Chapter 6

Institutional linkages between financial and labor markets

6.1 Introduction

Following the discussion of different sources of growth in chapter 3, productivity growth has been shown to be driven by three factors: entry and exit of firms; improvements of organizational and productive capacities within the firm (innovation); and investment in new technologies (adoption). In the subsequent chapters, we have analysed how these three sources of growth are influenced and affected by institutions on labor and financial markets and described various transmission mechanisms. However, for the moment, we implicitly assumed that these mechanisms are only individually at work, one at a time.

This, however, is rarely the case in modern economies and the simultaneous presence of a set of institutions and policies - potentially setting incentives in opposite directions - has the potential to modify to a significant extent the individual effects that we discussed earlier on. As we have seen in chapter 2, two things may happen - and it is the latter phenomena that deserves particular attention: (i) institutions and policies may cancel themselves out in their overall impact on productivity growth; this happens when contradictory incentives are set by institutions on the same market or incentives are set for two distinct activities that are not complementary to each other; (ii) institutions and policies may also reinforce each other or even turn around the initial direct effect; this happens when institutions foster complementary activities necessary for productivity enhancement.

The link through which these mechanisms may interact is provided by the firm's activities and the innovative strategies it pursues as discussed in chapter 3. We noted that various dimensions of firms' activities have to be considered as a system in order for a particular innovative strategy to succeed. In other words, different activities a firm is carrying out are complementary to each other and will only be profitable if they are pursued in a systematic, encompassing way, as has been shown by an earlier literature on supermodular production functions (e.g. Milgrom and Roberts (1995); Topkis (1998)) that examines the way by which choices of a firm's activity may be interrelated under different contractual settings.

In fact, incentive problems involving similar kinds of informational problems concerning one industrial activity (e.g. innovative research) may have a common cause suggesting that firms have to select a certain contract package to overcome these problems. However, this work has focused mainly on the firm level, not addressing differences between contractual and institutional (individual versus collective contracting) arrangements. Incentive problems may not be fully solved on the firm level whenever the institutional environment constrains the contractual space from which individual actors may be able to select. Conversely, some incentive problems may not be solved on the microeconomic level due to non-cooperative behavior, and only outside institutional (collective) arrangements allow to overcome these shortcomings.

Due to the complementary interaction of tasks, the extent to which particular institutional arrangements may contribute to overcome problems of asymmetric information, imperfect contracting or decision coordination may depend on the existence of particular arrangements on other markets. As most institutional arrangements act only locally - i.e. concentrated on a particular market or on a particular local area - while the agents' decisions that are affected by their presence are simultaneously influenced by conditions on a variety of markets, institutions will interfere which each other through market interaction, potentially contribute to institutional complementarities. A systemic effect, therefore, prevails as the adoption of one institutional arrangement on one particular market increases or decreases the marginal benefits of adopting another institutional arrangement on another market.

In the following chapter, we want to take these considerations one step further by setting up a model of the life cycle a firm is going through, from its market entry, through the negotiation of its financing terms to the particular relation with its workforce. At each stage in its life, the firm as well as its financiers and its employees are facing different incentive problems that are related to the concrete institutional set-up but also to the endogenous relations that arise out of their market interaction. We will analyse how these market interactions affect the characteristics of the different equilibria and we will discuss the different transmission mechanisms through which these market interactions run. This will allow us to distinguish between three different logics underlying institutional complementarities: the risk aversion logic, the market liquidity logic and the time horizon logic. The chapter concludes with a general discussion of the importance of isomorphism across markets for institutional fit and the emergence of these institutional complementarities.

6.2 Finance, industrial relations and firm development

6.2.1 The life cycle of a firm

In the preceding chapters we have discussed in some detail the various links that exist between different types of relations on labor and financial markets and firm decisions concerning employment, investment, and innovation. In order to bring together these different bits and pieces and consequently to analyze the links that exist between institutional arrangements on labor and financial markets, we have to represent the firm over its entire life cycle, from the moment of its creation to its final stage and its ultimate exit of the market. Considering the entire cycle of the firm is particularly important as many links between financial and labor markets only exist to the extent that they affected sequences of decisions but not one single decision simultaneously.

During the course of its life, the firm is assumed to pass through four stages that can be conceptually separated: it first has to raise the necessary funds to start its existence; then appropriate employees have to be hired to realize the expected profits; in the production stage the match produces a stream of output and profits which will be stopped once the firm is driven out of the market. In each stage a particular interaction between different market participants takes place, whereas the market interaction process runs through the intertemporal linkages that exist between different stages. As the entrepreneur is passing through the different stages of firm's life, he will carry out a sequence of decisions that are linked through a chain of constraints that have been built up from the start of the firm's existence. The firm's life cycle, therefore, becomes a complex net of interaction and agency problems:

- *Fund raising:* Entrepreneurs with investment projects of various quality are looking - at a flow search cost c - for a financial investor willing to finance the posting of a job vacancy. Financiers, in turn, are searching for clients with interesting investment projects at flow search cost k. Given the quality heterogeneity of investment projects, they also have to spend η in order to set up a monitoring technique during the production stage that allows them to closely watch the entrepreneur: the more closely financial investors watch the better will be the (endogenous) productivity. The probability that an entrepreneur meets a financier - or equivalently, the probability of transition to the recruitment stage - is $p(\phi)$.
- *Recruitment:* In stage 1, entrepreneurs invest in productive technology and start looking for the worker that will enable them to take up production. The investment consists of two parts: first, entrepreneurs will invest T in dedicated capital which is not contractible; dedicated capital comprises three major components: physical assets such as plants and machinery, immaterial assets such as blue prints and patents and human capital assets such as investment in workforce skills. Moreover, entrepreneurs have to decide upon the organizational structure of their firm, which takes up an amount m. This organizational capital is necessary to make sure that the firm obtains the optimal amount of effort from its workforce; the amount that has to be invested in organizational structures depend obviously on the incentives provided by the labor and the product market. The probability that an entrepreneur will meet a worker, and that the recruitment stage will end is $q(\theta)$. At the same time, the financial investor decides upon his commitment to the match by determining γ; it determines the degree to which the financial investor is willing to engage in liquidity provisions for momentanously faltering firms.
- *Production:* In stage 2, the firm starts production and is generating (stochastic) flow profits $y(T, e, h, \eta)$, depending on the installed technology, T, on the worker's effort, e, and its human capital[1], h, as well as on the financial investor's monitoring technology, η, (i.e. its corporate governance mechanism). It uses these profits to pay its workers a wage w and to pay back the principal and interest on its debt in form of a flow amount d for the entire duration of the match. Both factor payments are determined - either through negotiation or through

[1] The worker's effort, e, can be given a more general interpretation as it denotes any kind of specific investment by the worker that enhances her contribution to the match profits, such as effort, specific human capital, match-related social capital or other side payments necessary for taking up the job efficiently. In our context we want to make the distinction between human capital and effort.

posting[2] - before production starts and may be contingent on the production technology and the specific investments the three actors have undertaken.

- *Destruction:* In the final stage, the match between the firm and the worker is dissolved. Destruction is assumed to depend partly on the organizational technology that allows extracting effort and on exogenous factors such as the degree of product market competition; partly it depends on the realization of the profit flow: The lower the profits, the higher the risk to be driven out of the market by competitors. That means that firm survival depends on the willingness of the financial investor to refinance the firm during instances of momentaneous profit or liquidity shortages. Upon exit, entrepreneurs can recover the liquidation value $V^L(T)$ depending on the type of technology installed. Transition from the production stage to the destruction stage occurs with probability $\sigma(m, e, \gamma)$.

Given this presentation of the firm's life cycle at least three agency problems can be identified. The first one concerns the moral hazard problem for financial investors when selecting investment projects: entrepreneurs cannot commit to their maximum effort level (for instance due to private costs) and hence financial investors have to monitor them through the ex-ante set-up of a monitoring technology. The second agency problem concerns the technological investment related to the project that the entrepreneur is willing to undertake but whose value depends on the liquidity the financial investor is ready to contribute even during short periods of low performance (which are quite frequent with investments requiring large fixed sums). Finally, there is an agency problem between the firm and its worker as the latter cannot credibly commit to a particular level of his specific investment and therefore has to be framed by an organizational structure that sets his incentives.

6.2.2 The matching process

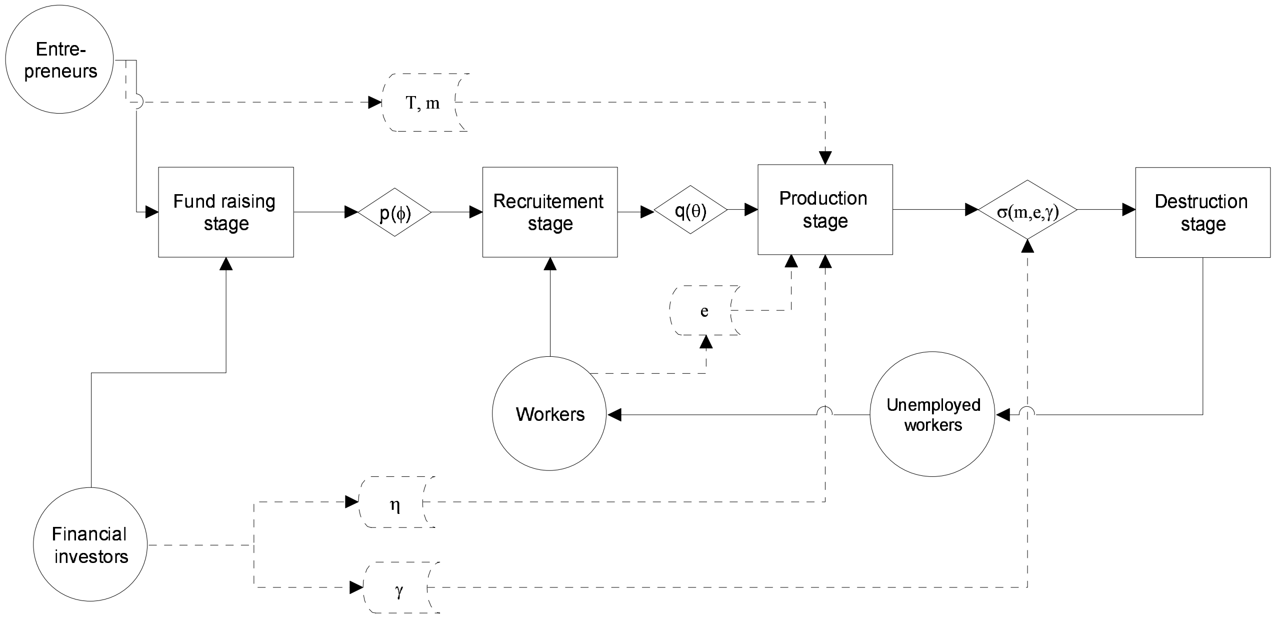
Following Wasmer and Weil (2002), the three actors considered here - entrepreneurs, workers and financial investors - are characterized by particular abilities and functions in the production process. Entrepreneurs have ideas but cannot work in production and possess no capital. Workers transform entrepreneurs' ideas into output but have neither entreprenuerial skills nor capital; financial investors have access to the financial resources required to implement production but cannot be entrepreneurs nor workers. A productive firm is thus a relationship between an entrepreneur, a financier and a worker. As has been discussed earlier, each agent may invest in a specific asset, improving his ability and lost when the relationship is dissolved.

Producing output in a firm requires a team of one entrepreneur and one worker. The two-sided search for job opportunities and appropriate workers causes labor market frictions yielding a matching process following Pissarides (2000), with a constant returns matching function $z(\mathcal{U}, \mathcal{V})$.[3] Matches between workers and firms depend on job vacancies $\mathcal{V}$ and unemployed workers $\mathcal{U}$. From the point of view of the firms, labor market tightness is measured by $\theta \equiv \mathcal{V}/\mathcal{U}$. Labor market

[2] Posting in these models means that market participants are price-takers; in the negotiated setting they are price-setters. The difference between the two situations may imply an important impact on incentives market participants have to undertake certain activities or investments. Not only may the price-setting set-up imply considerable rents to be shared but also that their payments depend in a different way on the realization of the match.

[3] z has positive and decreasing marginal returns on each input.

Figure 6.1: A firm's life cycle and market interaction



liquidity will be $1/\theta$. The instantaneous probability of finding a worker is thus $z(\mathcal{U},\mathcal{V})/\mathcal{V} = z(1/\theta,1) \equiv q(\theta)$, $q'(\theta) < 0$.

As an entrepreneur incurs search costs before production starts[4], these costs must be financed by external funding, given the lack of the entrepreneur's self-financing capacity. As discussed in an earlier literature (see Den Haan, Ramey and Watson (1999), Wasmer and Weil (2002)), this problem is isomorphic to the labor market search process and can be modelled using a matching function between borrowers and lenders, formalizing at the aggregate level the relationship between a banker and a firm.

If $\mathcal{B}$ is the number of bankers looking for borrowers and $\mathcal{F}$ the number of entrepreneurs looking for financing, the flow of loan contracts successfully signed is given by $m(\mathcal{B},\mathcal{F})$, with m a constant returns functions with positive and decreasing marginal returns to each input. From the point of view of firms, credit market tightness is measured by $\phi \equiv \mathcal{F}/\mathcal{B}$ and $1/\phi$ is an index of credit market liquidity, i.e. the ease with which entrepreneurs can find financing. The instantaneous probability than an entrepreneur will find a banker is $m(\mathcal{B},\mathcal{F})/\mathcal{F} = m(1/\phi,1) \equiv p(\phi)$. This probability is increasing in credit market liquidity, i.e. decreasing in credit market tightness. The probability that a banker will find a borrower is $m(\mathcal{B},\mathcal{F})/\mathcal{B} = m(1,\phi) = \phi \cdot p(\phi)$. This probability is increasing in credit market tighness, thus decreasing in credit market liquidity.

Figure 6.1 describes the different stages of the matching and production process. Using the notation introduced by this discussion we can now formalize the different stages of the firm's life cycle referring to the value of the firm's and the financier's assets as well as the job value.

[4] These start-up costs depend on a multitude of factors, including administrative burden and availability of venture capital; we will discuss some of these elements at a latter stage.

6.2.3 Technology and profits

Each stage during the market interaction can be described by a value function for entrepreneurs, financial investors and workers. All three of them will optimise their decision variables such as to maximise the different value functions. In our set-up, the problem simplifies as we immediately analyse the problem at the equilibrium, abstracting from transitional dynamics.

Technology. The technology a firm is using is not completely exogenously determined but can be choosen by the entrepreneur from a set of different production processes, in much the same way as we discussed it earlier in chapter 3. The technology choice $T \in [0,1]$ ranges from completely match-unspecific ($T = 0$) to completely match-specific ($T = 1$). The more specific a technology is, the lower will be its resale value in case of liquidation V^L, $V^L = V(T)$, $V' < 0$. Precisely we want to assume that $V^L(0) = V^{\max} > 0$ and $V^L(1) = 0$. The installed technology yields the expected output $y^e \equiv Ey = \psi(h)\,y(T,e,\eta)$ where $y'_T > 0$ and $\psi'(h) > 0$. The impact of the worker's specific investment on ψ will be more important the more specific the technology is.

Profits. Each period the firm expects to earn a return depending on its technology choice, $y^e = \psi(h)\,y(T)$, spending w to hire workers and facing a probability $\sigma(m,e,\gamma)$ to be liquidated due to a weak performance and impatient financial investors. Denoting r the interest rate, the firm's Bellman equation during the production stage (i.e. stage 2) can be set up as:

$$r\pi_2 = \psi(h)\,y(e,T) - w + \sigma(m,e,\gamma)\left[V^L(T) - \pi_2\right] + \dot{\pi}_2$$

which can be rewritten at the steady state (where $\dot{\pi}_2 = 0$) as:

$$\pi_2 = \frac{\psi(h)\,y(e,T) + \sigma(m,e,\gamma)\,V^L(T) - w}{r + \sigma(m,e,\gamma)}. \tag{6.1}$$

Firms. Let π_i, $i \in \{0,1,2,3\}$ denote the different stages of the firm's life cycle, $\nu \in \{0,1\}$ the entrepreneur's type ($\nu = 0$ means good performance) and r the given risk-less interest rate. Neglecting the $\dot{\pi}$, the Bellman equations for the firm values can be written as follows:

$$r \cdot \pi_0 = -c + p(\phi) \cdot (\pi_1 - \pi_0) \tag{6.2}$$
$$r \cdot \pi_1 = -T - m + q(\theta) \cdot (\pi_2 - \pi_1) \tag{6.3}$$
$$r \cdot \pi_2 = \psi(e)\,y(T,\eta) - w - d + \sigma(m,e,\gamma) \cdot \left(V^L - \pi_2\right) \tag{6.4}$$

where $\sigma(m, e = 1, \gamma) = \overline{\sigma}$ and $y_T(T,e,\eta) > 0$, $y_{TT}(T,e,\eta) < 0$. Moreover, for convenience, we want to assume that $y(T, e = 0, \eta) = 0$; nothing substantially is changed using this assumption.

In the fund raising stage, firms spend c to match with an appropriate financial investor which will happen with probability $p(\phi)$. After installing the productive technology, T, and organizing the production process, m, the firm finds a suitable worker and will switch to the production stage with probability $q(\theta)$. There, it receives a stream of gross profits of $\psi(e)\,y(T,\eta)$ that have to be used to pay wages, w, and make debt reimbursements, d.

Financial intermediaries. B_i ($i = 0, 1, 2, 3$) denote the value of a bank in the different stages similar life cycle determines the financial intermediaries investment decisions. The financial investor has to spend k in order to sort out the good entrepreneurs which can be met with probablity $\phi \cdot p(\phi)$. Financing the search period before the firm finds its labor force, the financial investor spends γ. After this period, he expects to recover his negotiated debt d before the firm quits the market with exit probability σ.

$$r \cdot B_0 = -k - \eta + \phi \cdot p(\phi) \cdot (B_1 - B_0) \tag{6.5}$$
$$r \cdot B_1 = -\gamma + q(\theta) \cdot (B_2 - B_1) \tag{6.6}$$
$$r \cdot B_2 = d + \sigma(m, e, \gamma) \cdot (B_3 - B_2) \tag{6.7}$$
$$B_3 = 0 \tag{6.8}$$

Workers. Workers expect wages w in exchange for their work effort $e \in \{0, 1\}$. When the firm quits the market, the work relation terminates as well, which happens with probability $\sigma(m, e)$. The effort of the worker, e, improves the firm's productivity but constitutes a specific investment as it is linked to the relationship between the worker and the firm. The higher the investment, the more specific it is and the more costly the loss of the job.

More generally, e can be interpreted as any kind of match-specific investment that is valuable for the firm, such as specific human capital investment or social capital that strengthen any implicit components in the labor contract. Once unemployed, workers benefit from a revenue b waiting to get a chance for a new match, leading to a value of U for unemployed workers. During their period of unemployment, workers can invest in human capital, h, at cost c_h to improve their productivity at the following match.

$$r \cdot W = w - e + \sigma(m, e, \gamma) \cdot (U - W) \tag{6.9}$$
$$r \cdot U = b - c_h h + \theta \cdot q(\theta) \cdot (W - U) \tag{6.10}$$

6.3 The endogenous value of the match

The model set-up so far contains two endogenously determined prices - wages and interest rates - and five decision variables - the choice of technology T, the monitoring technique m, the selection effort of good entrepreneurs η, the willingness to refinance γ, and the worker's effort level e. Before starting to analyse the market interaction that arises from the model's structure it is therefore worth recalling the equilibrium conditions that will be driving the results. Notice, however, that not all of the equilibrium conditions will be active in the discussion of the next section as we will concentrate on one aspect at the time.

In order to keep the model tractable we make a couple of simplifying assumption in the following set-up. First we consider monitoring and effort as additive separate inputs in the destruction probability: $\sigma(m, e) \equiv \widetilde{\sigma_1}(m) + \widetilde{\sigma_2}(e)$.

6.3.1 Wages and interest rates

Splitting profits between workers and employers. Wage bargaining takes place at the second stage. The firm and the union share the surplus of their relationship according to a generalized Nash bargaining rule:

$$w_u^* = \arg\max (F_2 - F_0)^{1-\chi} \cdot (W - U)^{\chi}$$

where $\chi \in (0, 1)$ measures the bargaining power of the union in the relationship and w_u^* denotes the bargained level of wages. This bargaining leads to the following wage:

$$w_u^* = \chi (\psi (h^*) \cdot y(e^*, T^*, \eta^*) - m^* - d^*) + (1 - \chi) (b - c_h h^* + e^*) \tag{6.11}$$

As we have shown at some length in chapter 4, the bargained wage is a weighted sum of the firm's output net of the repayment to the bank and a term expressing the annuity value of the utility of an unemployed plus the specific investment cost. The larger the worker's bargaining power, the larger the share of the firm's net surplus that he can extract. If workers have no bargaining power, they are paid their opportunity cost of working, i.e. $e^* + r \cdot U$.

Determining the optimal debt level. In principle both wages and debt levels are negotiated between the firm and workers and financial investors. Therefore, in the second period, firms and financial investors have to agree on the debt transfer, which will be negotiated using Nash bargaining. Hence, the optimal debt results from:

$$d^* = \arg\max (F_1 - F_0)^{1-\lambda} \cdot (B_1 - B_0)^{\lambda}$$

which yields:

$$d^* = \lambda (y(T^*, e^*) - m^* - w^*) + \frac{(\gamma (1 - \lambda) - T^* \lambda) (r + \sigma)}{q(\theta)} \tag{6.12}$$

6.3.2 Specific investments and market liquidity

Following wage and debt negotiations, firms, workers and financial investors are undertaking specific investments to enhance the profitability and the survival of the match. In determining the optimal investment in the match, the three actors take the flow parameters θ and ϕ as given. Once the optimal investment programmes have been determined, the reaction of the technology and organizational choice and the financial investors' screening and refinancing effort with respect to the liquidity on financial and labor markets can be determined. The optimality conditions for these specific investments being independent from the concrete market interaction, we will discuss them first before entering the details of the different institutional links.

Match-related investments

Effort decision by workers and monitoring. Workers will select their effort choice in their current match by maximizing the expected match value (6.9):

$$e^* = \arg\max \left\{ \frac{w - e - rU}{r + \sigma (m, e, \gamma)} + U \right\}$$

which in turn can be used to determine their best-response function of optimal effort, i.e $e^* = e(w, \sigma, U)$.

Given this optimal effort function and wages fixed through negotiations, firms have to determine the firing probability endogenously by choosing the appropriate monitoring technology. They have to select a firing probability that maximises their expected profits at stage 1:

$$m^* = \arg\max \pi_1(m)$$

which can be used to derive the following FOC for the optimal monitoring decision of firms:

$$\left(\frac{\psi_e y(T, \eta)}{r + \sigma} - \left(\pi_2 - V^L\right) \sigma_m\right) e_m^* = -\frac{1}{q(\theta)} \tag{6.13}$$

where $\pi_2 = \frac{\psi(e) y(T,\eta) - w^* - d^* - rV^L}{r+\sigma} + V^L$ and $\sigma = \sigma(m^*, e^*(m), \gamma)$.

Corporate governance. Financial investors will select their monitoring technology η such as to maximise their return, ρ. Hence in equilibrium, financial investors determine η^* by maximising their entry value B_0:

$$\eta^* = \arg\max B_0(\eta)$$

which results in the following FOC:

$$E\eta = \lambda\phi p(\phi)(1-\chi)\psi(e^*) q(\theta) \cdot \frac{\partial y(T^*, \eta)}{\partial \eta} - (1 - \lambda\chi)(r + q(\theta))(r + \sigma) \stackrel{!}{=} 0. \tag{6.14}$$

Determining optimal exit probability. Similarly, financial investors can decide whether or not they want commit their resources to a firm, even when firm profits are momentaneously below a certain threshold. In order to reduce the complexity of such a model, we only consider whether financial investors are ready to keep their assets even in case of low performance, $\gamma = 1$, or whether they want to liquidise the firm, i.e. $\gamma = 0$. In case, the financial investor decides to refinance the firm in periods of low outcome, he has to pay an upfront cost c^B, which represents his financial commitment.

This decision is taken on the basis of the returns for the financial investor, which in turn depend on his financial relation choice and on the technology T used by the firm:

$$\begin{aligned} \Psi_1(T, e, \gamma = 1) &= r \cdot \pi^e(T, \gamma = 1) - c^B \\ \Psi_0(T, e, \gamma = 0) &= r \cdot \pi^e(T, \gamma = 0) \end{aligned}$$

where the financial investor decides to refinance the firm whenever $\Psi_1 \geq \Psi_0$.

Technology choice by firms. Firms select the appropriate technology in the second period such as to maximize the firm's value. Recalling (6.15) and abstracting from the endogenous resale value we obtain the following first-order condition:

$$ET = -r - \sigma + q(\theta) \cdot \frac{\partial y}{\partial T} \stackrel{!}{=} 0 \Leftrightarrow \frac{\partial y}{\partial T} = \frac{r + \sigma}{q(\theta)}$$

where, using the implicit function theorem, we can show that $ET = 0$ implies $\frac{dT^*}{d\theta} < 0$.

Reaction to market liquidity

Changes in labor market liquidity. With these optimality conditions at hand, we can determine the reaction of the different types of specific investment with respect to labor and financial market liquidity[5]. Using the optimal monitoring decision m^*, the following proposition can be proved by inspection.

Proposition 6.1 (Optimal Monitoring) *Optimal monitoring increases with labor market liquidity, i.e.* $\frac{dm^*}{d\theta} > 0$.

Similarly, using (6.14), a relation between η and θ can be established.

Proposition 6.2 (Optimal Screening) *When worker's bargaining* $\chi \leq 1 - b$*, where* $b \in (0, 1)$ *defines the degree of concavity of* y*, the optimal screening necessary to sort out types of entrepreneurs increases with labor market tightness, i.e.* $\frac{d\eta^*}{d\theta} > 0$.

Proof. See page 137. ■

Summarizing, specific investment by firms, workers (indirectly represented through monitoring expenditures) and financial investors react in the following way:

$$\frac{\partial T^*}{\partial \theta} < 0, \frac{\partial m^*}{\partial \theta} > 0, \frac{\partial \eta^*}{\partial \theta} > 0$$

Changes in financial market liquidity. Many of the decision variables in our model will not react in partial equilibrium to a change of the financial market liquidity given that they are decided after financial investor and entrepreneur have met; only the optimal screening decision by financial investors will be affected:

Proposition 6.3 (Reaction to financial market liquidity) *An increase in financial market liquidity (increase in* ϕ*) leaves the optimal technology and the optimal monitoring decision unaffected; only the financial investor's screening will change:*

$$\frac{\partial T^*}{\partial \phi} = 0, \frac{\partial m^*}{\partial \phi} = 0, \frac{\partial \eta^*}{\partial \phi} > 0.$$

Proof. See page 137. ■

Notice that these are partial equilibrium relations; in general equilbrium, financial market liquidity will affect T and m through the interaction with labor market tightness as we will see in the following section.

[5] All propositions are proved in the appendix to this chapter, p. 137.

6.4 Institutional links

6.4.1 Transmission mechanisms of institutional complementarities

The set-up of interacting market participants that has been introduced so far gives raise to a multitude of different links between investment and pricing decisions that are likely to produce a complex relationship between the structural parameters describing the economy and the macroeconomic outcome. Before getting into the details of different transmission mechanisms, in this first section on institutional links we want to discuss the deeper inner logic that is common to the institutional arrangements on labour and financial markets and that shape the transmission mechanism in equilibrium. Table 6.1 summarizes the different links that can be identified following the current model set-up and sorted them according to their underlying logic in three categories: (i) The first transmission mechanism concerns the risk aversion of market participants. (ii) The second transmission mechanisms describes the mutual influence of individual incentives for specific investments through market liquidity effects. (iii) Finally, the model allows to identify a transmission mechanism through the strategic interaction of market participants and the influence of their time horizon.

As we describe in the last section of this chapter, it is this common logic that helps to explain the existence of the institutional complementarity and constitutes one crucial element for the working of the transmission mechanism. Shedding some light on these mechanisms by looking at them from the point of view of their inner logic opens up the discussion to point to the exemplary nature of the concrete links that we have discussed in the previous sections and will convey the main message of this chapter: it is the logic behind the institutional complementarities that is important to notice, not necessarily their concrete working in particular circumstances. While there may be a multitude of different institutional arrangements that all are able to deliver similar incentives or types of behavior, there is only a handful of different transmission mechanisms that will put these institutional relations in such an order as to be productivity enhancing.

Hence, before discussing these different transmission mechanisms in details using our model set-up, we first will present this underlying logic that lies behind the institutional arrangements on labor and financial markets and institutional isomorphism and structural similarity. In the last section of this chapter, this will be used to link this underlying institutional logic back again to a similar topology that characterizes the different dimensions of the institutional space. In particular, there we will discuss the problem of institutional fit and the dynamic process that links different institutions through a dynamic process of mutual interconnection.

Risk aversion. A first mechanism that can be identified concerns the impact of market interactions on the risk aversion of market participants. As is well known, the incentive to take up (excessive) risk does (partly) depend on the shape of the output profile the investor can expect. This output profile is, however, partly dependent on the interaction with other market participants, in particular related to the question: Who gets what when the project is failing?

For instance, leveraged firms may have an incentive to invest in more risky projects as an entrepreneurs revenue profile is cut at its lower debt repayment point. On the other hand, more risky projects may also be the more volatile ones, increasing the risks for workers to be laid off.

Table 6.1: Direct Effects and Complementary Crossings

	Direct Effects	Complementary Crossings
Credit and Job Protection	Pushes firms to adopt more risky projects & Reduces the impact of output volatility on workers' effort	Despite the riskier output profile the firm does not need to pay higher wages to attract workers and to induce their effort. Continuously high effort improves the outlook for the project realization.
Bank-finance and Wage drift	Reduces intertemporal fluctuations & Pushes least efficient firms out of the market	Reduced intertemporal fluctuations guarantee the exploitation of scale economies. In order to guarantee the most efficient use of available technologies, least productive firms have to be driven out of the market.
Ownership Concentration (Insider Monitoring) and Union's bargaining power	Improves the evaluation of firm specific assets & Pushes workers to invest in specific assets	Firms will reshuffle internally their workforce through specific investments as improved evaluation by outside financial investors will value this positively.
Banking Competition and Coordination of Wage Bargaining	Improves the evaluation of firm specific assets & Increases incentives for the use of internal labor markets	The incentives for the development of internal labor markets and provision of firm specific skills are increased by stronger monitoring from outside financial intermediaries when competition is low.
Credit and Trade Unions	Reduces firms' turnover & Increases workers' effort	Effort as a specific investment by workers into the firm value will be protected by lower managerial rotation. This increases marginal incentives for workers to provide effort.
Banks' and Unions' Time horizons	Allows investment in specific capital with long-term returns & Integrates future benefits into current wage negotiations	Building up firm specific capital is more profitable the stronger unions take future benefits into account; workers benefit from a longer time horizon the likelier the firm is going to survive.

Overall, then, the impact on a firm's productivity may not be monotonous. This can. However, be circumvented when workers share their lay-off risks with entrepreneurs through employment protection requirements. In this case, part of the higher risk that workers are exposed to is taken over by higher severance payments.

Similarly, risk sharing can be done intertemporally through the accumulation of a financial asset (Allen and Gale 2000). This, however, runs the risk that firms will not invest optimally in their resources when they expect exogenous shocks to be dampened through banks' provisions. Here, a continuous wage drift generated by productivity oriented wage bargaining can help to drive the least efficient firms off the market and creating a constant incentive for the upgrading of productive investment (Moene and Wallerstein 1997).

Incentive effects of market liquidity. Whereas the previous link was concerned with risk aversion and sharing across market participants through institutional arrangements, market liquidity also has the potential to create interactions between actors' decisions on different markets. Market liquidity - both on the financial and the labour market - enhance the chance for workers and financial investors to meet alternative partners to their current match: their outside option increases, which reduces their incentive to commit specific resources to the current productive relationship. Conversely, when liquidity is low on either or both markets, investments that help to stabilise and improve upon the ongoing relationship may increase.

In the table, two examples are being presented. The first one concerns the incentive of financial market investors to monitor closely the entrepreneurial activities in the firms, in which they have invested: the less liquid the financial market (the higher the ownership concentration), the stronger their incentive to look closely inside the firm. At the same time, this improves the evaluation of a worker's effort, which in turn strengthens the positive impact of wages on effort decisions (notice that in the "lighthouse" model of the wage-effort relationship the marginal effect of wages on effort is higher the lower the variance of the effort signal is).

Similarly, the better evaluation of the internal value of a firm (i.e. the correct evaluation of its intangibles) also helps to direct the uniformity of wages imposed by (European) wage bargaining systems (see Acemoglu and Pischke (1999) for a discussion of this relationship) into a more efficient use of internal labour markets. Similarly to the previous argument, internal labour markets are the more stimulating for employees' effort the lower the variance of the effort signal is. The incentive to improve on this evaluation is (partly) related to a relatively strict control by outside financial investors of internal decision processes.

Time horizon of market participants. Finally, market interactions of institutional arrangements may also affect the time horizon economic actors have. This time horizon is important as a strong discounting of future benefits of a relation may hamper initial investment despite the possibility for this investment being socially beneficial (i.e. there is a difference between the private and the social rate of time preference).

For instance, strong firm turnover and a regular change in firm ownership may prove to be disruptive for management-labour relations (Shleifer and Summers 1988). Introducing leverage as a means to avoid frequent IPOs on a firm may therefore help to stabilise the time horizon of management and to (correctly) evaluate the (social) benefits of employees' investment in human capital.

On a different scale, financial investors can also hold onto their assets despite the firm's (momentaneous) low profit outlook. The financial investor may then decide to restructure a firm's asset instead of liquidising the firm. This, in turn, provides an incentive for workers to adopt a long-term strategy regarding wage bargaining that favours employment growth and improves the prospect for the long-term survival of the firm.

6.4.2 Productive efficiency and firm survival

Efficiency improvements, reduction of managerial slack and the efficient use of installed capital are all very important factors in enhancing productivity at the firm as well as at the aggregate level. The first part of our investigation on institutional links will therefore concentrate on complementarities that jointly affect these determinants of productivity growth.

Incentives for efficiency improvements can come from two sides: the pay-off stream may be tailored in such a way that the least efficient activities are not remunerated at all; this happens for instance when low-productivity firms are driven out of the market by continuous wage increases. Or there may be particular protection measures in case a more efficient and often more risky activity is undertaken but fails (at least momentaneously); in this situation, the resistance to this type of activity will be lower. We will show in the following how a particular combination of incentive and protective measures on labor and financial markets may interact to provide synchronous incentives for all stakeholders.

Risk aversion on labor and financial markets

Both firms and workers may be characterized by risk aversion regarding the investment project that is going to be implemented. Despite the higher pay-offs that comes with more specific technologies, firms may fear the increased risk of loosing the invested assets through bankruptcy. Workers, on the other hand, may not be willing to invest much effort in the firm, a specific investment that would be needed for the succesful realisation of the project. Together, this will lead to an outcome that falls short the first-best outcome or even the constrained second-best (calculated by abstracting from the destruction possiblity).

In this situation, the capital structure will help to restore incentives for firms to invest in projects with a more pronounced risk structure. Modifying the pay-off distribution for firms in a particular way, a higher leverage will push managers to adopt projects with higher average returns. At the same time, thoughtful employment protection reduces the impact of output volatility on workers' effort. Given that in the presence of a debt leverage the destruction probability is endogenous, employment protection reduces the *ex post* bankruptcy value of the assets by imposing severance pay for collective dismissals. Hence, despite the riskier output profile the firm does not need to pay higher wages to attract workers and to induce their effort. Continuously high effort improves the outlook for the project realization and lead to a higher realization of the available investment capacity.

In the following we will demonstrate the complementary effects between the firm's capital structure and employment protection, taking the capital structure as exogenous. Given that this involves the analysis of decision variables at the same stage (effort e and technology T are both decided at stage 1, we can actually abstract from the market liquidity. Moreover, moral hazard with respect to workers' effort decisions is supposed to be the only source of frictions on the labor market.

Project selection by firms

Recall the stochastic nature of the innovation process and the firm's profit function (6.1).Then the following profit maximization problem for the leveraged firm arises:

$$r\pi = \int_z^\infty \psi(e)\, y(T)\, dF(\varepsilon) + \int_0^z \left(V^L - \pi\right) dF(\varepsilon) = \int_z^\infty \psi(e)\, y(T)\, dF(\varepsilon) + \sigma(z)\left(V^L - \pi\right)$$

with z chosen such that $E\left(d(z)|\, I\right) = (1 + r^*)\, L^*$ where r^* is the banks interest rate and L^* the loan amount. Notice that z determines the minimum state of the world at which the firm breaks even. Hence, the asset equation (6.1) can be rewritten as:

$$\pi = \frac{\int_z^\infty \psi(e)\, y(T)\, dF(\varepsilon) - w + \sigma(z)\, V^L(T)}{r + \sigma(z)}$$

where $V^L = V(T)$, $V' < 0$. The technology choice is undertaken in period 1, so the firm will maximize the value added between F_1 and F_0. Using the entry condition $F_0 = 0$, the first-order condition then writes as:

$$T^* = \arg\max\left(F_1 - F_0\right) \Leftrightarrow \Theta \equiv \int_z^\infty \psi(e)\, y_T(T)\, dF(\varepsilon) + \sigma(z)\, V_T^L(T) - \frac{r + \sigma}{q(\theta)} = 0. \tag{6.15}$$

Let us suppose that returns to innovative activity are higher in good states than in bad ones, i.e. $y_{T\varepsilon} > 0$. We then have $\frac{\partial^2\Theta}{\partial T \partial\varepsilon} > 0$. In order to assess the reaction of the firm's technology with respect to an increase in its leverage, we apply the implicit function theorem to (6.15). Given that $\Theta = 0$ describes a maximum we have $\frac{\partial\Theta}{\partial I} < 0$ and therefore $\frac{dI}{dz}$ depends on the sign of $\frac{\partial\Theta}{\partial z}$ which can be calculated as:

$$\frac{\partial\Theta}{\partial z} = -\psi(e)\, y_T(z)\, f(z) + \sigma_z(z)\, V_T^L(T)\,. \tag{6.16}$$

Marginal profits at the worst state of nature from the point of view of equity holders are positive. However, an increase of the minimum state to be reached, increases the risk of bankruptcy. Consequently the second term will be negative and the sign of the overall term ambiguous. Given our assumptions on the liquidation value, we can nevertheless safely conclude that there exists a singleton $\widehat{T}$ that nullifies (6.16). Therefore:

Corollary 6.1 *A change of the capital structure towards a higher leveraged firm, increases the specificity (riskiness) of the investment up to the maximum point* $\widehat{T}$.

Despite the upper bound of the second-best technology decision set, the leverage of the firm introduces a modification of the pay-off structure for managers in a way as to push them towards more risky, more specific technologies. This positive effect, however, may be partly offset by workers' risk aversion and the negative effect of an increased risk on their optimal effort decision.

Worker's specific investment

Workers decide upon their specific investment - their effort level e - they want to commit to the match. This input is important as it determines the probability of success of the investment projects and hence the likelihood of the firm's survival. As we have seen, firms have the possibility - *via* the wages they set and the organizational structure of the firm (the monitoring) - to set incentives in such a way as to make workers comply to the overall firm goal.

Nevertheless, as we have seen in chapter 4, the effort level also depends on the exogenously given level of project risk: at a given average return, the riskier the project the less likely workers are ready to put forward a high effort level. Here we recall rapidly the lines of the argument:

For a given wage w, any increase in the unrelated stochastic element of the job value W will decrease the marginal return the worker can expect from his specific investment. Consequently, the optimal effort the worker is putting into the match (see also proposition 4.1, p. 82) decreases. The effort decision can be easily integrated in the above optimal program (6.15). We can rewrite (6.16) as:

$$\frac{\partial \Theta}{\partial z} = -\psi(e) y_T(z) f(z) + \int_z^\infty \psi_e(e) \frac{\partial e}{\partial z} y_T(T) dF(\varepsilon) + \sigma_z(z) V_T^L(T)$$

Thus, a change of the capital structure towards a more leveraged firm will reduce the effort level of the worker as the chances for bankcrupcy are increasing. By consequence, the optimal technology the firm will choose is even further away from the first-best choice than in the above program. This leads to the following corollary:

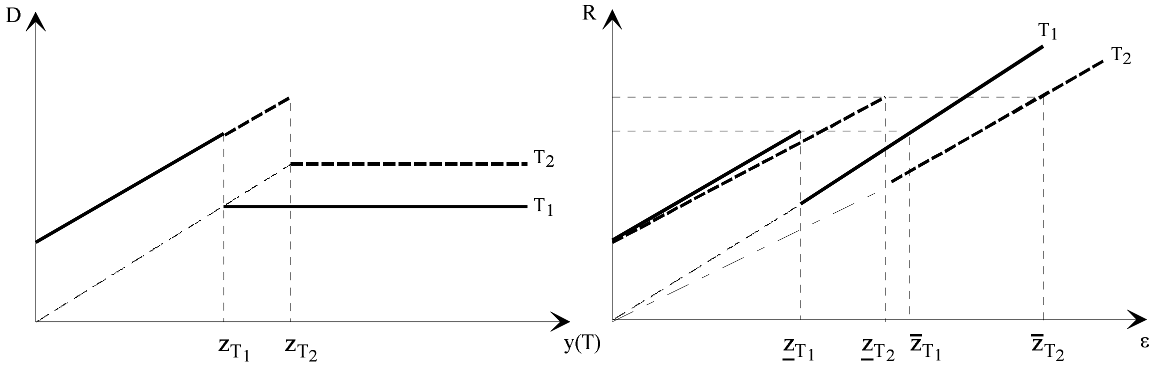
Corollary 6.2 *Increasing the leverage of the firm reduces workers' optimal effort decision. The marginal effect on effort in turn reduces the optimal degree of the specificity of the techonology.*

Whether the workers' risk aversion will offset completely or in part the positive effect of the firm's leverage on the optimal degree of the specificity of the technology is a matter of the concrete functional choice. It is clear, however, that $\hat{T}$ will be smaller when labor market frictions make the effort decision a function of the firm's risk exposure.

Credit finance and employment protection

The problem of the firm's risk exposure and the endogenous determination of its bankruptcy is even worsened due to the presence of a positive resale value in case of a not completely specific technology $T < 1$. Indeed, the resale value of the installed technology plays an important role in this set-up. As can be seen from figure 6.2, it introduces an important non-linearity into the pay-off function for entrepreneurs and financial investors.

Figure 6.2: Payoff structure of the leveraged firm



Note: The left panel represents the total value of the debt for the financial investor as a function of the realised value of the investment project $y(T)$, including the resale of the firm's asset after liquidation. The right panel represents the return on investment depending on the realisation of the randam shock ε, taking into account the distorsions following a positive resale value.

When the realization of the shock reaches the lower bound, the financial investor will take over the firm, sell the realized output and resell the installed technology depending on its resale value. Obviously, the lower the degree of specificity of this technology, the higher will be the second-hand value. However, the fact that the creditor can have a higher payoff when breaking up the firm and selling the realized output introduces an arbitrage possibility that leads to an endogenous determination of bankruptcy that is higher than it would otherwise be efficient: For shock realizations $z \in \left[\underline{z}, \overline{z}\right]$ the firm and the financial investor have an incentive - despite the positive net present value of the investment - to break down the firm and to share the resulting proceeds. This problem worsens with increased leverage of the firm (see the dashed line in figure 6.2).

Introducing employment protection legislation (EPL) in this situation will have a beneficial effect[6]. Depending on the importance of EPL and the working of the bankruptcy procedure, the costs of social plans in case the firm is broken up may take up all of the resale value or even more. Here we want to assume that social plans are senior to all remaining debt: Up to the point where all remaining assets have been sold, these plans have to be honoured before the rest of the stakeholders and shareholders can be served.

Turning again to figure 6.2, in such a situation, EPL reduces the scope for endogenous bankruptcy by reducing the proceeds the creditor can expect from breaking down the firm and reselling the remaining assets. Moreover, for sufficiently strict EPL, realizations even at or below the - exogenously - given shock threshold $\underline{z}$ at which the firm can no longer honor its outstanding debt may not lead to the break-up of the firm. Consequently, EPL mitigates the problem of the destruction probability on the workers' effort decision and increases incentives for firms to raise the degree of specificity of the technology. The following proposition resumes:

Proposition 6.4 *There exist an institutional link between the capital structure of a firm and mechanisms that insure job protection against exogenous shocks:*

[6] We only consider collective dismissals in this set-up. In practice, EPL may have implications for individual lay-offs as well, which will not be taken up here. Moreover, in line with legislation in a majority of OECD countries we assume that EPL increases the costs of EPL but does not make it impossible in principle. In particular, we do not consider reinstatement of fired workers as a possibility.

1. *At given debt levels, an increase in employment protection raises the maximum degree of technological specificity $\widehat{T}$.*

2. *At given levels of employment protection, an increase of the firm's leverage lifts the project return, provided that $T^* < \widehat{T}$.*

The set-up of this mechanism has been helped by the fact the the capital structure of the firm is completely exogenous to any effort and technology decisions. An exogenous increase of reduction of the firm's leverage, therefore, can play itself out through the whole system as financial investors will not reconsider their stakes. We will see in the following section that this may not necessairly be the case any longer, once the liquidity on the financial market is determined endogenously.

6.4.3 Firms innovative capabilities

The value of a match not only depends on the selection of an investment project among several others exogenously given but also on the investment the stakeholders are ready to undertake for a succesful realization of the project[7]. In a generic way, the endogenous determination of the match value through stakeholder investment may be called an innovation, relating us back to the discussion on technological regimes in chapter 3. There we noticed that different technological regimes are characterized by the variation in their knowledge processes, in particular concerning the degree of specificity of physical and human capital assets that have been identified as fundamental to the innovation process. This section therefore intends to elaborate on this idea making project screening, technology choices and effort decisions endogenous to each other over the life cycle of the firm.

The analysis in this section abstracts from banks intervention during a possible firm liquidation. Here, the exit value of the firm is considered to be independent of earlier investments, i.e. $V^L(T) = 0 \; \forall T$, and the influence of banks on the exit probability, γ, is given exogenously. Moreover, we consider the worker's human capital as exogenous with $c_h = 0$. These problems will discussed in more detail in the next section.

Here, financial investors only affect the matching process through their screening of applicants for funding. Debt reimbursements and wages are both negotiated and the technological aspects of the match are completely endogenously determined. We will start by characterizing the partial equilibrium and then show how multiple equilibria may arise in the general equilibrium

Equilibrium Relations in general equilibrium

In general equilibrium, the procedure of firm creation, production and destruction is not only run once but multiple times. Hence, new entrepreneurs will be able to react with their investment decisions on changing market conditions on both the financial and the labor market. Given the strategic complementarities between the different investment variables and the reaction in partial equilibrium of the different types of investment to either or both types of liquidity (see section 6.3.2, p. 114) we are expecting to see interesting interlinkages between the two markets.

[7] This section is based on Amable and Ernst (2003).

Proposition 6.5 *The simultaneous equilibrium on the financial and the labor market is determined by the following two relations:*

$$\frac{c}{p(\phi)} = \frac{1-\lambda}{(r+\sigma)(1-\lambda\chi)} \frac{q(\theta)}{r+q(\theta)} Y(\theta,\phi) \quad (6.17)$$

$$\frac{k+\eta^*}{\phi \cdot p(\phi)} = \frac{\lambda}{(r+\sigma)(1-\lambda\chi)} \frac{q(\theta)}{r+q(\theta)} Y(\theta,\phi) \quad (6.18)$$

where $\sigma = \overline{\sigma}$, $Y(\theta,\phi) = (1-\chi)\,(\psi(e^*)\,y(T^*,\eta^*) - m^* - e^* - b - \gamma(r+\sigma)) - (r+\sigma)\,\frac{T^*}{q(\theta)} > 0$ *and* $\frac{\partial Y(\cdot)}{\partial\theta} < 0$, $\frac{\partial Y(\cdot)}{\partial\phi} > 0$ *in equilibrium.*

Proof. See page 137. ■

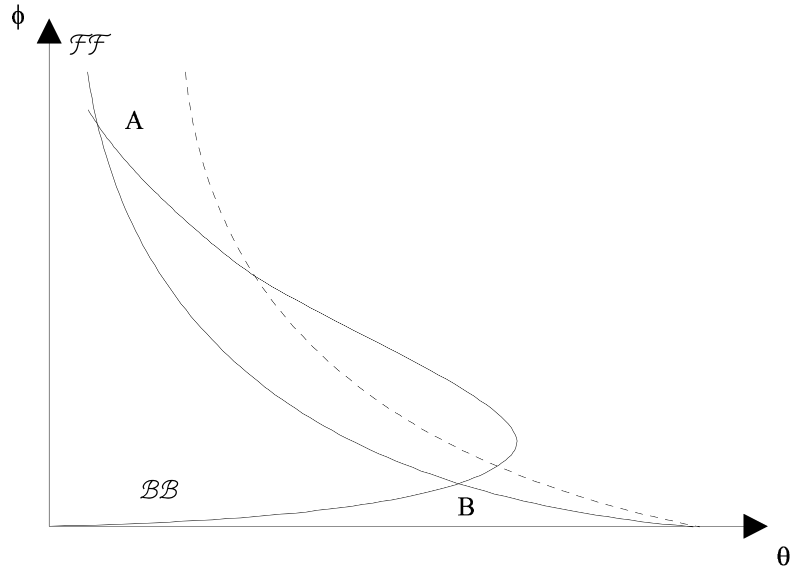
Moreover, given these two equilibrium relations, the following proposition can been shown to hold concerning the existence of equilibria:

Proposition 6.6 *Let the equilibrium relations be given by proposition (6.5). Then, there exists at most two equilibria.*

Proof. See page 137. ■

Figure 6.3 illustrates the shape of the equilibrium relations as well as the possibility for multiple equilibria to arise (only the downward-sloping branch of $\mathcal{FF}$ is represented).

Figure 6.3: Multiple equilibria and innovation regimes



Depending on the parameters , the model identifies two quite distinct regimes on both the labor market and the financial market. In equilibrium *A* both financial market liquidity - as measured by the ratio $1/\phi = \mathcal{B}/\mathcal{F}$ - and labor market liquidity - $\theta = \mathcal{V}/\mathcal{U}$ - are relatively tight from the point of view of financial intermediaries and workers respectively: Financial investors are getting more picky with strong firm competition for funds. At the same time, low labor market liquidity pushes firms to adopt more specific technologies while at the same time they can reduce their spending for more sophisticated monitoring technologies. The specific capital invested in a particular match is therefore particularly high in this equilibrium and can be protected through a relatively low liquidity on both financial and labor markets that reduces the value of the outside option for financial investors and workers.

On the other hand, in equilibrium B financial and labor markets are relatively liquid, allowing for a rapid turnover of firms and their workforce. Consequently, invested specific capital is low but the higher matching ratio on labor markets compensates for the loss in productivity in each single match. Without further specification of the production and matching process it is therefore impossible to Pareto-rank the two equilibrium that are qualitatively distinct.

Multiplicity of equilibria arises in this context due to a particular strategic complementarity between the incentive structures shaping specific investment undertaken by the three actors in the model. Following the discussion earlier, this type of market interaction refers to a situation of institutional complementarities (Aoki (1995); Amable, Ernst and Palombarini (2002)) as the incentive structures on different markets affect each other in providing a global incentive landscape in which the different agents locate their actions: In our case, the decisions to invest in particular technologies, T, to provide effort, e, and to monitor firms, η, are all interrelated in general equilibrium. Interestingly, only the monitoring of entering firms has non-trivial partial derivatives with respect to both θ and ϕ in partial equilibrium; nevertheless, the number of firms being endogenous in general equilibrium, both the technology choice as well as the effort decision will be affected by the monitoring effort and hence the financial market liquidity in general equilibrium.

Overall, market interaction creates the potential for multiple equilibria with structurally different characteristics that arise endogenously[8]. In particular, the differences in the extent to which equilibria A and B imply specific investments by stakeholders allows to draw a comparison to our earlier discussion regarding differences in sectoral performance across OECD countries. Consequently, the two equilibria not only differ in their aggregate macroeconomic performance but are likely to react differently to changes in the surrounding institutional and policy environment, an issue that we want to evaluate at some length in the following section.

6.4.4 Time horizons of market participants

In the previous two sections we have discussed the implications of institutional complementarities for the actors' degree of risk aversion and their incentives to undertake specific investments[9]. In addition to these two institutional links, actors' decisions may also interact regarding their time horizon. This will be the subject of the last of the three models we present in this chapter.

Contrarily to the degree of risk aversion that refers to the riskiness of an investment project and contrarily to the incentives for specific investments that refers to static effects of institutional links, time horizons have an impact on the discounting of future benefits: Investment projects may

[8] In the model of the preceding section, the strategic complementarity between agents did not produce multiple equilibria but allowed for otherwise inefficient institutional settings - employment protection - to fulfill a productive role.

[9] This section is based on Ernst, Amable and Palombarini (2004).

display profits only far in the futur given the huge and time-consuming up-front investments that have to be made. After realisation, this investment may be fully general and resold in case of a match destruction but whenever its profits are heavily discounted, alternative - short-term - projects may be favoured as they deliver much faster their benefits. It is around this topic that we want to discuss the effects of institutional linkages in the following paragraphs.

Going back to the original market interaction described in section 6.2 but concentrating on binary decision choices (high effort $e = 1$ vs. low effort $e = 0$, specific $T = 1$ vs. un-specific $T = 0$ technological choice, refinancing $\gamma = 1$ vs. short-term $\gamma = 0$ financing), a coordination problem between trade unions, financial intermediaries and firms arise in the multi-dimensional strategy space. Firms have access to a long- and a short-term technology where the productivity of the long-term technology crucially depends on stable labor relations: as soon as the firm is obliged to lay-off parts of its workforce, the technology does not yield any profits any more as it cannot profitably used with unexperienced workers. The short-term technology is more flexible and allows an easy rotation of the workforce which can be used a strategic weapon against strong wage demands.

Workers, on the other hand, have the possibility to bargain over wages (only) or to make use of an additional (costly) instrument to increase employment stability: following our setting we suggest that this second element is a favorable decision for human capital formation, h, which helps to reduce the idiosyncratic risk on the plant level. However, the firm's technology choice will affect their wage bargaining as it not only affects the value of their current match but also their outside option: the less specific the installed technology, the lower the probability to find a job with a bargained wage and the more time workers have to spend to search for a job with wage rents sufficiently high to pay for their human capital investment.

Lastly, financial investors have the choice to invest directly into the stock market or to join (or form) a bank. The first choice gives them the full access to the dividend flow whereas in the second case they have to bear intermediation costs. Both strategies have different impacts on the risk distribution and the availability of information in the economy. In particular, the refinancing strategy will help to stabilise output at the plant level as it reduces the exit probability of firms, i.e $\sigma(\gamma = 1) < \sigma(\gamma = 0)$. This, in turn, may improve incentives for both firms and workers to select their long-term strategy.

The marginal return to each type of strategy (either long or short term) is increased when at least one of the other players adopts the same strategy type (and even more so when both remaining players do). Hence, a coordination problem may arise - depending on the parameters - with equilibria that can be Pareto-ranked.

Strategic time horizons

Having defined the various pay-offs we can now determine the equilibria of this three players game. Firms have the choice over technologies, T, while trade unions chose the amount of human capital, h, they are ready to secure in the labor relation. Financial investors decide upon the degree, γ, to which they are ready to reschedule debt and to save failing firms from bankcrupcy. For the sake of analytical ease we want to limit the choice of financial relations on the level of the individual pool to the two extremes: banking ($\gamma = 0$; *FL*) versus arm's length finance $\gamma = 1$; *FS*). Forming a bank comes at a cost as the restructuring of failing investment projects will necessitate time and money to proceed. Moreover, the information produced by the firm through the stock market is no longer available; the bank has to go through costly monitoring in order to obtain the necessary information.

In order to simplify the representation, we are only considering binary choices such that $T \in \{0,1\}$, $h \in \{0,1\}$ and $\gamma \in \{0,1\}$ with the eight strategy combination denominated as (**S**,*s*,*FS*), (**S**,*s*,*FL*), (**L**,*s*,*FS*), (**L**,*s*,*FL*), (**S**,*l*,*FS*), (**S**,*l*,*FL*), (**L**,*l*,*FS*), (**L**,*l*,*FL*). In the following game, firms choose rows, trade unions choose columns while financial investors chose matrices.

Table 6.2: Strategic game between trade unions, firms and financial investors

Financial Investors	*Short term (FS)*		*Long term (FL)*	
Firms, Trade Unions	Short term (s)	Long term (l)	Short term (s)	Long term (l)
	$\delta\pi^e(T=0,\gamma=0)$	$\delta\pi^e(T=0,\gamma=0)$	$\delta\pi^e(T=0,\gamma=1)-c^B$	$\delta\pi^e(T=0,\gamma=1)-c^B$
Short term (S)	$W_1(T=0,h=0)$	$W_2(T=0,h=1)$	$W_3(T=0,h=0)$	$W_4(T=0,h=1)$
	$\pi^e(T=0,\gamma=0)$	$\pi^e(T=0,\gamma=0)$	$\pi^e(T=0,\gamma=1)$	$\pi^e(T=0,\gamma=1)$
	$\delta\pi^e(T=1,\gamma=0)$	$\delta\pi^e(T=1,\gamma=0)$	$\delta\pi^e(T=1,\gamma=1)-c^B$	$\delta\pi^e(T=1,\gamma=1)-c^B$
Long term (L)	$W_1(T=1,h=0)$	$W_2(T=1,h=1)$	$W_3(T=1,h=0)$	$W_4(T=1,h=1)$
	$\pi^e(T=1,\gamma=0)$	$\pi^e(T=1,\gamma=0)$	$\pi^e(T=1,\gamma=1)$	$\pi^e(T=1,\gamma=1)$

Given the structure of the game, the following proposition can be easily verified:

Proposition 6.7 *Given the above hypotheses concerning the technology choices and profit functions and*

(i) banking costs lie in the intervall:

$$\psi(e)\,y(1) - w^b > \frac{r\,(r+\overline{\sigma})\,c^B}{\delta\overline{\sigma}} > \psi(e)\,y(0) - w^b - rV^L(0) \;\; \forall w^b, e \tag{6.19}$$

with $\overline{\sigma} = \sigma(0)$,

(ii) and human capital investment has the following characteristics:

$$\frac{\eta\,(\sigma(\gamma)+\beta r)}{(1-\beta)\,(r+\theta-\overline{q}(\xi))} > y(0)\,(\psi(1)-\psi(0)) \;\; \textit{and} \;\; \frac{\eta\beta r}{(r+\theta)\,(1-\beta)} < y(1)\,(\psi(1)-\psi(0)) \tag{6.20}$$

*there exist two Nash equilibria in pure strategies in the above game: (**S**,s,FS) and (**L**,l,FL). The game is therefore a coordination game.*

Proof. See page 138. ■

Remark 6.1 *Given that* $\overline{q}(\xi) \in (0,1)$

$$\frac{\sigma(\gamma)+\beta r}{r+\theta-\overline{q}(\xi)} > \frac{\beta r}{r+\theta}$$

this second condition is not trivial, the coordination game structure therefore only emerges for human capital to have a sensibly different impact on the productivity of the two technologies. Moverover, notice that the first part of (8.5) depends on the availability of outside labor (which in turn may be influenced by net immigration). Therefore, when $\exists\bar{\xi}$ *such that*

$$\frac{\eta(\sigma(\gamma)+(1-\chi)r)}{\chi(r+\theta-\overline{q}(\xi))} < y(0)(\psi(1)-\psi(0))\,\forall\xi<\bar{\xi}$$

then only the long-term strategy will emerge.

Hence, the strategic complementarities that exist between the three decision variables T, γ and e create a coordination problem. As we have shown elsewhere (Amable, Ernst, Palombarini, 2000), in order to determine the equilibrium emerging in the long-run when the players face a problem of strategic uncertainty, the theory of global games can be used to find conditions under which either the long-run or the short-run equilibrium will be chosen. In general, low banking costs, high profitability of the long-run technology and low education costs will be beneficial for the ($\mathbf{L}$,l,FL)-equilibrium to emerge. However, in this contribution we want to concentrate on the possibility of endogenous stochastic processes as they emerge out of a macroeconomic demand spillover.

Evolutionary equilibria

In order to further characterise the constraints to which the two equilibria are subject to, one can recurr to additional game-theoretic equilibrium concepts, such as evolutionary game theory. Evolutionary game theory allows to strengthen the requirements for an equilibrium selection process whenever we can assume that agents are not perfectly rational and choose strategies more according to a predefined rule of thumb than by using well-known mathematical principles. Even that, however, does not always assure a unique equilibrium: In our above game the coordination structure continues to hold as the Nash equilibria are strict (i.e. the best reply set at each equilibrium is a singleton) and hence are also evolutionary stable (see Weibull, (1995), p. 37). We therefore have to use an even stronger concept, stochastic evolutionary stability introduced by Foster and Young (1990).

This concept is particularly appropriate when we want to analyze how conventional equilibria evolve over the long-run as agents are supposed to have imperfect recall about former situations and to experiment on new strategies and will therefore play the field with some (small) randomness. Agents therefore remain rational to the point that they are able to play their best replies (up to some experimentation). However, they base their expectations on past outcomes and use these to determine the optimal strategy. More specifically, each agent in the playing pool draws a random sample of k plays from the last m records. Each agent chooses his best reply relative to the observed distribution of strategies adopted by the other player in this sample. If we then consider any regular perturbed Markov process P^{ε} we can establish for any 2x2 coordination game that the process $P^{m,k,\varepsilon}$ converges with probability one to the risk dominant equilibrium of the coordination game (Theorem 4.1, Young (1998) p. 68).

In the above model this can be reconsidered as follows: Suppose agents will play their best replies againts some draw of k plays from the last m records almost always (”trembling hand”, experimentation with probability θ_l where l designs the player). The perturbation in this case comes then from the stochastic realization of idiosyncratic shocks, and from the individual probabilities with which the players experiment ("global game", see Carlsson and van Damme (1993)). However - as has been stated there (Carlsson and van Damme (1993) p. 996) - the equilibria of this global game have the same stochastic characteristics as the game initially analyzed by Foster and Young, i.e. players will choose the risk-dominant equilibrium. In order to apply this fact to our game we can consider any of the resulting 2x2 games when alining one player's strategic choice to any of the other players. Here, the most convenient way to do this is to aline trade unions' and firms' strategies as the bargained wage is not subject to any stochastic process (notice that the random shock is completely absorbed by the firm). We therefore want to concentrate on the analysis of the risk dominance of the firm's and the financial investors strategies; this reduced game may be denoted as G'. Simply adapting Carlsson and van Damme's theorem (1993, p. 996) we can state the following:

Proposition 6.8 *Consider game G' between financial investors and firms. The players are supposed to experiment with probability θ_l, $l \in \{Financial\ investor, Firm\}$; with probability $1-\theta_l$ they play their best reply against a history of k plays from the last m records. The short-term coordination equilibrium will be the generically stable one when the following inequality holds (at least weakly):*

$$\begin{aligned}(\pi_1^e(\gamma=1)-\pi_2^e(\gamma=1))(\Psi_1(\gamma=1)-\Psi_1(\gamma=0)) \geq \\ (\pi_2^e(\gamma=0)-\pi_1^e(\gamma=0))(\Psi_2(\gamma=0)-\Psi_2(\gamma=1)).\end{aligned} \tag{6.21}$$

Otherwise the long-term coordination equilibrium will be choosen.

Knowing that in the long-run we can concentrate on the characteristics of the risk-dominant equilibrium we want to consider more specifically its characteristics. Condition (6.21) allows us to see easily how the equilibrium selection changes under the influence of varying parameters.

Proposition 6.9 *Consider game G'. Then the long-run equilibrium (**L**,l,FL) becomes more generically stable as the cost of banking, c^B, decreases and as the long-term technology ($i = 2$) increases its profitability relatively to the short-term one.*

Proof. See page 138. ■

Especially the last point makes clear the origin of the institutional complementarity in this game as it directly compares the likelihood of reaching the pareto-efficient long-term equilibrium under assumptions 4 and 5: The use of a long-term strategy by unions increases the profitability of the long-term technology with respect to the short-term one even in the presence of banks. This increases the incentive for firms to use this technology conditionally on the fact that financial investors are ready to refinance the project even in the case of low expectations. Therefore, all three players have to use the long-term strategy to provide incentivs for the two others to do the same.

6.5 Isomorphism and institutional complementarities

When looking through the various complementary relationships identified in this chapter, one cannot help but to notice similarities between the mechanisms on the labor and the financial market that are involved in each institutional link (see table 6.1). In every instance, the two complementary institutional arrangements produce a similar incentive leverage, orienting the actors' decisions in the same direction. In particular, we structured our theoretical analysis around the three topics risk aversion, market liquidity and time horizon. In this final section we now want to further develop our theory of institutional complementarities that we started to lay out in the second chapter (see section 2.3.3, p. 48) in order to uncover more fundamental links that combine market- and non-price types of intermediation of individual actions into a powerful system for enhanced economic performance.

We will first discuss the structural similarities that lay behind institutional links that we have identified in the previous sections. The isomorphic structures that make up for the taxonomy in table 6.1 then represent the starting point for a discussion of the process of institutional fit. However, institutional fit is rarely intended and the divergence between institutional design and institutional outcome - otherwise referred to as institutional ambiguity - will turn our interests to the dynamics of institutional systems. As institutions make certain activities profitable, their dynamics render the institutional system pareto-superior. The discussion of the dynamics of institutional complementarities will then be the starting point of a more complete analysis in the next part.

6.5.1 Structural similarity and market interaction

Let us start our discussion of relations between structural similarity and institutional complementarities with a caveat. In fact, as Streeck (2002) notices, complementarity must be distinguished from both structural similarity and isomorphism. He continues:

> ”Organizations that belong to a given social system, or the institutions that form such a system, may be built according to similar blueprints or they may adhere to a common ’style’. This may be the result of diffusion, of social norms, or of a common repertoire of ’ways of doing things’, of historical experience or cultural dispositions.”

Nevertheless, institutions that follow a common style may not necessarily be functionally interrelated. While isomorphism may help tp improve the system's functioning, it does not necessarily account for links between institutions or institutional subsystems. There are instances of institutional systems where certain distributional norms - such as corruption and nepotism - may be generalized throughout the economy; however, despite their isomorphic structure they do not form complementary links that would help to improve economic performance, nor do the individual institutional arrangements improve the functioning of other institutions in adjacent socio-economic subsystems.

On the other hand - as we have noticed in the introductory paragraph to this section - complimentary institutions are characterized by isomorphic structures. Regarding table 6.1, we have identified three different types of isomorphic interaction: (i) the impact of institutional arrangements on agents' risk aversion; (ii) their impact on agents' incentives to undertake specific investment (in its various forms) and (iii) the impact of institutional arrangements on the time horizons actors have. In all three cases, institutional arrangements on one market increase their efficiency of soliciting a particular agent behaviour when structurally similar institutions exist on the other market. In this sense isomorphism is a sufficient but not a necessary condition for institutional complementarity, i.e. all complementary institutional relations are isomorphic but not all isomorphic structures form complementary relations.

The isomorphic structure of institutional complementarities rises, however, a number of questions that we want to discuss in this section. First and foremost, we are interested in analyzing how the particular condition of institutional complementarity is achieved; this goes beyond the analysis of how institutions may work together as it intends to show how they fit together in the absence of any intentional *ex-ante* fit. Second, we will have a look at the institutional dynamics that underlie and come about structurally similar institutional arrangements; this will be taken up in the next section and will form the main body of discussion in the following part of this book.

The type of institutional analysis at which we have proceeded in this and the last two chapters often leads economists to what is usually called the "functionalist fallacy", i.e. many researchers - especially in the New Institutional Economics vein - would subscribe to the idea that institutions exist because of their performance enhancing role; otherwise a selection mechanism would drive them out of the "market for institutions". This is, however, a short-cut from the economic analysis of institutions to their real-world behaviour and will often lead to false conclusions about institutional change and institutional design[10]. Analyzing the proper interaction of institutions with economic variables will therefore by of utter importance to understand how the isomorphic structure that seems to underly the complementary relationships comes about.

The ideal-type interaction between institutions and institutional subsystem, however, is rarely achieved by intentional design and that at least for two main raisons: First, it is highly unlikely that any individual actor is capable to assess to its very end the implications of his decisions for the evolution of the whole system; the market interaction links are simply too complex to be integrated in any decision process beyond the immediate and relatively easily analyzed first-order effects. Second, institutional change and design is not necessarily motivated by efficiency considerations but much more so by distributional objectives[11]: As we have noticed in passing in the first chapter, the political process will play an important role in the intermediation of individual decisions towards aggregate institutional change[12]. This may even lead to situations where actors oversee the efficiency enhancing role of the institutional system in place to point out unfavorable distributional consequences.

In general, then, there will be a divergence between the institutional design actors are putting forward and institutional outcomes of the process of fitting institutions together. In other words, institutions do not as a rule fit with each other because they were designed for this purpose. It

[10] It is very important to bear in mind that analyzing the economic impact of institutions is not the same as to say that their very existence is justified by their performance enhancing role. In this respect, the institutional links identified in this chapter do by no means imply that these relationships will emerge at one point in time given their superior economic impact.

[11] See Knight (1992).

[12] The issue of the relationship between the political economy and institutional change has been taken up in another contribution, see Amable et al. (2002). Given the complexity of the issue we deliberately have abstracted from this discussion here to concentrate solely on the efficiency aspects of institutional systems.

is important to bear in mind that institutional change can only take place against the background of an existing ”collection” of institutions already in place, whether they work as a system or not. Whether the new elements fit in the existing collection will then be determined also by the degree of ambiguity they allow in the implementation process: The degree to which certain aspects can be changed *ex-post* may allow for an easier fit in the exisiting system. On the other hand, particular institutions may constitute functional equivalents for other arrangements that have been identified as crucial for a certain complementary relationship. In this respect, the various forms under which an isomorphic type of institutional complementary comes in table 6.1 have to be interpreted as different realizations of a common underlying logic.

The ambiguity of an institution refers to a very important point. As can be see easily from the summary table 6.1, certain institutions may have different implications for actors' incentives and decisions, depending on the particular subsystem in which they are brought in[13]. All institutional arrangements are characterized by an absence of full determination of actors' decisions, simply due to the fact that the mere existence of an institution and the day-to-day implementation of its effect may differ in important ways[14]. Consequently, institutions usually leave room for interpretation and may give more or less option for actors' decisions to cover a wide variety of activities.

It is the ambiguous nature of institutions that allow for structural similarity and the emergence of a common ”logic” behind the whole institutional system where a general principle shapes a multitude of different relations. Moreover, it is this amgiuous nature that opens for the possibility that institutions - despite the rigidities that they introduce in the functioning of the economic system - may fit together, yielding a system of complementary relations. Existing institutions will mold agents' decisions in a certain way selecting only particular activities to be undertaken. Any additional institutional relation or any form of an institutional change has to accomodate these existing incentive structures and may allow for institutional complementarities when it helps to select complementary activities[15] by putting up new or different types of incentives for particular economic actors.

In some rare instances, however, a different phenomenon can be observed, usually referred to as ”institutional hierarchy”. Here, a change in a particular institution - or the introduction of a new institutional arrangement - will lead to the accomodation of the *remaining* institutional subsystem in such a way that the complete set of activities will be switched against another one, possibly exposing similar complementarities. In this situation the grip of the modified institutional arrangement is sufficiently strong to flip the entire logic of the given system around in order to impose a completely different system of incentives and constraints on individual actors[16]. Still, an isomorphic structure of institutional arrangements will be put in place that reorient the actors' decision processes in similar directions.

[13] See for instance the role of credit finance in the selection of investment projects: whether more risky projects are financed or projects with long term gestation periods depends on the labor market institutions in place.

[14] One may take the example of a central bank to clarify the difference: The formal independence of a central bank may still be circumvented in case of informal ties between senior management and political decision makers outside.

[15] Complementary to the existing set of activities that is.

[16] In the current situation, this is believed to be the case with financial market institutions. Modifying more relational-based finance to be replaced by competitive equity and bond markets may imply a disruption to the isomorphic, relation-based structures on the labor market.

The emergence of institutional complementarities as such can therefore be explained by a two-fold scheme. On the one hand, the complementarity of institutions is deeply rooted in the division of labour in any modern economy with almost all activities affected by some kind of transactional friction that cannot be solved by recurring to the market alone. And on the other hand by a set of institutions that need, however, not necessarily promote incentives for complementary activities. The fact that the performance landscape is characterized by multiple equilibria[17] and that ambiguous institutions may fit together when their ambiguity allows for the selection of any of these performance equilibria form the necessary and the sufficient conditions for the existence of a complementary relation between institutions.

6.5.2 Isomorphism and institutional dynamics

The ambiguity of institutions may also open up the path for particular, institutions-driven dynamics of the social system as well as for dynamics triggered by exogenous factors but multiplied through the institutional system. The precise impact an institution or an institutional system may have is underdetermined due to the ambiguous nature of institutions and has therefore to be specified by the economic subsystem or by some other, exogenous factors that are influenced outside the socio-economic system. Moreover, the isomorphic structure that lays over both the economic and the institutional subsystem simultaneously creates a potential tension that can result in sudden break-downs of the socio-economic equilibrium (see also section 2.4.1 where we introduced the concept of coevolution).

In particular, the slow evolution of the economic subsystem following the institutional impact may modify the conditions of existence for the institutional arrangements themselves; this will be called in the following the social composition effect. Besides this effect, due to the non-ergodic nature of any innovation process, there are also exogenous factors - such as the change of technological requirements - that may explain why institutions may enter into complementary relations at one point in time and leave them at a different point again.

In this section we therefore want to extent our discussion on isomorphism and institutional complementary to shed some light on the dynamics that may come about. The more formal treatment of these issues, however, will be left for the next part where we introduce a fully dynamically specified system that allows us to go deeper into the quantitative analysis of these issues. Here, we are mainly concerned with the qualitative consequences that result from the complementary relations that may exist between institutions.

Identifying possible dynamic links between institutions and the economy is not easy task. One can nevertheless identify at least three possible meachanisms: (i) An underlying change of the technology due to the continuous accumulation of innovations and the change of technological requirements that may directly affect the degree and quality of market frictions; (ii) a lock-in of technological trajectories due to an endogenous or exogenous institutional change that may make alternative institutional arrangements unviable; and (iii) the slight erosion of positive feedback links between institutions and the economy following a change in the social composition and the prevalence of negative ones due to the ambiguous nature of institutions.

The existence of technological regimes suggests that inherent technological requirements -

[17] As we have seen in the discussion in section 6.4.3.

determined outside the socio-economic system - may make perform industries differently in countries with distinct institutional systems[18]. However, these technological requirements may evolve over time and may affect the market frictions institutional arrangements are facing and the kind of structural similarity that has to exist between the two. Consequently, a change in the technological requirements of well-established industries may put a country's institutional system under stress, eventually leading to a break-up of the historical compromise that underlies the system. Moreover, technologies may benefit differently from distinct institutional systems during their evolution from being nascent to mature. An exogenous dynamic pattern of technological evolution may hence put pressure on any institutional setting from time to time[19]. Taking, for instance, a Schumpeterian pattern of waves of radical innovations followed by longer periods of incremental innovations as a starting point, one would easily be able to identify a certain subset of institutions that favor the raise of the wave while a different set of institutions would favor its spread.

Moreover, the dynamics of the socio-economic system may also be triggered by exogenous changes of the institutional subsytem leading possibly to socio-technological lock-ins. A technology set only constitutes a potential and not all technological trajectories are necessarily active at all time. When the selection of particular technological trajectories are characterized by important economies of scale, not pursuing one of these trajectories may close the associated institutional comparative advantage for countries durably. Politically decided convergence of institutional arrangements may therefore lead to an irremediable reduction in the available variety of technologies. Consequently, when one believes in evolutionary diversity (or in option theory for that matter), on normative grounds an institutional (and consequently) technological convergence would decrease world social welfare.

Finally, institutional change can come through the ambiguous nature of institutions and a social composition effect. These changes change the payoff structure of the game and agents redefine their strategies accordingly. As the discussion makes clear, payoff changes come in two forms: as a result of social composition and following deeper technological evolutions. In the first case, agents change their strategies as the strategy composition of society is affected which in turn modifies expected payoffs from random matching. When a society switches technological trajectories, payoffs are more profoundly affected as even without a different strategic composition, agents may consider to switch to a new strategy.

6.6 Conclusion

In the preceding chapter we presented an integrated model of the firm's life cycle and its interactions with financial investors and workers. Our objective was to show how in such a model imperfections on one market may spill over to the other market, thereby mutually influencing the macroeconomic outcome and giving rise to multiple equilibria. Given the multiplicity of transmission and market interaction channels, we discussed the different ordering principles that are underlying these interactions and developed a model around each of the three arising principles. In particular, we analysed how market interactions may affect the investment project selection through the agents' risk aversion, their specific investments through market liquidity effects and

[18] Such as the technological regimes we have described in chapter 3.
[19] This is the main theme of a recent paper by Acemoglu and Zilibotti (2002).

their time horizon through an effect of strategic complementarity. Finally, we discussed how these market interactions and institutional complementarities may arise endogenously in a framework of institutional change. In particular, we discussed the role of institutional ambiguity as an important leverage for institutional fit that is underlying these models.

The analysis in this chapter does not claim to be exhaustive. In fact, many other models can be found in the literature, that make use of similar market interaction mechanisms, albeit in a different context. For instance, the fact that lowering 'imperfections' or the level of 'frictions' does not necessarily produce the better macroeconomic performance - as we have shown in our model in section 6.4.3 is akin to similar results found in the literature on interactions between product and labour markets, such as (Amable and Gatti 2002) where higher competition on product markets may increase unemployment because of the presence of an effort incentive mechanism on the labour market. More generally, more 'liquidity' or 'flexibility' does act as a disincentive to specific investments in these models, be they work effort, entrepreneurial screening or innovative outlays.

Finally, the analysis in this chapter can be extended to account for a different industrial specialization a country may follow, corresponding to the different structural characteristics of the multiple equilibria that we detected. Indeed, different industries are identified by different technological characteristics that may determine the extent to which specific investment are necessary for its successful evolution. When only low levels of specific investments are required - or similarly when the marginal productivity of these kinds of investment is high - then lower market frictions may in fact lead to both higher employment and higher industrial growth. Conversely, where industries are characterized by high levels of specific investments, stronger frictions provide the necessary incentives for strong industrial performance. As in this situation, one size does not fit all, one might expect different industrial portfolios to be selected by countries characterized by different degrees of frictions on their credit and labour markets.

6.7 Appendix - Mathematical Details

Proof of propositions 6.2 and 6.3

Reaction to labor market liquidity.

Reaction to financial market liquidity. By inspection we can easily see that neither m^* nor T^* depend on ϕ. Regarding η^* we fully differentiated (6.14). This yields:

$$\frac{d\eta^*}{d\phi} = -\frac{\xi(v^*, T^*)\,(1-\lambda\chi)\,(A\,r\,(1-\lambda) + C\ (1-\lambda\chi))\,p(\phi)\,p'(\phi)}{(r+\sigma)\,(C\ (1-\lambda\chi) - A\ (1-\lambda)\ p(\phi))^2\,\delta'(\eta)}$$

where $A = \gamma\,(1-\chi) + \frac{1-\chi}{r+\sigma}\widetilde{Y} - \frac{T^*}{q(\theta)}$ and $C = k\left(\frac{r}{q(\theta)} + 1\right)$. Given that $p'(\phi)$ is negative, this derivative is unambiguously positive.

Proof of proposition 6.5

In equilibrium, no entry opportunities will be missed, hence $B_0 = 0$ and $F_0 = 0$. Together with $B_3 = F_3 = 0$ this yields:

$$B_0 = 0 \Leftrightarrow B_1^b = \frac{k+\eta^*}{\phi \cdot p\,(\phi)}$$
$$F_0 = 0 \Leftrightarrow F_1^b = \frac{c}{p\,(\phi)}$$

which defines the backward-looking relations of firm and bank values. Moreover, the forward-looking values for B_1 and F_1 can be obtained by plugging B_2 and F_2 into (6.5) and (6.3). This yields:

$$B_1^f = \lambda\frac{\frac{1-\chi}{r+\sigma}q(\theta)\,(\psi\,(e^*)\,y\,(T^*,\eta^*) - m^* - e^* - b) - (T^* + \gamma\,(1-\chi))}{(1-\lambda\chi)\,(r+q(\theta))}$$
$$F_1^f = (1-\lambda)\,\frac{\frac{1-\chi}{r+\sigma}q(\theta)\,(\psi\,(e^*)\,y\,(T^*,\eta^*) - m^* - e^* - b) - (T^* + \gamma\,(1-\chi))}{(1-\lambda\chi)\,(r+q(\theta))}$$

Noting that in equilibrium $B_1^b = B_1^f$ and $F_1^b = F_1^f$ and using (6.14) to substitute η^* the two equilibrium relations follow immediately.

Proof of proposition 6.6

Following the results that apply in partial equilibrium and the concavity of y, $Y\,(\theta,\phi)$ will react negatively to changes in labor market liquidity, while it has an ambiguous sign with respect to ϕ. $\mathcal{FF}$ describes a downward sloping graph in the (ϕ,θ)-quadrant for low ϕ, while it is upward sloping for large ϕ.

Regarding the $\mathcal{BB}$ schedule, the right-hand side unambiguously decreases with increasing labor market liquidity, θ; the overall sign therefore depends on its reaction to ϕ. Here, the right-hand side of the equation increases with ϕ while the left-hand side of the equation has an ambiguous reaction with respect to ϕ, leaving the overall sign ambiguous as well. However, as both the numerator and the denominator of the left-hand side increase monotonically with financial market liquidity, only one crossing points exists, yielding at most one maximum or minimum. Given that the numerator of the left-hand side unambiguously decreases with θ, the sign of the partial derivative of $\mathcal{BB}$ with respect to ϕ will be determined by the denominator of the left-hand side for low θ and by the numerator of the left-hand side for high θ; in total this yields a $\mathcal{BB}$ -schedule that takes a minimum in the $\theta-\phi$-quadrant.

Proof of proposition 6.7

In order for a coordination game between (**S**,*s*,*FS*) and (**L**,*l*,*FL*) to exist we must have for financial investors (see game 1):

$$\Psi_1 > \Psi_2 \text{ and } \Psi_3 < \Psi_4 \tag{6.22}$$

with

$$\Psi_1 (T = 0, \kappa = 0, h) = \delta\pi^e (T = 0, \kappa = 0) = \delta \frac{p(h)\, y(0) + \bar{s} V^L (T) - w^b}{r + \bar{s}} \tag{6.23}$$

$$\Psi_2 (T = 0, \kappa = 1, h) = \delta\pi^e (T = 0, \kappa = 1) - c^B = \delta \frac{p(h)\, y(0) - w^b}{r} - c^B \tag{6.24}$$

$$\Psi_3 (T = 1, \kappa = 0, h) = \delta\pi^e (T = 1, \kappa = 0) = \delta \frac{p(h)\, y(1) - w^b}{r + \bar{s}} \tag{6.25}$$

$$\Psi_4 (T = 1, \kappa = 1, h) = \delta\pi^e (T = 1, \kappa = 1) - c^B = \delta \frac{p(h)\, y(1) - w^b}{r} - c^B \tag{6.26}$$

Substituting (6.23)-(6.26) into (6.22) leads to condition (8.4).

Given that (8.4) holds, the condition for trade unions boils down to the following two inequalities:

$$W_1 > W_2 \text{ and } W_3 < W_4 \tag{6.27}$$

where $W_1, \ldots, W_4$ represent job values under different strategic choices with

$$W_1 (T = 0, \kappa = 0, h = 0) = \frac{(1-\sigma)\left(p(0)y(0)+\bar{s}V^L(0)\right)(r+\theta-\bar{q})+(r\sigma+\bar{s})R}{r\left[r+\bar{s}+(\theta-\bar{q})(1-\sigma)\right]} \tag{6.28}$$

$$W_2 (T = 0, \kappa = 0, h = 1) = \frac{(1-\sigma)\left(p(1)y(0)+\bar{s}V^L(0)\right)(r+\theta-\bar{q})+(r\sigma+\bar{s})(R-\eta)}{r\left[r+\bar{s}+(\theta-\bar{q})(1-\sigma)\right]} \tag{6.29}$$

$$W_3 (T = 1, \kappa = 1, h = 0) = \frac{(1-\sigma)\, p(0)\, y(1)\,(r+\theta) + \sigma R r}{r\,[r + (1-\sigma)\,\theta]} \tag{6.30}$$

$$W_4 (T = 1, \kappa = 1, h = 1) = \frac{(1-\sigma)\, p(1)\, y(1)\,(r+\theta) + \sigma\,(R-\eta)\, r}{r\,[r + (1-\sigma)\,\theta]} \tag{6.31}$$

where $\bar{s} = s(0)$ and $\bar{q} = q(0)$. Substituting (6.28)-(6.31) into (6.27) leads to condition (8.5).

Proof of proposition 6.9

The following provides the proof for the propositions (3) and (4). Condition (6.21) can be rewritten as follows:

$$\frac{c^B}{r} \geq \pi_2^e (\gamma = 0) - \pi_1^e (\gamma = 1)\,.$$

Ceteris paribus, the ratio π_2/π_1 increases with A_2/A_1 making it more and more unlikely for the inequality to hold. The other results stated in the proposition follow be simple inspection.