the inefficiencies created by suboptimal choices of quality under separation become more and more costly. An increase in competition makes the cost disadvantage of hold up heavier to bear for the firm. Term (II) is also a decreasing function of σ for the similar reasons. As competition increases, the cost disadvantages of bad coordination and high transport costs become larger. Term (III) is an increasing function of σ and is the most interesting effect. This last effect is larger when uncertainty (Σ) is high. As competition increases the need to adapt the supply becomes more and more critical. When σ is very large, consumers just choose the least expansive product and taste for variety does not insulate firms from their competitors anymore. In this case, it becomes critical to be able to choose quantity optimally.

2.1.5 The Choice of Ownership Structure: Consequences

A less obvious consequence of our model is that outsourcing itself increases firm level uncertainty regarding output, labor demand, and profits, while pricing strategy tend to become less senstive to demand. As we will see, these results are not the product of simple size effect, but come from the fact that the *elasticity* of output and profits to demand become higher under vertical separation.

For technological or regulatory reasons - exogenous to the model - γ decreases. The firm goes from integration to vertical separation. How do output, labor demand and prices change ? Recall that under vertical integration:

$$\widetilde{q}^{\text{OUT}} = \left(\frac{\varphi\alpha}{\gamma c}\right).\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.\left(\left(\frac{\varphi\alpha}{\gamma c}\right)^{\alpha}.\left(\frac{1-\alpha}{w}\right)^{1-\alpha}\right)^{\sigma-1}.\widetilde{T}$$

while under vertical separation $\overline{q}$ is deterministic. Labor demand a a function of the level of chosen quality q is deduced from (3):

$$\widetilde{l} = \left(\frac{(\sigma - 1)(1 - \alpha)}{\sigma w} \right)^{\sigma \varepsilon} .q^{1-\varepsilon}.\widetilde{T}^{\varepsilon}$$

Hence:

$$\begin{aligned} var \log \widetilde{l}_{\text{IN}} &= \varepsilon^2.var \log \widetilde{T} \\ var \log \widetilde{l}_{\text{OUT}} &= var \log \widetilde{T} \end{aligned}$$

where $\varepsilon < 1$. Taking out pure level effects, the relative variance of labor demand is thus larger under vertical separation. This result comes from the fact that marginal productivity of labor is an increasing function of the other input - a property that standard production functions have. Given this, the "flexible" regime promotes more variation in labor demand because it exhibits more variation in the other input q.

Under vertical separation, both quality and labor demand fluctuate more; thus overall output also fluctuate more:

$$\begin{aligned} var \log \widetilde{y}_{\text{IN}} &= \varepsilon^2.(1 - \alpha)^2 .var \log \widetilde{T} \\ var \log \widetilde{y}_{\text{OUT}} &= var \log \widetilde{T} \end{aligned}$$

Given the demand curve (2) and the production levels, we get the following variance for prices:

$$\begin{aligned} var \log \widetilde{p}_{\text{IN}} &= \left(\frac{\varepsilon}{\sigma} \right)^2 var \log \widetilde{T} \\ var \log \widetilde{p}_{\text{OUT}} &= 0 \end{aligned}$$

the outsourcing firm can fully adapt its production level to demand and thus always charge the monopoly price, which is here given by $p = \frac{\sigma}{\sigma - 1} C$ where C is the unit production cost - we have a CRS technology. On the contrary, the vertically integrated firm cannot adapt its production fully to the shock. As the demand curve moves up (or down), it cannot increase production by as much as would be possible for an outsourcing firm, because q is fixed. Thus, when demand exceeds the mean, the firm does not increase production enough and the prices goes up (larger than the monopoly mark up). The firm hits its production capacity. Conversely, when demand undershoot its average level, excess production capacity makes it relatively costless to expand production above monopoly level, and the price goes down. Thus prices covary more with demand under vertical integration.

Since prices and quantities react oppositely to demand shocks, it is worthwhile computing overall profit variances:

$$\begin{aligned} var \log \widetilde{\Pi}_{\mathrm{IN}} &= \varepsilon^2 . (1-\alpha)^2 . var \log \widetilde{T} \\ var \log \widetilde{\Pi}_{\mathrm{OUT}} &= var \log \widetilde{T} \end{aligned}$$

as it turns out the quantity effect dominates the price effect: the reason is that the price elasticity of demand is larger than 1. Hence the loss of variability in prices is fully counteracted by increased volatility of quantities.

We summarize these results under the following proposition:

Proposition 2 *Outsourcing ampilifies uncertainty. More precisely, an increase in outsourcing causes, at the firm level:*

1. An increase in the volatility of output, labor demand and cash flows: $var \log \widetilde{y}$, $var \log \widetilde{l}$, $var \log \widetilde{\Pi}$ *are larger when the firm is vertically separated.*

2. A decrease in the volatility of prices: $var \log \widetilde{p}$ *is lower when the firm is vertically separated.*

These effects are not size effects, but come through increased elasticity of these quantities with respect to local uncertainty.

2.2 Aggregate Versus Idiosyncratic Uncertainty

From the previous analysis it should be clear that vertical separation impacts output, cash flow and labor demand volatility. Given the increased reliance in outsourcing in France (see section 3) and in the US (see the discussion on domestic outsourcing in Antras and Helpman [2003]), this theory is a priori a natural candidate to explain the rise in firm volatility documented in the introduction of this paper.

Assume now that the economy is affected both by firm level and economywide uncertainty. We know from the available evidence discussed in introduction that, while idiosyncratic uncertainty seems to have increased (see Campbell et al. [2001] on cash flows, Chaney et al. [2002] on sales and labor demand), aggregate uncertainty has remained stable (Campbell et al. [2001]) or has decreased slightly (Stock and Watson [2002]). So the next step we take consists of looking in our model at the differential impact of outsourcing on aggregate and firm level uncertainty. To account for equilibrium relations at the aggregate level, we need to embed the previous microeconomic framework in a simple general equilibrium model.

2.2.1 The General Equilibrium Model

At the firm level, the situation is similar to the one described in the previous section. To simplify exposition, the production function is now given by (1) with $\alpha = 1$:

$$f(q) = q$$

In addition, in order to produce a quality q, the manager must hire a number q of workers such that it costs him $c(q) = wq$. So the decision for the manager is now between hiring labor ex ante and ex post. Final assembly lines operated by the entrepreneur use no labor.

At the aggregate level, this is a closed and static economy. The product market is broken down into a continuum of varieties $i \in [0, 1]$; each variety is produced by a monopoly (ie. an entrepreneur and a manager) in quantity y_i. Varieties are used to assemble a final good Y such that:

$$Y = [\int_0^1 (\tilde{\tau}_i)^{\frac{1}{\sigma}} y_i^{\frac{\sigma-1}{\sigma}} di]^{\frac{\sigma}{\sigma-1}} \tag{14}$$

where $\sigma > 1$ and $\tilde{\tau}_i > 0$ are technological shocks affecting the marginal productivity of each variety i. Shocks have both a micro and a macro component. For the sake of simplicty we assume that these shocks can be broken down into two terms: an aggregate technological shock $\tilde{A}$ and a variety-specific idiosyncratic technological shock $\tilde{\delta}_i$:

$$\tilde{\tau}_i = \tilde{A}.\tilde{\delta}_i \tag{15}$$

where $cov(\tilde{A},\tilde{\delta}_i) = 0$ and $cov(\tilde{\delta}_i,\tilde{\delta}_j) = 0$ for $i \neq j$.

Each variety i is supplied by a monopoly; because of the final production technology (14), the demand adressed to a monopoly i is given by:

$$\tilde{y}_i = \tilde{\tau}_i.\frac{\widetilde{D}}{\tilde{P}^{1-\sigma}}\tilde{p}_i^{-\sigma} \text{ where the price index is: } \tilde{P} = [\int_0^1 \tilde{\tau}_k.\tilde{p}_k^{1-\sigma} dk]^{1/1-\sigma} \tag{16}$$

where $\widetilde{D}$ stands for the total expenditure dedicated to the purchase of final goods - a priori random; σ is the price elasticity of demand.This demand function is a particular case of the one studied in the previous section (see equation (2)) where the demand shock $\widetilde{T}_i$ is:

$$\widetilde{T}_i \equiv \widetilde{D}.\tilde{\tau}_i.\tilde{P}^{\sigma-1} \tag{17}$$

The demand shock faced by each monopoly has two components: an exogenous shock $\tilde{\tau}_i$ and an aggregate *endogenous* shock $\widetilde{D}.\tilde{P}^{\sigma-1}$. Hence it is important to solve for the macroeconomic equilibrium in order to figure out how the price index impacts the demand shock.

2.2.2 Solving the model

Firm-level analysis At the level of the firm, the problem is slightly different than above because of aggregate uncertainty. Given that aggregate productivity may fluctuate, it may be that $\widetilde{w}$ also does. Formulas computed above therefore do not apply. Look first at the case where the firm is integrated. In this case, the entrepreneur - manager contract is rigid and the manager hires labor before the shock is revealed. To simplify matters as possible, we assume he commits to pay the ex post market clearing wage, such that workers are ex ante indifferent between tying their destiny with a rigid or a flexible manager. In this case, ex ante labor demand solves:

$$\max_q \left(E\left(\widetilde{T}^{\frac{1}{\sigma}}\right)q^{1-\frac{1}{\sigma}} - E\left(\widetilde{w}\right).q\right]$$

Hence, labor demand, optimal price and profit are given by the following equations:

$$\begin{aligned}
\widetilde{l}^{\mathrm{IN}} &= \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.\left(\frac{E\left(\widetilde{T}^{\frac{1}{\sigma}}\right)}{E\left(\widetilde{w}\right)}\right)^{\sigma} \\
\widetilde{p}^{\mathrm{IN}} &= \frac{\sigma}{\sigma-1}.E\widetilde{w}.\left(\frac{\widetilde{T}^{\frac{1}{\sigma}}}{E\left(\widetilde{T}^{\frac{1}{\sigma}}\right)}\right) \\
\Pi^{\mathrm{IN}} &= \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}.\left(\frac{1}{E\left(\widetilde{w}\right)}\right)^{\sigma-1}.E\left(\widetilde{T}^{\frac{1}{\sigma}}\right)^{\sigma}
\end{aligned}$$

labor demand is fixed, while prices have to adjust ex post for the monopoly to be on the demand curve.

Under vertical separation q is now fully flexible and solves:

$$\max_q \left[\varphi\widetilde{T}^{\frac{1}{\sigma}}q^{1-\frac{1}{\sigma}} - \gamma.\widetilde{w}.q\right]$$

which yields the following expressions for labor demand, prices and profits:

$$\begin{aligned}
\widetilde{l}^{\mathrm{OUT}} &= \gamma.\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.\left(\frac{\varphi}{\gamma}\right)^{\sigma}.\frac{\widetilde{T}}{\widetilde{w}^{\sigma}} \\
\widetilde{p}^{\mathrm{OUT}} &= \frac{\sigma}{\sigma-1}.\frac{\varphi}{\gamma}.\widetilde{w} \\
\Pi^{\mathrm{OUT}} &= \left(1+(1-\varphi)(\sigma-1)\right).\frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}.\left(\frac{\varphi}{\gamma}\right)^{\sigma-1}.E\left(\frac{\widetilde{T}}{\widetilde{w}^{\sigma-1}}\right)
\end{aligned}$$

Hence, a firm chooses vertical separation as soon as $\Pi^{\mathrm{IN}} < \Pi^{\mathrm{OUT}}$. This occurs whenever $\gamma < \overline{\gamma}$ defined through:

$$\left(1+(1-\varphi)(\sigma-1)\right).\left(\frac{\varphi}{\overline{\gamma}}\right)^{\sigma-1}.E\left(\frac{\widetilde{T}}{\widetilde{w}^{\sigma-1}}\right) = \left(\frac{1}{E\widetilde{w}}\right)^{\sigma-1}.E\left(\widetilde{T}^{\frac{1}{\sigma}}\right)^{\sigma}$$

given that $\widetilde{T} = \widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}.\widetilde{\delta}$, and that $\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}$ and $\widetilde{\delta}$ are independant processes, this condition rewrites:

$$(1+(1-\varphi)(\sigma-1)).\left(\frac{\varphi}{\overline{\gamma}}\right)^{\sigma-1} = \underbrace{\frac{\left(E\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}}{E\widetilde{\delta}}}_{\text{(I)}}.\underbrace{\left\{\left(E\left(\frac{\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}}{\widetilde{w}^{\sigma-1}}\right)\right]^{-1}.\left(\frac{1}{E\widetilde{w}}\right)^{\sigma-1}.E\left(\left(\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}\right)^{\frac{1}{\sigma}}\right)^{\sigma}\right\}}_{\text{(II)}} \tag{18}$$

the decision to outsource thus depends on idiosyncratic uncertainty, exactly as in the previous section (term (I)). It may now also depend on aggregate uncertainty (new term (II)). We thus need to solve for the general equilibrium, which is going to tell us how $\widetilde{w}$ is related to $\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}$.

Equilibrium Conditions We just need to write down two equilibrium conditions. The first one is the labor market clearing condition; the second one is the equivalent of the final consumer's budget constraint - in this case the aggregate price determination. In these equilibrium conditions, idiosyncratic uncertainty will disappear because of the central limit theorem. Aggregate uncertainty will, however, remain.

Making use of the fact that $\widetilde{T} = \widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}.\widetilde{\delta}$, and that $\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}$ and $\widetilde{\delta}$ are independant processes, the labor market clearing condition writes:

$$L = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma}.\left\{s.\varphi.\left(\frac{\varphi}{\gamma^*}\right)^{\sigma-1}.\frac{\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}}{\widetilde{w}^{\sigma}}.E\widetilde{\delta} + (1-s)\left(\frac{E\left(\left(\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}\right)^{\frac{1}{\sigma}}\right)}{E\left(\widetilde{w}\right)}\right)^{\sigma}.E\left(\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}\right\} \tag{19}$$

where $(\gamma^*)^{1-\sigma} = \int^{\overline{\gamma}} \gamma^{1-\sigma} dG(\gamma)/G(\overline{\gamma})$ is the average cost of coordination across vertically separated firms. $s = G(\overline{\gamma})$ is the fraction of vertically separated firms.

Similarly, the representative consumer's budget constraint writes:

$$\widetilde{D} = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}.\left[s.\left(\frac{\varphi}{\gamma^*}\right)^{\sigma-1}.\frac{\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}}{\widetilde{w}^{\sigma-1}}.E\widetilde{\delta} + (1-s).E\left(\widetilde{w}\right)^{1-\sigma}.\frac{\left(\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}\right)^{\frac{1}{\sigma}}}{E\left(\left(\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}\right)^{\frac{1}{\sigma}}\right)^{1-\sigma}}.E\left(\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}\right] \tag{20}$$

These two conditions should provide us with the two unknown quantities we are interested in: $\widetilde{D}/\widetilde{P}$ the aggregate production and $\widetilde{w}/\widetilde{P}$ the real wage.

2.2.3 Results

We are now in a position to show that this economy has an equilibirum where aggregate uncertainty *does not interact at all* with outsourcing:

Proposition 3 *There exists one equilibrium such that:*

1. Aggregate uncertainty does not *affect the outsourcing decision: s does not depend on the distribution of $\widetilde{A}$.*

2. Idiosyncratic uncertainty is amplified by outsourcing: $var \log \widetilde{y}$, $var \log \widetilde{l}$, $var \log \widetilde{\Pi}$ are larger for vertically separated firms.

3. Aggregate uncertainty is not *amplified by outsourcing: $var \log \frac{\widetilde{D}}{\widetilde{P}}$, $var \log \frac{\widetilde{w}}{\widetilde{P}}$ do not depend on the fraction of outsourced firms.*

The structure of equilibrium equations (19-20) does not allow to compute the equilibirum directly. It is, however, possible to conjecture that there exists an equilibrium such that: $\widetilde{w}^{\sigma} = \lambda(s).\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}$. This conjecture allows to get from (18) the equation that defines the cutoff value of γ below which firms choose vertical separation:

$$(1 + (1-\varphi)(\sigma-1)) . \left(\frac{\varphi}{\overline{\gamma}}\right)^{\sigma-1} = \frac{\left(E\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}}{E\widetilde{\delta}} \tag{21}$$

where it can be seen that s does not depend at all upon aggregate uncertainty (the distribution of $\widetilde{A}$). Hence, outsourcing in this model does not allow at all firms to hedge from aggregate risk. The economic intuition behind this is the following: vertically separated firms compete with each other for labor, within a given pool of workers, which is the total supply L, minus ex ante labor demand from vertically integrated firms. Hence, total labor supply available for those firms is already fixed once the shocks are known. Assume to simplify that there is no idiosyncratic uncertainty. When demand ($\widetilde{A}$) is high, all vertically separated firms ask simultaneously for more labor (in the form of asset quality q). But since the residual labor supply available for these firms is fixed, none of them gets more labor than the others, and the shock $\widetilde{A}$ cannot be accomodated. Hence, because the real wage comoves with aggregate uncertainty $\widetilde{A}$, the gains of flexbility due to outsourcing are completely cancelled out by the ex post scarcity of labor.

We still need to check whether our conjecture $\widetilde{w}^{\sigma} = \lambda(s).\widetilde{A}\widetilde{D}\widetilde{P}^{\sigma-1}$ is compatible with our two equilibrium equations (19-20). Under those circumstances, a little algebra with the two equilibrium conditions shows that:

$$\begin{aligned}\frac{\widetilde{D}}{\widetilde{P}} &= L.\widetilde{A}^{\frac{1}{\sigma-1}}.\left[s.\left(\frac{\varphi}{\gamma^*}\right)^{\sigma-1}.E\widetilde{\delta} + (1-s).E\left(\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}\right)^{\frac{\sigma}{\sigma-1}} \\ &\quad \times \left[s.\varphi.\left(\frac{\varphi}{\gamma^*}\right)^{\sigma-1}.E\widetilde{\delta} + (1-s).E\left(\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}\right)^{-1}\end{aligned} \tag{22}$$

which allows to see directly that the elasticity of $\frac{\widetilde{D}}{P}$ with respect to $\widetilde{A}$ does not depend on s. Hence, the variance of $\log \frac{\widetilde{D}}{P}$ does not depend on s. The intuition is similar to the discussion of the above paragraph: even when vertically integrated firms are more numerous, they still draw labor from a given pool of residual labor supply. When demand is high, all firms try to attract the same additional amount of labor. Wages go up, and firms end up with the same quantity of labor produced as with a low $\widetilde{A}$. Hence, an economy with a larger number of "flexible firms" does not display an increased sensitivity of production to aggregate demand shocks.

Equation (22) however shows that the level of production depends on the diffusion of outsourcing. The reason for this is that a "flexible" economy (with a larger s) allows for a better allocation of labor across firms; those firms who face large idiosyncratic demand get more labor. This does not occur with "rigid" firms. There is, however, a countervailing force: flexibility comes at a cost. Because of hold up inefficiencies and coordination costs, the unit cost of production of a flexible economy is on average higher. All in all, there must be a value s, for which expected production is maximal. We go back to this efficiency related issue in the next paragraph.

2.2.4 Too Little vertical separation?

We know from equation (21) how $\overline{\gamma}$ is defined in equilibrium. Let γ^o the cutoff value of γ that maximises expected output ? From (22), we get, after a few manipulations, that the first order derivative of $\log E\widetilde{Y}$ with respect to γ is proportional to:

$$\begin{aligned}\frac{d\log E\widetilde{Y}}{d\gamma} \sim & \left[\left(\int^{\gamma}\left(\frac{\varphi}{\gamma'}\right)^{\sigma-1}dG(\gamma')\right).E\widetilde{\delta}+\left(\int_{\gamma}dG(\gamma')\right).E\left(\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}\right] \\ & \times\left[(1+(1-\varphi)(\sigma-1)).\left(\frac{\varphi}{\overline{\gamma}}\right)^{\sigma-1}-\frac{\left(E\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}}{E\widetilde{\delta}}\right] \\ & +\sigma(1-\varphi).\left(\int^{\gamma}\left(\frac{\varphi}{\gamma'}\right)^{\sigma-1}dG(\gamma')\right).E\widetilde{\delta}\times\left[\frac{\left(E\widetilde{\delta}^{\frac{1}{\sigma}}\right)^{\sigma}}{E\widetilde{\delta}}-\left(\frac{\varphi}{\overline{\gamma}}\right)^{\sigma-1}\right] \qquad (23)\end{aligned}$$

where we assume that the problem is concave (it is for φ close enough to 1).

When $\varphi = 1$, the second term in (23) is cancelled, and the derivative is therefore zero when the equilibrium condition (21) holds. In the absence of hold up inefficiencies, the equilibrium diffusion of outsourcing is therefore optimal. This result is not really surprising since in this case firms balance the costs and benefits of outsourcing at their own level. Imperfect competition does not introduce further distorsions in the decision. When $\varphi < 1$, the second term becomes positive in equilibrium: equilibrium γ as defined by (21) is too small.

2.3 Discussion

A possible increased reliance of firms on vertical separation is therefore a good candidate to explain the rise in firm level uncertainty documented in the introduction. Indeed the model's main predictions are in line with the following empirical empirical facts: the spread of externalization and outsourcing, the rise in cash flows volatility (as documented by Campbell et al. [2001]), in sales volatility (Chaney et al. [2002]) and in labor returns volatility (Gottshalk and Moffit [1994]) which empirically occured at the firm level (ie. within firm and not between firms) and were driven by idiosyncratic shocks only. Regarding macroeconomic volatility our model predicts that vertical separation, despite the greater ex-post reactivity to demand shocks it provides, has no impact on macro volatility. This is in line with experience of most developed countries.

To be fair, our model does not have any predictions on the idiosyncratic volatility of wages, because workers are free to move from one firm to the other. We believe nonetheless that adding reallocation costs - like search frictions, or firm specific human capital - would yield this kind of prediction[9]. What matters ultimately is that labor demand itself becomes more uncertain: whether this translates in wage or employment variance depends on labor market institutions.

These results allow to rationalize the relation between globalization and insecurity. Antras and Helpman [2003] document the rise in foreign outsourcing For Rodrik [1997], the key to the political economy of globalization is the uncertainty it creates. Accordingly this is one of the reasons why more open economies have larger governments. These larger government provide voters with the safety

[9] For example the model could be modified in the following way. Consider that: (i) workers must acquire some human capital otherwise their market value is zero (ii) this human capital is specific to a particular firm (iii) the human capital investment takes time and must be decided before information disclosure.

The labor market is then broken in as many pieces as there are firms. Assuming firms do not notice that they are monopsonies, all firms hire at period 1 the same amount of workers L. We then get that wages are now firm specific and depend on the ownership structure:

$$\tilde{w}_i^{sep} = \widetilde{\delta}_i.w$$
$$\tilde{w}_i^{sep} = (\widetilde{\delta}_i)^{\varepsilon}.w$$

where w is given by (??).

Hence using our measure of volatility we get:

$$\sigma(w^{in}) = \frac{var\left[\tilde{\delta}^{\varepsilon}\right]}{E\left[\tilde{\delta}^{\varepsilon}\right]^2} < \frac{var\left[\tilde{\delta}\right]}{E\left[\tilde{\delta}\right]^2} = \sigma(w^{sep})$$

which is in line with the evidence pointed out by Gottschalk and Moffit.

nets necessary to make the turbulences of globalization bearable. Globalization brings wealth and uncertainty: willing to enjoy the first as consumers, voters demand to be sheltered from the second as employees (see also Rodrik [1998]). What Rodrik seems to have in mind however is aggregate uncertainty, as modelled by terms of trade shocks. These shocks are large, and open economies are more sensitive to them. The problem with this approach is that as industrialized economies opened to trade, their aggregate fluctuations should have increased, which does not seem to be the case. Does that mean that globalization cannot create employment insecurity ? Our model provides a way of reconciling globalization and insecurity. As transportation costs or barriers to trade decline (ie., in the model, a mean reducing spread of the distribution $G(.)$ of transports costs γ), firms rely more on vertical separation (see condition (21)) and idiosyncratic uncertainty increases.

Similarly our model link the diffusion of Information Technologies, organizational change and uncertainty. The diffusion of Information Technologies has decreased some of the traditional costs of outsourcing. The coordination of suppliers is made easier through quick transmission and processing of orders, even for customized products. Dell - again - has heavily and successfully relied on IT develop its well oiled, responsive, network of suppliers and transporters. In our model, the "IT effect" corresponds to a mean reducing spread of the distribution $G(.)$ of transports costs γ, as for globalization. We will be able to say a little bit more than this on technology: section **??** is going to propose a richer model of the interaction between innovation, trade and outsourcing.

Aside from its microeconomic predictions, our model thus proposes an explanation of the rise in corporate uncertainty. On the empirical side, one would like to know whether the rise of vertical separation is visible in the data, and whether is possible to observe the amplification mechanism at the firm level. This is the goal of our empirical section 3.

3 Empirical Evidence

Our main result is that a greater reliance on vertical separation increases the return to adjust in house production. For the sake of exposition, we chose to focus in our theoretical analysis on a discrete tradeoff where firms can choose to be either fully integrated or fully integrated. Assume now that firms have a large number of tasks to perform: then our analysis shows that some tasks will be outsourced and others will not (see Thesmar and Thoenig [2002] for a formal analysis). Then, the very same intuitions carry in this new model: the share of outsourced tasks is going to increase with uncertainty, and decrease with hold up costs and outsourcing costs. In turn, firms with a higher fraction of outsourced tasks are going to exhibit higher volatility.

We should therefore expect that a firm that rely more on intermediate inputs are in a position to adapt more to demand shocks. To test these implications, we use firm level data from three French surveys.[10] Our main source of information is a fiscal database used by the French administration to levy the corporate tax: for all French firms whose total sales exceed some 750,000 euros, it provides us with detailed accounting variables such as sales, value added, fixed assets, as well as employment. The period is 1984-1999. The second source is ACEMO, a quarterly survey conducted each year between 1987 and 1997 by the Ministry of Labor on some 12,000 firms. This dataset provides us with quarterly employment, short term contracts, part time workers and interim employment: we extract employment based measures of uncertainty. Last, we will be using the 1982-1999 waves of the French Labor Force Survey, in order to get industry level measures of employment turnover and flexibility.

3.1 Macroeconomic Evidence

3.1.1 Trends in vertical separation

Our theory relates vertical separation, firm level output and labor demand volatility. Do recent macroeconomic trends motivate the construction of such a theory ? Using French National Accounts, we are in a position to compute the ratio of intermediate input consumption to total value added (GDP). This standard measure of vertical separation (see Feenstra, 1998) is plotted in figure 3. Thus measured, economywide vertical separation increases on a constant trend throughout the 1980s and 1990s, from 85% up to almost 100% of GDP. Around this trend, this aggregate measure of vertical separation exhibits cyclical movement, going up in periods of booms (i.e. the late 1980s and the late 1990s), and down during economic slowdowns.

[Figure 3 here]

Hence, French macro data display a very clear acceleration in average reliance on external production in the 1990s. This aggregate evolution however conceals a considerable intra industry heterogeneity. To get an idea of composition effects, consider the industry breakdown laid out in table 1. The most impressive figures are to be found in the automobile industry, where the share of intermediary inputs in total sales has increased by 14,9 percentage points between 1978 and 2000. Then come consumer goods and food processing where average reliance on intermediate input has increased by some 9,5 percentage points. In three industries, this figure has decreased (energy, equipment and

[10] As the evidence we presented in the introduction was mostly US based, we thought it natural to look first at US firm databases like COMPUSTAT. As it turned out, however, COMPUSTAT does not provide information on *intermediate input consumption* (sales - value added), which is going to be our main counterpart for outsourcing here. This line does exist in our French accounting data.

agriculture). Most of the others have experienced a positive, sizeable, increase. The timing of these changes varies across industries. In most manufacturing industries, as well as financial services and transportation, most of the increase occurred in the 1980s. A slight acceleration of vertical separation in the 1990s is sensible, albeit moderate, in real estate, trade and construction.

[Table 1 here]

Hence, although there seems to be considerable heterogeneity in behaviors across sectors, there is in macro data a clear trend for most industries to decrease the share of in-house value added in total sales.

3.1.2 The Rise in Uncertainty

The first piece of evidence that we have on the rise in uncertainty comes from firm level data. Campbell et al. [2001] show that US stock returns have become more volatile over the past 40 years. The interprete it as evidence of the rise in cash flow volatility. This interpretation is consistent with Chaney, Gabaix and Philippon [2003], who show that the volatility of sales of COMPUSTAT firms has increased over the same period, in particular in the 1970s. We computed the same sales weighted variance of sales and employment as them using our French tax files. It must be noted that our dataset does not include listed firms only, but also a lot of small, private firms. In that sense, it is more representative of the average firm than COMPUSTAT is. Trends on sales and employment volatility are displayed in table 4. Sales variance increases markedly from the mid 1980s, so it seems that France caught up, with a small delay, with the american evolution. The sales weighted variance of employment is, however, fairly flat over the whole period, in contrast to Chaney et al's evidence.

[Figure 4 here]

Given the many institutional rigidities and the diversity of the French labor market, it is worthwhile, however, to take a look at individual datasets, instead of firm level datasets. Figure 4 plots the trend in French firms' use of "flexible" labor over the past 20 years. The top line corresponds to the percentage of workers hired under fixed term contracts over total employment, as computed from the 1982 - 1999 waves of the French Labor Force Survey. The bottom line is the share of interim workers in total employment. The share of workers employed under FTC is multiplied by 3 over the period (it goes up from 2 to 6% of total employment). This figure is of course more impressive when we focus at employees that have less than 6 month seniority. Among them, FTCs account for more than 28% in 1999, against 17% in 1982. Interim employment figure, albeit smaller, display evolutions that have the same order of magnitude. The fact that the increase in FTC reliance could be triggered by regulatory changes is unlikely, given the timing of these events (Givord et Maurin [2001]). The first law that made FTC possible was very restrictive and was enacted in 1978. In 1986, the newly elected conservative government then relaxed many of the constraints previously associated with hiring under FTCs. In 1990, the socialist government reintroduced some marginal limitations (like a slight increase in the associated end-of-contract redundancy payment). All in all, the use FTCs experienced a marked increase over the 1986-2001, in spite of limitations introduced in 1990. As far as the 1980s are concerned, the trend does not exhibit any break in 1986.

[Figure 5 here]

This heuristic reasoning is confirmed by quantitative findings by Givord and Maurin [2001], who show that job loss probability increased between the 1980s and the 1990s, even after proper accounting for macroeconomic fluctuations, and the two regulatory changes recalled above. This trend toward increased job turnover has also been documented by Neumark [2000], which records a significant increase in involuntary job loss in all developed economies. In a widely cited paper, Gottshalk and Moffit [1994] have shown a marked increase in earnings instability since the early 1980s: this evolution could be consistent with a rise in job turnover, and a more frequent loss of firm specific human capital. In the US, those demographic groups that were the more exposed to firm specific human capital, like middle aged, skilled men, have experienced a downward trend in job security - as measured by the probability of keeping one's job from one year to the other. However, aggregate evidence on the trend in job instability is more mixed in the US than in France: the share of workers with less than 1 year does not seem to have increased in the United States (Jaeger and Stevens [1999]).

3.2 Microeconomic Evidence

At the microeconomic level, our theory predicts that vertical separation should respond to and at the same time increase the variance of sales. While causality is difficult to trace here (we do this in the last sub-section of this part), our model predicts an unambiguously positive correlation between the degree of vertical separation and (1) the variance of sales and (2) the variance of employment at the firm level, a prediction opposite to Carlton [1979]'s theory.

3.2.1 Vertical Separation and Uncertainty : Evidence From Correlations

For a start, we use the fiscal dataset described above allows to compute firm level variance of the year to year change in log(sales), using all observations we have for a given firm between 1984 and 1999.

Simultaneously, we compute the share of sales divided by intermediate consumptions at the firm level, as a measure of the degree of vertical separation at the firm level (see Feenstra, 1998).

We then take the average of this measure of vertical separation over the 1984-1999 period and we regress it on the variance of sales, controlling for firm size. Results are displayed in the first column of table 2. They show a strong correlation at the firm level between externalization and the variance of sales.[11]

[Table 2 here]

The next column seeks to include firm effects into the regression (and therefore to control for unobserved, though fixed, factor that increase the likelihood of vertical separation and the variance of sales). We do this by computing the average level of externalization and the log(sales) variance over two subperiods : 1984-1991 and 1992-1999. Correlation between the change in externalization and the change in variance, controlling for firm size, are given in column 2 of table 2. It remains significant and the 5% level, but looks much less robust. One possible reason is measurement error, since variances are computed using only 7 points per firm.

Let us now turn to employment: equation (**??**) legitimates the estimation of the following empirical equation:

$$var \log L_{it} = \alpha_i + \beta_t + \gamma \left(\frac{pQ}{R}\right)_{it} + \delta \left(\frac{wL}{R - pQ}\right)_{it} + \varepsilon_{it}$$

If our assumptions are correct, employment fluctuations should be increasing in the share of intermediary inputs used for sales: $\gamma > 0$. Once again, the measurement of $var \log L_{it}$ is the key empirical issue. Starting with the ACEMO survey (which provides four measures of total employment par year), we will use three measures of firm level demand for labor flexibility: (1) the share of Fixed Term Contracts in total employment, (2) the share of interim workers in total employment, and (3) the difference between the highest and the lowest level of employment in the current year, normalized by the average level of employment. While the last proxy is a clear empirical counterpart for labor demand variability, the first two require a few explanations. Indeed, their being good proxies depend on an underlying model of labor demand that may not be true at the firm level. We assume that "flexible" workers (such as those hired under fixed term contracts) are less productive (because they put less effort, as in Saint Paul [1995]), but their jobs are easier to terminate than LTC. In this case,

[11] What counts here is to compute the variance of the unexpected sales changes. Computing var(log(sales)) implicitly implies that only an average firm level effect of log(sales) may be forecast by the firms' managers. There could however be firm specific trend in sales - due for example to industry decline, or bad quality of the firm itself. In alternative specifications, that are not reported here, we tried other models of sales dynamics, including an industry level trend in log(sales), a firm level trend in log(sales), or an AR(2) model of $\Delta \log(sales)$. Results of table 2 were robust to these alternative specifications.

the share of FTC in employment is a measure of the relative return of flexibility, and increases when the firm wishes to adjust employment more. Conditionally on that model being true, the share of "flexible" workers should be a good proxy for expected employment variance.

[Table 3 here]

Regression results are produced in table 3. Since regressions embody fixed effects, estimates are identified on the correlation between changes in intermediate input reliance and changes in employment variability. As displayed in columns 1 and 2, firms that increase their reliance on intermediate inputs increase their demand for labor flexibility. The order of magnitude of estimated coefficients are moderate. In the sample, the average share of fixed term contracts in overall employment amounts to some 5% (2.9% are interim workers). An increase by 6 percentage points in the share of intermediate inputs (which corresponds to one sample standard deviation of the change) is therefore accompanied by an increase of 0.2% in the share of FTC, and 0.4% in the share of interim workers. Results given in column 3 confirm this diagnosis using the more direct measure of labor demand variability. In the sample, the average within year change in employment is 11% of the total. A one standard deviation increase in the reliance on intermediate inputs increase employment variability by 0.2 percentage points.

These encouraging results should however not be taken too seriously. At this stage, our estimates are plagued with endogeneity and simultaneity biases. For example, they could reflect that labor flexibility and intermediate input purchase are organizational complements, such that firms choosing to switch a new organizational form do both simultaneously. A crude way to account for this would be to instrument dependant variables by their lags: we tried to used 2 years lagged levels of pQ/R and $wl/(R - pQ)$. Results, not displayed here but available from the authors upon request, confirm the positive relations discussed above. They are still vulnerable to many kind of simultaneity bias, since firms organization change may take more than two year. Another, more serious critic, is that the positive relation found above could reflect firm reactions to unexpected, temporary, positive demand shocks. In this case, firms temporarily hire flexible workers, and outsource a larger part of their production.

In addition to this limitation, the methodology used so far does not allow to disentangle the effect of uncertainty on vertical separation from the reverse. While it is difficult to show that firms respond to uncertainty by vertical separation more (our "flexibility effect"), the most interesting prediction of our model is indeed that vertical separation amplifies uncertainty. Fortunately, it is possible to design a method that (1) does not require the actual measurement of variance, (2) accounts for some degree of unobserved firm heterogeneity and (3) pinpoints the causality from vertical separation to uncertainty. This is what we do in the next section.

3.2.2 Vertical Separation Amplifies Uncertainty : Evidence From Industry Shocks

Firms that tend to rely more on external production should adapt more easily to exogenous demand shocks. As a result, their labor demand should also adapt more. The trick here is to use industry sales shocks to identify exogenous demand - or technology - shocks.[12] Let us take the model outlined in (**??**) and derive the ex post production level:

$$\log R = \frac{1}{(1-s)(1-\alpha)}(\log A - \log\left(\frac{w^{(1-s)(1-\alpha)}p^s}{s^s((1-\alpha)s)^{(1-\alpha)s}}\right))$$

Assume now that s does not change from one period to another. Output growth is then given by, after a first order Taylor expansion:

$$\Delta \log R \sim (1+s-\alpha)\Delta \log A - \Delta \log w - s\Delta \log p$$

Posit now that A, p and w are fixed at the industry level. In this case, if we denote industry averages by "hats", we get:

$$\Delta \widehat{\log} R \sim (1+\widehat{s}-\alpha)\Delta \log A - \Delta \log w - \widehat{s}\Delta \log p$$

where $\widehat{s}$ is the average reliance to intermediate inputs. Combining both equations help us to remove the unobserved productivity shock:

$$\Delta \log R \sim (1+s-\widehat{s})\Delta \widehat{\log} R - (1+s-\widehat{s})\Delta \log w - (\widehat{s}-s).\Delta \log p$$

Hence, this equation relates own output fluctuations to industry sales shocks, and their interaction with the relative level of vertical separation. Since home production and intermediate inputs are complements in this model, a greater reliance on outside production (ex post adjustable) improves the level of in house adaptation to industry sales shocks. Our assumptions can thus be tested using the following empirical equation, for a firm i, operating in industry s, at date t:

$$\Delta \log R_{ist} = \alpha + \delta_s + \beta \left(\frac{Q}{R}\right)_{ist-k} + \gamma_0 \Delta \log R_{st} + \gamma_1 \left(\frac{Q}{R}\right)_{ist-k} .\Delta \log R_{st} + \gamma_2 \left(\frac{Q}{R}\right)_{st-k} .\Delta \log R_{st} \quad (24)$$

where R_{ist} stand for total sales, $\Delta \log R_{st}$ for the industry average growth in sales (excluding firm i) and Q is the total cost of intermediary inputs. δ_s is an industry effect. γ_0 captures the basic reaction of individual firms to industry (exogenous) shocks.

[12] This approach is borrowed from the corporate finance literature, which often lacks proper instruments for its explanatory variables (see e.g. Bertrand and Mulhainathan [2001]).

Hence, this equation looks at the reactions of a given firm to industry shocks, depending on its "excess" level of vertical separation (difference w.r.t. the industry). If our assumptions are correct, $\gamma_1 > 0$ and $\gamma_2 < 0$, i.e. the larger the reliance on intermediate inputs, the more sensitive a firm is to demand shocks. In the basic model $k = 2$, which means that the reliance on intermediate inputs is lagged in order to remove the potential spurious correlation that would arise if $k = 1$.[13]

[Table 4 here]

Equation (24)'s estimates are summarized in table 4. The accounting and employment dataset is the fiscal source described above. It covers all firms whose total sales exceed 75,000 $ a year, and goes from 1984 to 1999. It is an unbalanced panel, and we restrict our estimations to firms that do not leave and reenter the panel. We used two different dependent variables : total sales and employment.[14] We also present two sets of estimations, the first one without industry dummy, and the other including industry effects. Estimates from these two sets are motivated by the fact that industry variability in sales shocks is at the core of our identifying strategy, so that adding industry dummies is likely to deteriorate our estimates. We do it however in order to check whether our results are purely driven by industry effects, or whether our interaction term $\gamma_1 \left(\frac{Q}{R}\right)_{ist-k} .\Delta \log R_{st}$ really has identifying power on its own.

When estimated without industry effects, estimates suggest that reaction of both own sales and own employment to sales shock increases with the level of excess vertical separation with respect to the industry average. Estimates from columns 1 and 3 show sizeable effects. Considering a 1% shock of industry sales, own sales go up on average by 0.2%. If own externalization is 15 percentage points greater than the industry average (about one sample standard deviation), then own sales react by an increase of 0.3% instead of 0.2%. This result is robust to industry effects. The impact on own sales of an industry sales shock remains sensitive to the extent of excess vertical separation, though a little smaller. The reaction of labor demand is less robust to the introduction of industry effects, since the t-statistic goes down from 7.8 to 2.4, but remains significance at the 5% level. Here lie the limits of our identifying strategy. Another interpretation of this lack of significant could be that adjustment costs of labor - remember that we are working on French data - compel firms to have a smoother

[13] Indeed, an increase in R_{it-1} would simultaneously reduce Q/R_{it-1} and decrease $\Delta \log R_{it}$, inducing an upward bias on the estimate of γ_1. Taking Q/R_{it-2} partially aleviates this problem.

[14] Recall that under our Cobb Douglas assumption:

$$L = \frac{s(1-\alpha)}{w} R$$

so that a simple equivalent to equation (24) can be found relating employment to industry shocks.

labor demand than required. Were we to add adjustment costs within our framework, more vertical separation would, we believe, increase the equilibrium level of unemployment.

Last, a critical reader may raise some concerns about the simultaneity of the choice of s (the share of intermediate inputs in total sales), and a temporary demand shock, that would have little to do with the causal impact of reliance on intermediate inputs on reaction to shocks. Taking $\left(\frac{Q}{R}\right)_{ist-2}$ partially accounts for this. Another way to look into this issue is to instrument $\left(\frac{Q}{R}\right)_{ist-1}$ through its lagged values (we have no better firm level instrument). We thus performed regression (24) using as instruments, contemporaneous industry shocks interacted with 3 year lagged share of intermediate inputs. Results were not very different than those displayed in table 4.

4 Leads for Further Research

Although the argument we develop in this paper is fairly simple, we believe it yields interesting insights on the relation between the product market and job market instability. Because of its very simplicity though, we believe that this intuition pursued in this paper delivers several promising leads for further research. First, we have not really modelled imperfections that may arise from frictions on the labor market. Assuming we add frictions in the labor market, vertical separation would be increasing mismatch of workers to vacancies, decreasing employment, and increasing unemployment. Another vein of research would be to look at the interplay between unionization and vertical separation : in a Grossman and Hart-like framework, vertical separation can be modelled as a tool for shareholders to increase their outside option when they bargain with unions. We believe that such a theory would go a long way explaining recent organizational trends in continental europe, particularly in France.

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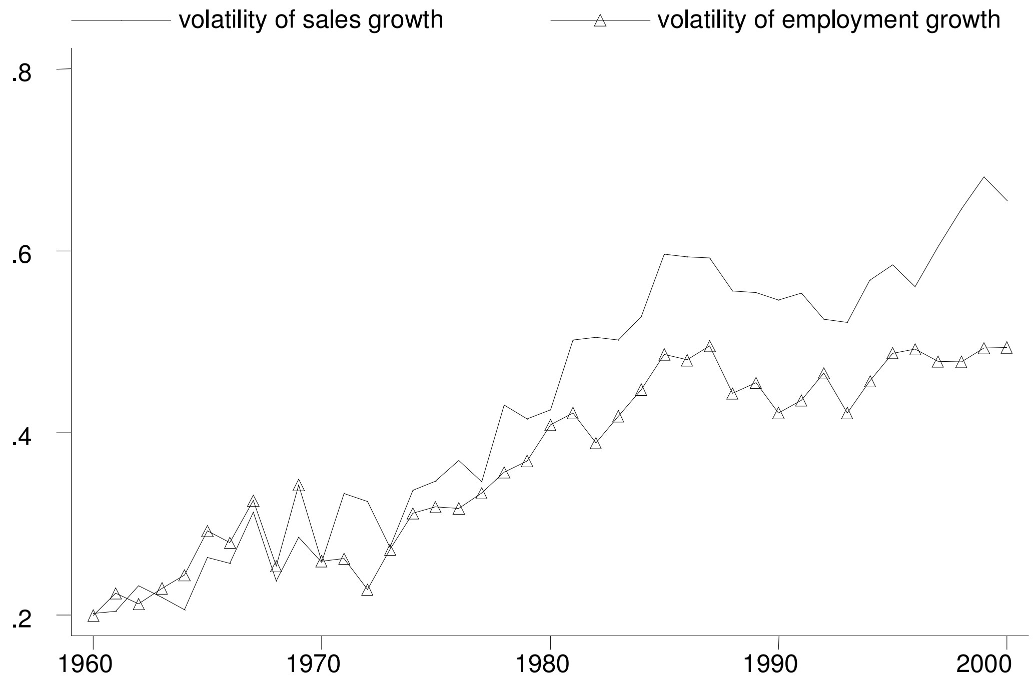
Graphics and Tables



Volatility of Sales and Employment Growth in US at the Firm level

Source: Compustat (from Chaney, Gabaix and Philippon 2002, used with permission)

Figure 1

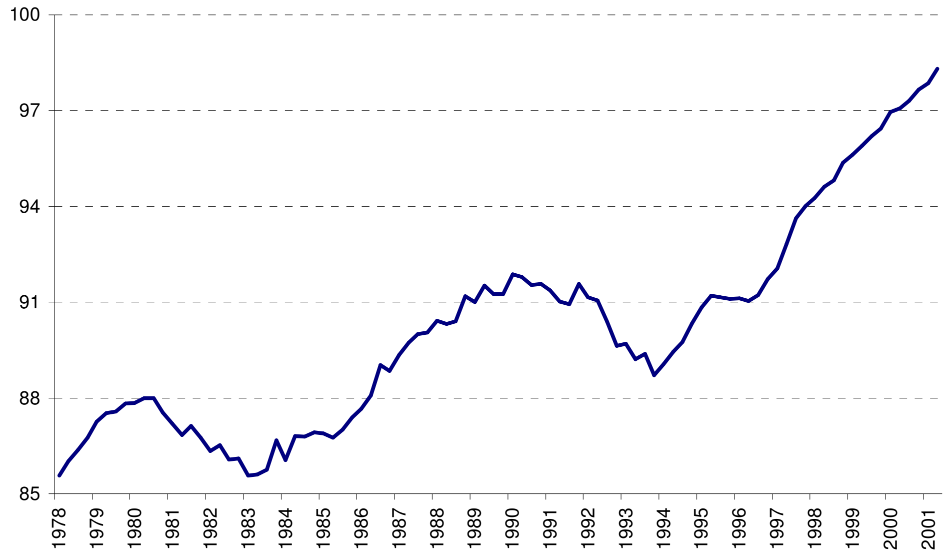


Figure 3: Consumption of Intermediary Inputs : 1978 - 2000

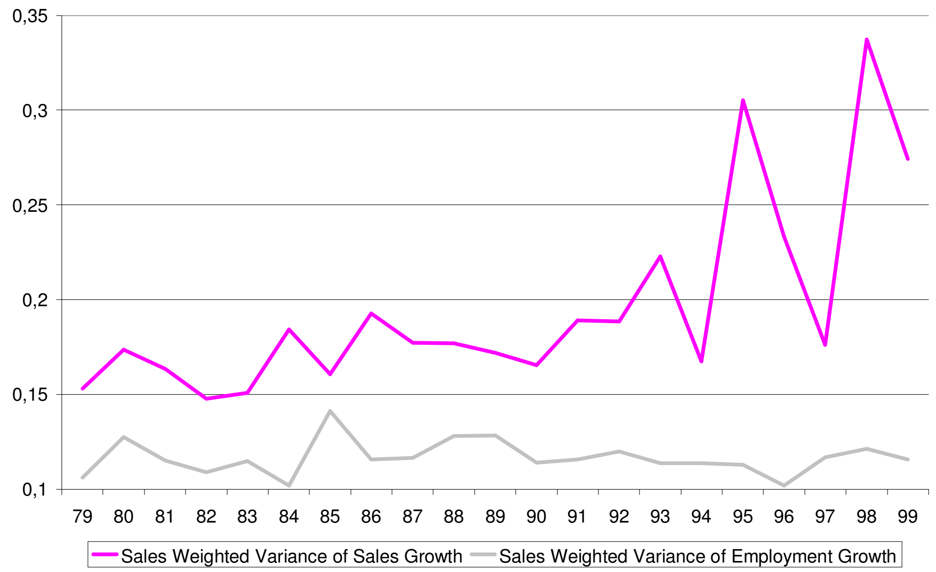


Figure 4: Firm Level Variance in French Data: 1979 - 1999 (Source: Tax Files)

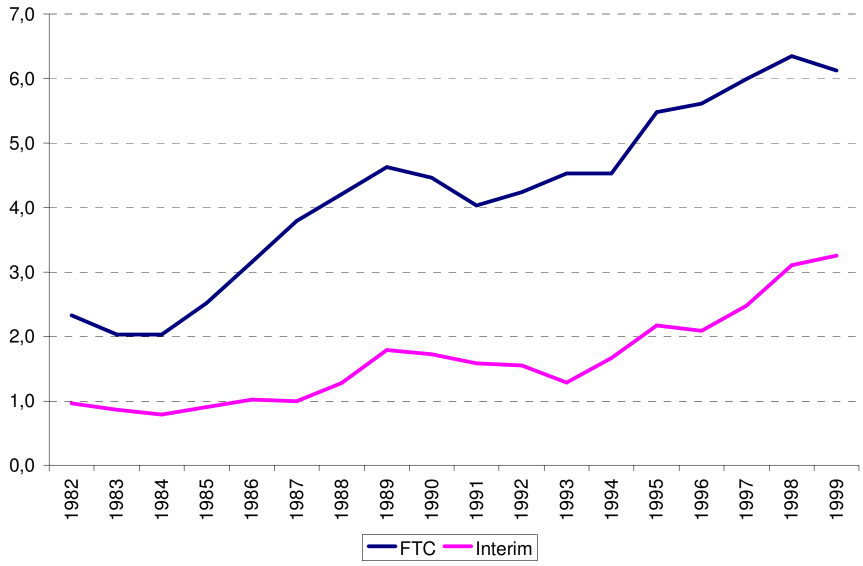


Figure 5: Firms' Use of Flexible Labor : 1982-2001

Table 1- Trends in Outsourcing : Breakdown by Industry

% of change	1978-2000	1978-1990	1990-2000
Agriculture	-3.5	-4.6	0.8
Food Processing	9.5	7.3	2.2
Consumer Goods	9.7	8.7	1.0
Automobile	14.9	7.3	7.6
Equipement Goods	-3.8	-4.2	0.4
Intermediate Goods	6.8	9.2	-2.4
Energy	-17.3	-15.6	-1.7
Construction	3.5	1.3	2.2
Trade and Repair	0.2	-0.8	1.0
Transportation	3.4	2.4	1.0
Financial Services	7.6	7.9	-0.4
Real Estate	0.6	-0.2	0.9
Corporate Services	-2.6	0.0	-2.6
Household Services	4.2	3.9	0.4
Education and Health	0.3	0.0	0.3
All Economy	2.9	1.3	1.6

Reading: Between 1978 and 2000, total purchase of intermediate inputs by firms in the food processing industry has increased by 7.3 points of total production.

Table 2 - Reliance on intermediate consumption and Sales Variance

	IC / Sales	
$var(\log(\text{sales}))$	11.2	3.6
	(1.9)	(1.6)
log(sales)	-0.2	-2.7
	(0.1)	(0.4)
Industry effects	yes	no
Firm effects	no	yes
Nb obs.	7,398	12609

Reading: All estimates are multiplied by 100. Heteroskedasticity-robust standard errors are between parentheses. The dependent variable is the share of intermediate inputs in total sales. Column 1 regresses the mean share of intermediate consumption (IC) in sales on the variance of log(sales). Mean and variance are computed over the 1984-1999 period, for all firms present for at least 5 consecutive years in the panel. Model uses both means and variance computed over two sub periods: 1984-1991 and 1992-1999. For the sake of robustness, all regressions exclude top and bottom 5% values of dependent and independent variables.

Table 3 - Intermediate inputs and Employment Fluctuations

	Model 1	Model 2	Model 3
pQ/R	3.2	10.0	3.9
	(0.6)	(0.4)	(1.3)
$wl/(R-pQ)$	-1.2	-3.2	1.9
	(0.3)	(0.2)	(0.7)
$\log L$	1.3	0.3	-2.2
	(0.1)	(0.1)	(0.4)
Firm effects	yes	yes	yes
Year effects	yes	yes	yes
Nb obs.	83,903	83,901	83,912

Reading: All estimates are multiplied by 100. Heteroskedastic standard errors are between parentheses. The dependent variable is the firm level variance of employment which is identified by three different proxies: Model 1 uses the share of Fixed Term Contracts in total employment as a proxy for the firm level variance of employment. Model 2 uses the share of interim workers. Model 3 relies on the difference between the current year highest and lowest level of employment, normalized by the average level of employment. All regressions exclude top and bottom 1% values of dependent and independent variables.

Table 4 - Use of Inputs and Sales Employment Fluctuations

	Dependent variable			
	$\Delta\log(\text{Sales})$		$\Delta\log(\text{Empl.})$	
$\Delta \log R_{st}$	20.9	18.7	10.2	1.2
	(2.2)	(2.7)	(1.7)	(1.9)
$\left(\frac{Q}{R}\right)_{ist-k}$	-2.7	-1.7	-0.4	0.8
	(0.2)	(0.3)	(0.1)	(0.2)
$\left(\frac{Q}{R}\right)_{ist-k}.\Delta \log R_{st}$	56.3	43.0	23.7	6.7
	(4.3)	(4.9)	(3.0)	(3.3)
$\left(\frac{Q}{R}\right)_{st-k}.\Delta \log R_{st}$	-49.8	-32.0	-41.5	-5.2
	(5.2)	(6.6)	(3.7)	(4.6)
Industry effect	no	yes	no	yes
Year effects	yes	yes	yes	yes
Nb obs.	183,918	183,918	183,918	183,918

Reading: All estimates are multiplied by 100. Heteroskedastic standard errors are between parentheses. All regressions exclude top and bottom 5% values of dependent variables, as well as observation with negative value added.