Exploration of markets at distant shores:
Knowledge, investment and governance in the 15th century
Portuguese trade with West Africa*

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Abstract: In the paper the economic organisation of the Portuguese trade with West Africa and of later Portuguese explorations is addressed. The theoretical framework used herein is that of innovation processes. Undoubtedly, exploration of distant shores and overseas trade were serving the proper interests of merchants, courtiers, military orders and the royal family. The establishment of trade relationships with West Africa became possible, because knowledge of seafarers on nautical issues combined with the commercial interests of merchants and the capital available from military orders and noblemen who were looking for profitable investment. The Portuguese Crown played a key role in mediating these interests, in defining goals of exploration and market development and as a back up for commercial risks of private persons. It also provided adventurers and merchants with organisational routines, partly to make it easier for them to carry out exploration and trading voyages, partly to monitor closely trade operations. Finally, the Crown developed different schemes of trade licenses to assure itself against the contractual risks of adverse selection and moral hazard that evolved from licensing its exploration and exploitation monopoly to agents.

Focus of the paper

Although the voyage of Christopher Columbus into the Caribbean in 1492/93 and the opening of the Cape-route to India by Vasco da Gama’s trip in 1497–99 are commonly regarded as milestones in the commercial transition from the Middle Ages to the early modern period, overseas expansion of Europeans started much earlier. Already from the early 15th century onwards the Portuguese had begun to expand overseas systematically, conquering and colonising the Atlantic archipelagos of Madeira and the Azores as well as exploring the West African coast southward. In the 1440s and 1450s they established a profitable trade with West Africa. Spices, ivory, gold and slaves were brought to Portugal and sold to all across Europe, this contributing significantly to the revenues of the Portuguese Crown by the middle of the 15th century.

For economic history the Portuguese trade with West Africa is important mainly for two reasons: Firstly, because there was a clear aim of the Portuguese Crown at using overseas trade as a valuable source of income, and this in turn made necessary

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considerable investment into exploration and market development at distant shores. Secondly, since it was a precursor of the European overseas expansion in the 16th century, the trade with West Africa was a sort of testbed for all later commercial endeavours of Portugal. Not only nautical knowledge was accumulated in these early stages. More importantly, also methods of fund-raising and trade administration, sophisticated trade license schemes and an approach to monopolise and restructure existing trade of indigenous populations all were developed during the 1440s and 1450s and could then be used later on with much greater experience in India, South-East Asia and Brazil. The exploratory efforts of the Portuguese enabled early modern European expansion and thus marked the beginning of the presence of European culture all over the globe. Even the discovery of the American continent, although resulting from Spanish efforts, was significantly spoiled by the knowledge and experience that has been collected by Portuguese seafarers earlier on.¹

Given the enormous historical importance of the Portuguese overseas expansion, it is worthwhile taking a closer look at certain economic aspects of the issue. In order to elaborate the management of explorations in more detail, the following questions will be discussed, after having given an overview of the Portuguese expansion of the 15th century and a brief sketch of the theoretical framework in the next two sections of the paper:

- What were the technological and organisational prerequisites needed to set off the exploration process in early 15th century Portugal?
- Which instruments were used to manage the exploratory efforts and to handle the uncertainty stemming from the cooperation with explorers who obviously had to fulfil their task at distant places and therefore could hardly be monitored?
- Is it possible to distinguish different phases in the progress that Portuguese seafarers made in sailing toward Guinea, the Cape of Good Hope and the Malabar Coast in India?

¹ Christopher Columbus had close connections to the Portuguese Crown, and in 1488 he was an eyewitness of the return of Bartolomeu Dias’ expedition, the first ever to succeed in doubling the Cape of Good Hope, and he was a participant of the reception king John II gave for Dias at the royal court in Lisbon.
Overview of the Portuguese expansion in the 15th century

The overseas expansion of the Portuguese has started sometime after 1415 in a systematic manner. This particular date is symptomatic, because in this year the port of Ceuta, held by the Muslims, was besieged during a Portuguese military campaign under the command of King John I and his sons Eduard, Peter and Henry. Ceuta by that time was one of the Maghrebian trading centres that were located at the northern end of trading routes on which Muslim caravan traders brought salt and gold from inner West Africa via Timbuktu to the Maghreb and into the Mediterranean. Although Ceuta was captured by the Portuguese after a short siege only and thereafter also could be held by them, the campaign as a whole was more or less a failure. Since the Muslim traders immediately relocated their operations to other towns, the Portuguese never were able to get this profitable trade under their control, which is thought to have been their primary goal with the Maghrebian campaign. This geostrategic failure served as a sort of starting impulse for the extensive overseas expansion into the Atlantic then to begin, after the Portuguese royal family had decided to support the exploration projects of numerous adventurers and merchants. Very likely, the rationale behind this strategy was to attempt at gaining direct access to the places in West Africa from where the valuable commodities came, instead of relying on the Muslims’ services to be provided with these goods.2

The Portuguese overseas expansion then developed in different directions. One focal point was the rediscovery and the conquest of the archipelagos of Madeira and the Azores in the 1420s and 1430s. These islands became part of the princely demesne and were colonised by settlers thereafter. Madeira, for instance, quite soon was developed into a centre for the cultivation of wheat, sugar and wine, products that were sold with high profits in the Portuguese mainland.3 Another focal point of the expansion was the exploration of the West African shores. There, as a result of continuous efforts, Portuguese mariners advanced in the 1430s and 1440s from cape

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3 Madeira and Porto Santo, the two islands of archipelago were rediscovered between 1418 and 1425. Tristão Vaz Teixeira (Madeira) and João Gonçalves Zarco (Porto Santo) were the two first governors who began with the islands’ colonisation and started the cultivation of wheat, sugar and wine there. The Azores were discovered in 1427 by Diogo de Silves and were systematically explored by Frei Gonçalo Velho Cabral in 1432. Similarly to the Madeira islands the Azores became part of the demesne of Henry the Navigator who in 1439 gave permission to colonise the islands. The settlers there concentrated on grain cultivation and sheep breeding. Cf. PINHEIRO MARQUES 1990; HAMANN 1979, col. 1171f.
to cape until Dinis Dias by doubling the Cape Verde reached Sub-Saharan Africa in 1445.\textsuperscript{4} Only about a decade later, by the late 1450s the Portuguese had already reached the Pepper Coast in Liberia and the Cape Verdean islands as well.\textsuperscript{5} In contrast to their strategy of conquest and colonisation pursued on several islands in the Atlantic, the Portuguese did not try to colonise the African mainland. Instead they built trading posts such as Arguim and, later on, São Jorge da Mina.\textsuperscript{6} In using such trading posts and various other contacts to local people\textsuperscript{7}, by the 1450s they had established a fairly complex and extremely profitable trade with African tribes, bringing slaves, gold, ivory, spices and all other sorts of valuable goods to Portugal.\textsuperscript{8} As the Portuguese claimed a monopoly on the exploration of West African shores south of Cape Bojador and the exploitation of resources there to be found, a claim that was confirmed in a series of papal bulls throughout the 1440s and 1450s\textsuperscript{9}, their trading position in those times was rather unchallenged. For adventurers and merchants, but also for the royal family and the courtiers of the Portuguese royal and princely courts explorations were quite a profitable enterprise. Infant Henry, better known as Henry the Navigator, played a leading role in the promotion of the overseas explorations. His brothers also financed exploration voyages, and many courtiers invested in such undertakings or even owned ships by themselves.\textsuperscript{10}

For the period of 1469–75, the monopoly of exploration and exploitation of newly discovered shores was transferred to a merchant from Lisbon named Fernão Gomes, who paid in return for this a fixed annual license fee to the Portuguese Crown.\textsuperscript{11} Gomes’s strategy was in a way twofold: he organised enterprises to West Africa on an annual basis and equipped for this purpose squadrons of up to 20 ships from

\textsuperscript{4} The breakthrough to West African waters came when Gil Eanes in 1434 succeeded in sailing round Cape Bojador, a cape where the Portuguese expeditions had failed several times before as the chronicler Gomes Eanes de Zurara writes in the early 1450’s in his Crónica dos feitos notáveis que se passaram na conquista da Guiné por mandado do Infante D. Henrique. See for the edition of this chronicle in the original contemporary Portuguese and in modern Portuguese SOUSA SOARES 1978.

\textsuperscript{5} It was Pedro de Sintra in 1460 who doubled the Cape Mesurado. In 1456 the Venetian adventurers Alvisio Cadamosto and Antoniotto Usodimare discovered the eastern islands of the Cape Verdian archipelago which were explored two years later by Antonio da Noli and Diogo Gomes. The western islands were discovered by Diogo Afonso in 1460. See on this DIFFIE 1960, p. 37.

\textsuperscript{6} Cf. BALLONG-WEN-MEWUDA 1993, pp. 51–70 and pp. 155–186.

\textsuperscript{7} See for an overview and an analyis of various forms of contact between the Portuguese and nativea ELBL 1992, p. 165–204.

\textsuperscript{8} Cf. BIRMINGHAM 2000, pp. 27–48.

\textsuperscript{9} Such papal bulls were issued in 1443, 1455 and 1456. Cf. OLIVEIRA MARQUES 1998, p. 165.

\textsuperscript{10} Cf. NEWITT 1986a, p. 3f.; OLIVEIRA MARQUES 2001, p. 91.

\textsuperscript{11} Gomes had to pay 200,000 Reais per year to the Crown for using all rights exclusively. In return for another 100,000 Reais annually he also had the monopoly of the trade with Malagueta Pepper. Cf. HAMANN 1968, p. 81–84.
which most were used for trade at the already known trading facilities, whereas one or two vessels were scheduled to dig deeper into the Gulf of Guinea that was so far unknown. Within his contract with the Portuguese Crown Gomes had committed to the substantial advancement of discovery and knowledge about African shores, and by employing this multilateral pattern of exploration he not only was able to finance his expenditures including the due license fee, but also could easily fulfil the contractual obligation of discovering shorelines of a certain length each year.\(^\text{12}\) During this period shores along the Gulf of Guinea were explored systematically and Lopo Gonçalves was the first European to be recorded crossing the Equator.\(^\text{13}\)

Had the process of the Portuguese expansion and discovery up to the 1470s been focussed merely on the exploration and exploitation of the West African coast, it was only by the mid 1470s under the auspices of Infant John, the later King John II, that discovering activities of Portuguese seafarers were reorganised and redirected to find a sea route to India round the African continent. In 1474 King Afonso V had transferred the Crown’s responsibility for the African project to his son John\(^\text{14}\), and after the Portuguese-Castilian war of 1475–79 during which the Portuguese trading monopoly for Africa was seriously challenged by Castilian ships\(^\text{15}\), the organisation of the exploration voyages completely changed. The Portuguese trading voyages to West Africa were continued of course and could even be intensified, as Castile in the treaty of Alcáçovas with Portugal in 1479 had accepted Portugal’s claim for a monopoly of Portuguese ships in all waters that lie south of Cape Bojador and the Canary Islands. Henceforth, voyages to the so far unknown Southwest African shores looked more like as being real expeditions. These latter enterprises were fully financed by the Crown and were scheduled to explore the coastal conditions, and not to find new opportunities to trade, one reason for this being of course the barely attractive character of shores in that region which made it almost impossible to hire private merchants for this kind of voyages. A much more important reason was, that reaching the Malabar Coast of India, which was the place from where many of the expensive spices were traded by Arab and Venetian merchants to Europe, had been

\(^\text{12}\) This obligation was to newly discover shorelines of a length of 100 *Leguas* (about 600 kms) per year.

\(^\text{13}\) The expeditions were commanded by Jão de Santarem, Pero de Escobar, Martim Fernandes and Alvaro Esteves (1470/71), Fernão de Poo (1472/73), Lopo Gonçalves (1473/74) and Ruy de Seguira (1474/75). Cf. HAMANN 1989, col. 1784f.

\(^\text{14}\) Cf. DIFFIE/WINIUS 1977, p. 147f.

clearly defined as a goal to be attained by the exploratory enterprise.\textsuperscript{16} The shorelines already known to Portuguese seafaring were expanded to the delta of the River Congo and beyond with the two expeditions carried out under the command of Diogo Cão in 1482/83 and 1485/86.\textsuperscript{17} In 1488 Bartolomeu Dias was able to sail round the Cape of Good Hope, but after this his expedition finally failed to go much further ahead.\textsuperscript{18} In terms of the knowledge and experience that was gained with them, this later series of discovery expeditions certainly prepared the missing final step on the way to the Malabar Coast, which was successfully taken then by Vasco da Gama and his crew who landed in the port city of Calicut in 1498.\textsuperscript{19}

What finally followed was again a complete restructuring of the whole exploration enterprise, bringing the Kingdom of Portugal to the extremely powerful global position it was in during the 16\textsuperscript{th} century when European colonialism started. Within a few years only, the Portuguese were able to organise trading voyages to India on an annual basis, with squadrons made up of numerous trading ships. Italian merchant bankers and firms from Upper Germany soon applied for participation in the successful Portuguese spice trade and obtained privileges from the Portuguese Crown allowing them to equip single trading vessels of the convois to India in return for a share they had to pay of the commodities they carried from India back home to Lisbon. All trading activities of Portuguese vessels in West Africa, in Guinea and at the Malabar Coast were administered by the Casa da Guiné, da Mina e da Índia, a central trading organisation which had been formed in 1503/04 from the older Companhia de Lagos and was based in Lisbon, being under direct supervision of the King of Portugal.\textsuperscript{20}

The innovation characteristic of overseas explorations: theoretical considerations

Research into historical discoveries in general also bears an economic theoretical dimension. The process of discovery itself is an innovation insofar as new knowledge – in the case of the Portuguese overseas expansion knowledge about commercial opportunities at distant locations – is produced by developing new technologies or

\textsuperscript{16} How eager the Portuguese were to gain access to the spice trade with India can be seen from the organisation of the project. In parallel to the expedition of Bartolomeu Dias two envoys, Pero de Covilhã and Affonso de Payva, were sent eastward to the Arabian peninsula and to India in order to gather information on the trading conditions in the ports at the Arabian sea. Cf. NEWIT 2005, p. 53f.

\textsuperscript{17} Cf. HAMANN 1968, pp. 130–262; AXELSON 1973, pp. 39–96.

\textsuperscript{18} Cf. HAMANN 1968, pp. 275–336.

\textsuperscript{19} Cf. SUBRAHMANYAM 1997, pp. 79–94, pp. 112–121 and pp. 128–149.
through combining already known techniques in a manner unknown before. It is rather a commonplace statement that such an innovation in most cases is based on the efforts of many individuals for which in turn an efficient coordination of collective actions was needed to succeed. Moreover, this kind of endeavour usually was equipped with multiple resources which had to be managed efficaciously. Thus, treating the discoveries as innovation processes opens them to an analysis on the grounds of management science categories.

How was the sequence of exploration managed, or more precisely, by which institutions was it initiated and controlled? And what can be said about goal definition? These two questions are pertaining to the management aspect of innovation. Regarding the management of innovation, two points shall be made herein, the existence of several promoters or promoting instances of innovations and the structure of goal definition. For many empirical examples it has been found, that a gradual definition of goals is the rather normal procedure to focus forces.\(^{21}\)

In general, in management science different management roles in processes of innovation are assumed, each of these roles being capable of surmounting specific barriers to the innovation.\(^{22}\) Innovations can fail or can even not be set off because potential innovators do not have the knowledge necessary to innovate. In a situation like this there would be a barrier of »not knowing« to a potential innovation. However, if potential innovators do not want to innovate, there would be a barrier to an innovation as well, a barrier of »not wanting«. The barrier of »not knowing« can be surmounted with the help of technical equipment used by so-called technical promoters, that is by people who do have the knowledge necessary and who do know what to do in order to innovate. However, this sort of promoter usually fails in getting over barriers of »not wanting«, barriers of ignorance so to speak. Thus, the adverse effect of this latter type of barrier can be neutralised by a so-called power promoter, a person who is capable and determined to set off or to continue a process of innovation even against resistance of opponents.\(^{23}\) One result of the research into innovation processes is that innovations typically need a well coordinated cooperation of both power promoters and technical promoters to finally succeed.\(^{24}\)

\(^{20}\) See in more detail EWERT 2009.
\(^{21}\) Cf. HAUSCHILDT 1993, p. 116f.
\(^{22}\) Cf. HAUSCHILDT 1993, p. 116f.
Overcoming the barrier of »not wanting«: minimisation of commercial risks, goal definition and license schemes of trade

It seems not quite clear yet, why exactly the process of the Portuguese discoveries was set off, and it is a rather intriguing question, why it happened not until the early 15th century although many of the necessary ingredients had been present already in the 14th century. Fairly enough merchants, many of them of Italian prominence, operated in the Portuguese port cities, to form a group of potential innovators. Moreover, Portuguese seafarers had a very good expertise and reputation in nautical affairs, as they could build and handle ships that were capable of crossing the high sea.

A participation dilemma, prevention of free-riding and risk-minimising institutions

The main issue to be focussed is certainly the uncertainty that was related to any kind of expedition into the Atlantic waters, this may either be a raid or a trading voyage. Initially existing uncertainty is quite a typical problem arising with innovations, and solving it contradicts in some sense the common assumption of rational behaviour that is made in economic theory. Treating it as a classic investment problem is a good approach indeed, because by this it can be explained, why merchants and seafarers behaved in a rational manner when they refrained from sailing onto the Atlantic. Since almost no experience had been made with this sort of enterprise before, it must have been impossible for them to calculate not even the risk of such expeditions. This was completely different for the trading voyages to Flemish and English ports which were made on a regular basis during the 14th century. Thus, lacking expectations regarding the likelihood of returns on investment for voyages into the unknown waters of the South Atlantic presumably had diminished the present value of potential investments below zero, meaning that these investments better should not have been done at all. Much the same holds for the rich courtiers at the Portuguese royal court, who could have served as potential financial bakers of such expeditions, but who in principle were not able to correctly estimate future returns of trading opportunities in West Africa.

26 Some very few expeditions onto the Atlantic had been undertaken in late thirteenth and early fourteenth centuries. Two of these enterprises, the one of 1335 and that of 1341, had been co-sponsored by the king of Portugal, Affonso IV.
The problem of uncertainty became even more complicated due to its economic characteristics. Knowledge about trading opportunities and valuable resources to be found at distant shores in a way can be treated as a public good. Once discovered, it could not be held secretly and would spread rather costless throughout the whole merchant community. As a consequence, a free-riding situation emerged, even though potential explorers would have been able to estimate the risk they would have had to bear with their investment. Anyone who decided to make such an exploratory effort would have been at risk that other potential explorers would take his discoveries for free. By this an additional barrier to investment was set.28

As no one wanted to take the first step onto the Atlantic, this caused a sort of participation dilemma, and the situation definitely called for an institution through which potential exploratory activities could be coordinated in a sense that incentives were set for investments and to prevent agents from free-riding. The chronicler Gomes Eanes de Zurara described the problem of lacking incentives fairly precisely when he wrote in the early 1450s, that neither sailor nor merchant would take the risk of an expedition, if it not was directed to a place where some profits could be made.29 He was well aware of the fact, that a coordinating instance had been needed to kick off the process of discoveries. Exactly this sort of coordinating role was played by the royal family, especially by Prince Henry, but also by his father, King John I, and by his brothers Edward and Peter. Claiming the monopoly for exploration and trade, a claim that has been confirmed by the papal court, meant being able to transform the originally public good into a club good which then was licensed for exploitation purposes to merchants and adventurers willing to make exploratory voyages. The members of the royal family also were able to connect the financial capital of their courtiers and that of the Portuguese orders of knights with the manifold interests to equip exploratory voyages, and thus potential explorers could be provided with a sufficient amount of financial capital. In addition, there existed an much older institution of a sea insurance which helped to cope with uncertainty and which was now activated.30 By applying these mechanisms it was possible to overcome the existing bar-

28 See for a more detailed discussion of this issue Ewert 2008.
30 This insurance, called bolsa, was financed through payments from ship owners and seafarers who had to pay 2 percent of the outgoing freight their ships carried onboard. Having made this payment they were eligible to obtain a compensation for potential losses and damages that were due to their voyage. Originally the bolsa was founded by King Dinis in 1293, but King John I renewed this institution in 1397. Cf. Diffie 1960, p 69.
rier of »not wanting« and to set off the discovery process, because incentives to invest in such explorations were set and the initially existing unmanageable uncertainty was changed to a risk that at least could be handled to a certain extent.

**Definition of goals**

Claiming the monopoly for exploration and trade was the result of a rather complex process of goal definition by the Portuguese Crown. It is quite a vivid but nevertheless partly false legend, created namely by the chronicler Gomes Eanes de Zurara, that Henry the Navigator was the powerful general manager of an exploration project that has been focussed on West Africa from the very beginning.\(^{31}\) Within the process of Portuguese discoveries the first goal had been a twofold one, namely the conquest of fertile islands in the Atlantic and the raids at the Muslim-held shores of Northwest Africa. Only after years this scope changed to the profitable trade with gold, spices and slaves in West Africa. And it has been only in the final stages of the discoveries, more than a decade after Henry’s death, that finding the cape-route to India was defined as the primary goal to be attained by future explorations. However, defining goals concerning the exploration of the Atlantic and of the West African shores was also a viable strategy to surmount the barrier of »not wanting«, and it turned the members of the royal family into the very power promoters of the whole endeavour.

**Licensing of explorations and a changing governance**

A further problem that was due to the structure of explorations in the 15\textsuperscript{th} century was that of control. As seen above, the royal family could help in various ways to set off the discovery process – not an unselfish attempt of course, since the discoveries generated income to the members of the royal family –, but obviously neither Henry the Navigator nor his brothers, the king or any other financial baker from the royal court or one of the military orders could undertake such explorations by himself. Participating in the returns on investments that had been made by numerous people therefore meant to find solutions to the problems of governance and agency. As seen above, a fairly clever solution that was found to these problems was to license the right to make an exploratory voyage to merchants and adventurers.

Such agreements in general can be analysed in a principal-agent framework using contract theory. This allows for historical contractual designs to detect potential risks of adverse selection and moral hazard and the precautionary measures taken against these risks. In contract theory two ideal type contract designs are distinguished. A fixed price contract in which an agent is payed a fixed sum that has been negotiated beforehand in return for his efforts, is somewhat risky for the principal insofar as an agent who is clever enough to deceive the principal regarding his real costs will earn an information rent. The principal has to be aware of a potential adverse selection. In contrast, a cost-plus contract in which the agent is reimbursed for all his costs and is payed in return for his efforts with a share of his costs is more prone to the risk of an agent’s moral hazard, because this particular design provides no incentive for the agent to act in an efficient manner. Thus, the principal who cannot control the agent while the agent is fulfilling his task, has to take the risk of paying the agent too much for a too less efficient result. The framework of contract theory can also be applied to license agreements. Although in such agreements the agent is paying the principal in return for being allowed doing a particular thing instead of getting payed for his efforts, the incentive structure remains practically the same.

From chronicles it is known, how in the era of Henry the Navigator these license agreements in principle were designed. Potential explorers could choose out of two variants. They either could opt to pay themselves all things necessary for undertaking an exploration voyage including the freight to be brought to Africa, or instead Prince Henry was organising the full investment including hiring a ship. In the latter case the license fee to be payed after the explorers’ return from Africa was half the value of the commodities they brought back home to Portugal, whereas in the former case it was only a quarter. This kind of license agreement was structured similar to the cost-plus contract that is discussed in contract theory. In principle, the licensor (the principal) was not able to control what exactly the licensee (the agent) was doing or whether he was doing it efficiently. As the licensees were fulfilling their tasks

33 See for the examples of contracts in armament and construction industries in the Third Reich STREB/STREB 1998 and STREB 2006.
35 The Venetian adventurer Alvisio Cadamosto was hired by Henry the Navigator in 1455 for explorations. In 1455 and 1456 he made to voyages to West Africa and wrote a report that was published in 1463 under the title *Navigazioni* and in which he described the circumstances of such voyages.
thousands of miles away from Portugal, this general problem is quite evident in the case of Portuguese discoveries. Nevertheless, by profit sharing obviously a solution to this risk of moral hazard was found. And as seen above, the more risk the licensee was willing to bear himself, the more profit he could make himself from the trade goods he brought back to Portugal.

Transferring all monopoly rights for Guinea to a merchant for a fixed annual license fee in 1469 meant a profound change in the explorations’ licensing policy of the Portuguese Crown. This nevertheless was not a quite extraordinary step as may seem at first glance. The principle of licensing monopoly rights for fixed sums had been practised before for a wide range of commodities from West Africa. The advantage of proceeding this way was to generate returns immediately and steadily in an amount that could be calculated in advance. This kind of license agreement was structured similar to a fixed price contract. In this example, the licensor was not interested in controlling the licensee while he was doing his explorations, but the licensor would have taken the risk of selecting an agent who in principle was capable of working more efficiently but would be willing to pay a too small license fee only, because he wanted to profit from his information rent. Fernão Gomes, the merchant chosen to be granted the monopoly, was well-known to the Crown and was named in the contract a cidadão honrado, a respectable citizen of Lisbon.36

However, why to change the design of license agreements in that particular way? This question can also be answered using contract theory. Contractual risks like adverse selection and moral hazard are caused of the asymmetrical distribution of information between principal and agent. As the principal becomes more experienced over time, he can reduce this asymmetry being the reason for agents to gain information rents in their own favour. Nevertheless, he would only be able to profit in terms of contract costs from this gain in experience with respect to lowering the risk of adverse selection. In a cost-plus contract the principal always would have to invest in costly control measures, no matter whether he is experienced or not.37 This can explain why the Portuguese Crown switched to a fixed fee license agreement at a point in the discovery process where it probably had learned enough about conditions and possible results of exploration voyages to West Africa.

36 Cf. HAMANN 1968, pp. 81–84.
Coping with the barrier of »not knowing«: technological requirements

Innovations are usually based on some sort of technology. This is the technology dimension of innovation. Two important questions do arise from this aspect: firstly, what sort of technical requirements were needed to innovate? Secondly, how were these technologies developed in the process and what kind of technological effects were produced through innovating? Thus technological progress can be inherent to a discovery process which in itself is primarily focussed on the accumulation of geographical and commercial knowledge. And a technical advancement can either be restricted to this process in a sense that it is useful only for the purpose it has been developed for, or it can be transceding, meaning that, as an side effect, it can support also other improvements.38

Three types of technology, all of them already sufficiently enough developed in early 15th century, seem to have been vital prerequisites for Portuguese seafarers to enable them to safely dig deeper into the Atlantic.39 The caravel had been the first device that was necessary for the overseas expansion, a type of ship that was fast and could be used at high sea and by which one could cruise against the wind.40 The caravel was developed to the caravela redonda only in late 15th century when for the then long sea travels into the South Atlantic bigger ships were needed that could carry more provisions for the crew. This turned out to be of advantage also in the expeditions to India, because these bigger caravels could also carry more freight. The second necessary device was the compass, which had been developed and used in the Mediterranean from late 13th century onwards.41 Navigation remained nevertheless fairly simple for most of the 15th century, because sailing at high sea could be managed with the help of compass and the stars, especially the Polar Star. Again, only entering into southern hemisphere made necessary a substantial improvement of navigation devices, because there the Polar Star no longer could be seen. For that reason solar inclination tables were developed that allowed for a navigation far away from coast also in the South Atlantic. A third prerequisite needed for the discoveries was the knowledge of the prevailing wind direction and currents in Northwest African waters. From the earlier expeditions of the 14th century is was known that along the Northwest African coast the wind usually came from northeast and current flow

39 See on this in more detail Law 1987; Albuquerque 1990; Rogers 1990.
southward. Because of this, the Portuguese seafarers could reach quite easily the Northwest African shores, but faced problems to sail back home. They learned quickly that a much easier way home was sailing first westward onto the Atlantic and then on high sea along a great northeastward turn back to Portugal. A quite similar learning process can be seen in the later stages of discoveries when Vasco da Gama in 1497 on his way to India was the first to sail to the Cape of Good Hope not by following the coastline in Southwest Africa, but to use a long turn over the South Atlantic. A somewhat transcending development stemming from the Portuguese discoveries were the advancements that were made in cartography throughout the 15th century. Improved planisphere maps and globes were not useful for the discovery process itself, but they fundamentally changed the imagination of geography at the turn of 15th century.

**Time structure, protection of knowledge and the embeddedness of the expansion**

**The phase theorem of innovation**

Was there a clear-cut subdivision of the process of Portuguese explorations into several phases? This asks for empirical evidence for or against a theorem assuming a sort of phasing in of innovations. Innovation is commonly understood as being a process rather than a single event. The conceptual distinction between invention on the one hand side and innovation on the other hand points to this kind of understanding. »Invention« describes the creation of something new – a technology, a device, or knowledge –, whereas »innovation« usually stands for the process of getting such an invention commonly accepted.42 The process of innovation itself can be divided into phases. A common criterion for doing this would be the increment of knowledge over time or with respect to the amount of cumulative input.43 An ideal type pattern would distinguish four phases: a start phase with rather marginal returns, a progress phase with increasing returns, a stagnation phase with only moderate or even diminishing returns and finally an acceleration phase with again steeply increasing returns to the investment of time and money. As the development of returns plotted against time or cumulative inputs usually produces a s-shaped relationship, this concept of efficiency progress curve is also known as the s-curve-paradigm (see Figure 1).44

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41 Cf. LANE 1963, pp. 605–617.
42 Cf. HAUSCHILDT 1993, pp. 3–22.
44 See on this for instance AYRES 1988; POGANY 1986; MERINO 1990.
A pattern similar to this ideal type pattern can be found in the course of Portuguese fifteenth centuries discoveries. The start phase began with the decision of the royal family to foster systematically investments in adventurous explorations into the Atlantic that were carried out by seafarers, and it ended when Cape Bojador was successfully doubled in 1434. Since many attempts to sail round this cape had failed before, the returns on investment were rather moderate up to this point in time. During the following progress phase returns obviously increased, because it was in this time that the Portuguese were able to establish their extremely profitable trade with West Africa and also the colonisation of Madeira and the Azores developed into a profitable enterprise. A period of relative stagnation then began when the barely attractive shores in the southern part of the Gulf of Guinea were reached in the 1470s. Visible signs for this were the diminishing interest King Afonso V had in the explorations and his decision to lease the exploration monopoly to the merchant Fernão Gomes. Moreover, the knowledge returns were quite moderate within this period and the advancement for many years seemed to be stagnant. Interestingly enough, this was also the point in time when the Portuguese Crown finally took over, because Infant John who was much more interested in the discoveries than his father, sent out expeditions.
with the clear aim at discovering the sea route to India round the African continent. These expeditions added substantially to the knowledge already gained in the earlier explorations and marked the beginning of a phase of acceleration which finally resulted in the opening of the cape-route to India. Within little more than a decade the Portuguese advanced from the Gulf of Guinea to the Cape of Good Hope and beyond.

The impact of competition
What role did competition play in the process of Portuguese explorations? This question points to some kind of market aspect of innovations. By dividing historical discovery processes into distinct phases it can also be seen that competition seems to have been played a prominent role especially immediately before and during phases of rapid progress. Such an effect of competition can be detected for the process of Portuguese discoveries during the war with Castile 1474–79, when Spanish pirates and interlopers, who were openly supported by King Fernando and Queen Isabella, challenged the Portuguese monopoly of trade and exploration in West Africa. This challenge made King Afonso V and his son John to decide taking a more serious approach than before to exploration and discovery by sending out real expeditions by which the forefront of known shores was tremendously stretched during the 1480s. In 1493 the Portuguese experienced their kind of »Sputnik shock«, because after the return of Christopher Columbus from the Caribbean, it seemed at first glance that he finally had discovered the long searched sea route to India. This shock clearly stimulated the upcoming phase of acceleration, in which forces were focussed once more, this time upon the opening of the cape-route to India.

The protection of new knowledge
An important element of innovation is the protection of the new knowledge that is found within an innovation process against an unauthorised use of another party. How tried the Portuguese to protect their discoveries against the unauthorised use of competitors? In modern innovation processes such protective measures to be deployed usually are patents. Opportunities to gain at least a temporary monopoly cre-

45 Zurara notes that those captains who had failed to double the Cape Bojador made raids in the Mediterranean before returning to Portugal, obviously with a clear aim at getting at least some return for the capital invested. Cf. Gomes Eanes de Zurara in SOUSA SOARES 1978, Vol. I., p. 49.
46 Cf. EWERT 2008.
ated strong incentives for potential innovators to invest, because this increased the present value of their investment due to the monopoly rent that could be earned. However, protection of knowledge at an international scale was almost impossible during the 15th century, given the weakness of juridical institutions. And potential competitors could be attracted by the simple fact, that buying a sea ship capable of sailing onto the Atlantic probably was not cheap in early 15th century, but could be afforded by a rich merchant or an adventurer, possibly in a joint venture with several other financial bakers. Nevertheless, a sort of patenting, that was internationally accepted, was used also by the Portuguese Crown to protect the geographical and commercial knowledge generated by explorations. Henry the Navigator as one of the leading figures in the earlier stages of the Portuguese discoveries obtained the monopoly of seafaring, trade and explorations through papal bulls. Of course, to get this monopoly rights accepted by potential competitors had to been done by the Portuguese themselves, but also a modern patent system cannot guarantee full protection of material rights and intellectual property.

Another strategy of protection is negotiation with potential competitors.47 Concerning explorations and commercial activities in West Africa, in the later 15th century a duopoly had evolved where Portugal was the leading innovator, followed by Castile as a kind of imitator. As can be shown in a repeated market-entry game, the initially more powerful party would have to arrange in the long-run with the less powerful competitor, because the latter cannot be credibly and efficiently deterred from a market entrance.48 This pattern can be seen very clearly with the Portuguese discoveries. Once Castile had become powerful enough to challenge the monopoly claimed of Portugal for all shores of Northwest Africa and all waters south of Cape Bojador, Portugal and Castile in 1479 compromised in the treaty of Alcáçovas.49 Castile thereby accepted the Portuguese monopoly claims, but got in return at least limited access to all waters north of Cape Bojador. A decade and a half later, both parties entered into a second contract in 1494, the treaty of Tordesillas.50 In this contract they agreed on a sort of dividing line stretching from the north pole to the south pole by which not only those parts of the Atlantic already known, but also all parts of it so far undiscovered were claimed by either Portugal or Castile.

47 This is shown in more detail in EWERT 2011.
The embeddedness of innovation

Finally, the embeddedness of the Portuguese discoveries should be looked at. In what kind of social and cultural environment these explorations were made? As has been stated earlier on, the discovery of new places and new spaces introduced a new perspective into the contemporary imagination of geographical space and the thinking about it in general, respectively. Such profound changes in peoples’ imagination nevertheless were not radical in the sense that they did not came accidentally, but instead relied on earlier changes of the world view. Being a result of the Portuguese exploratory efforts, in late 15\textsuperscript{th} century Europeans became aware of the southern hemisphere and of Asia as possible fields for European economic and political activities to take place in. Although the fact that the earth is being a globe had been an acknowledged wisdom since Antiquity, it was only beginning in late 15\textsuperscript{th} century that this globe was considered as such in the very sense of the word. For this to emerge, it had been necessary for Europeans to view the Atlantic no longer as an ocean on the edge of the world so far known to them. Exactly this change in thinking already had happened much earlier, in late thirteenth and early fourteenth centuries, when the first expeditions onto the Atlantic were made by Italian and Portuguese seafarers. So, the 15\textsuperscript{th} century overseas expansion of the Portuguese was clearly embedded in a more long-term change of the imagination of the globe.

Conclusions

In this paper, the 15\textsuperscript{th} century expansion of Portugal is interpreted as an extensive process of innovation that was directed to discover and to explore geographical spaces which had been unknown to Europeans before for commercial purposes. Looking at this historical process from an innovation perspective allows to describe this phenomenon in terms of economic theoretical concepts. Organisation and process dynamics of the Portuguese discoveries can be explained on the grounds of economic theory and management science.

Exploration of distant shores and overseas trade were serving the proper interests of merchants, courtiers, military orders and the royal family. The establishment of trade relationships with West Africa became possible, because knowledge of seafarers on nautical issues combined with the commercial interests of merchants and the capital available from military orders and noblemen who were looking for profitable investment. The Portuguese Crown played a key role in mediating these interests, in
defining goals of exploration and market development and as a back up for commercial risks of private persons. It also provided adventurers and merchants with organisational routines, partly to make it easier for them to carry out exploration and trading voyages, partly to monitor closely trade operations. Finally, the Crown developed different schemes of trade licenses to assure itself against the contractual risks of adverse selection and moral hazard that evolved from licensing the exploration and exploitation monopoly to agents.

The approach taken herein helps to get clearer explanations for some of the phenomena in the case of the Portuguese discoveries. Economic theory can explain why the Portuguese explored the Atlantic and the West African shores in a more systematic manner only after 1415, although geographical knowledge and basic technologies had been available to them already in 14th century. Economic theory can also explain why license agreements with explorers and the governance structure of the exploratory enterprise changed in the course of the process. Therefore, more general conclusions are: the process of discovery was divided into distinct phases with respect to the return on investment, the basic knowledge for innovation already was available and technologies that were needed to succeed and to get along with the barrier of »not knowing« had been invented beforehand. Also, the final goal direction emerged rather late in the course of exploration, a powerful and charismatic leader was needed to focus forces on a particular goal and to surmount the barrier of »not wanting«. Thus, both technical promoters and power promoters were present, and their well coordinated interaction were necessary prerequisites for an also commercially successful process of discoveries. Finally, competition played a crucial role in intensifying the exploring activities and in accelerating the returns to the input of time and resources made.

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