

# A Preliminary Comment on Amaral's, Sales's, and Guizzardi's "Towards an Ontology Network in Finance and Economics"

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## Abstract

The concepts of Ontology Network in Finance and Economics OntoFINE and possible additional concepts such as Economic Resource and Economic Relator are discussed.

## Keywords

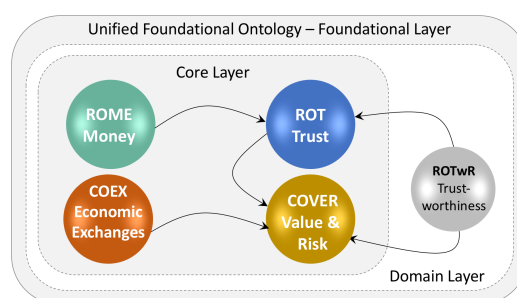
UFO, OntoUML, OntoFINE, COFRIS, Economic Resources

## 1. Introduction

In a recent paper [1] the leading developers of Unified Foundational Ontology (UFO) state that an integrated ontological framework can improve ontology-based applications in finance and economics, as well as improve communication among the different actors in these sectors. The framework called OntoFINE [1] is being built incrementally and as a network, grounded in the Unified Foundational Ontology (UFO) [12].

We agree that OntoFINE, powered by the OntoUML tool [13] can play a fundamental role in building applied ontologies in financial reporting and accounting such as COFRIS – a core ontology for financial reporting information systems [7-11], but have several comments and suggestions.

OntoFINE investigates the conceptual foundations of the following concepts in finance and economics - *Money*, *Trust*, *Value*, *Risk*, and *Economic Exchanges* (MTVRE core), see Fig.1. Three reasons for choosing these subdomains are listed in [1]. Firstly, because of their ubiquitous presence in the realm of finance and economics. Secondly, because they are related to recent challenges faced by the financial industry, which involve new forms of money and trust, as well as new business models for digital exchanges. And finally, because they have been little explored by other initiatives in the same direction.



**Figure 1:** OntoFINE: the network view [1]

Of course, all these are important and evolving concepts in the realm including financial reporting. The question is how fundamental, complete, and related to other UFO subontologies these concepts are. To

*Proceedings of the 16<sup>th</sup> International Workshop on Value Modelling and Business Ontologies (VMBO 2022), held in conjunction with the 34<sup>th</sup> International Conference on Advanced Information Systems Engineering (CAiSE 2022), June 06–10, 2022, Leuven, Belgium*

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CEUR Workshop Proceedings (CEUR-WS.org)

address recent challenges and to explain the new forms is a good tactic to attain the interest in the domain, but from a strategic point of view, we also need to understand the existing theories and forms.

Depicted OntoFINE subdomains are social and perhaps fundamentally social, thus grounded in UFO-C [16] which probably needs some refreshment, e.g., the inclusion of *reciprocity*, *trust*, and *lifecycle* concepts. Consequently, the OntoUML tool deserves the inclusion of *agent*, *action*, and other social stereotypes and patterns. The core concepts should have social and possibly legal counterparts and *economic* substance. In the ontologies of economics, most concepts get the adjective *economic*, which means that these entities are mediated or measured by money. This distinctive feature must be depicted in OntoFINE concepts.

An important issue is which *core* subdomains to include in OntoFINE and under what priority. Of course, modern economics cannot be operational without money; exchange and valuation often require the establishment of trust and risk assessment, but leading economists reviewed e.g., in [6] and accounting ontologists [14, 21, 22] list scarce and useful *Economic Resources*; mutual-gain *Economic Production* and *Exchanges*; and *Economic Agents* - going concerns of bounded rationality, as main economic concepts (*REA* core).

In the financial and economic subdomains often the substance of economic phenomena and their legal form are the same [4]. This requires the OntoFINE to have grounds in UFO-L. The REA concepts should correspond with e.g., Property and Personal Rights and Legal Liability Law; Contract Law; Enterprise and Consumer Law subdomains in UFO-L.

## 2. Some Comments about Economic Exchange Subontology of OntoFINE

We support the thesis of leading economists that capitalism is a social order that is organized, structured, and maintained by and through production that is oriented for exchange toward profit in the form of money, cf. [27]. Within COFRIS we have developed our ontology of economic exchanges including production, validated by applying to financial reporting standards and comparison with other UFO grounded economic exchange ontologies [7]<sup>2</sup>.

The core assumption made by the Action Theory of Exchanges (ATE) and OntoFINE COEX subontology [1, 19] is that “in any economic transaction, the “object” of the transaction is a pair of actions to be performed by the relevant agents involved in it”.

It is obvious that an exchange is an agreed<sup>3</sup> interaction of agents. However, referring to valued economic resources of exchanging agents – transferred and affected – is unavoidable when we need to describe the meaning, goal, and preferences of economic exchange. Neither agreed economic resource nor agreed value is depicted in COEX. We have several comments in this context.

Firstly, the “object” of exchange is not a pair of *any* actions, e.g., sports competition or executed for fun (a “valid” exchange example in ATE). Economic exchange assumes reciprocal legitimate *transfers* of economic resources (or assumptions of obligations) held by the exchange parties. Transfer of goods consists of a transfer of property rights and additional services. Transfer of services (standardly used in [4] and even in [29]) consists of the transfer of service rights<sup>4</sup> [29] and the performance of the service. The “unifying” [19] *transfer of rights action type* is typically omitted when specifying a transfer (see the dashed box in Fig.2).

Secondly, economics is typically less concerned with actions (which in some situations are even not observable) but mainly about action (or abstaining) *results* in the situations of the transacting parties. A transfer leads to a decrease in resources for one party and an increase for the other. Services *affect* the resources of the receiving party [24, 25]. The *affecting* of resources (in contrast with actions) is *claimed* and *accepted* by the other party, e.g., the repaired house, the haircut. Affecting means that there is a persisting resource, controlled or received, that is transformed, presumably to increase its value and control [25]. If the service is not directly affecting a specific resource but supports some activity, then the affected resource is a cash-generating unit, or a business itself – also a resource.

Thirdly, resource transfers are made in consideration of something received as an equivalent. Consideration is either intermediate such as conditional or unconditional claim or final in the form of

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<sup>2</sup> see the OntoUML diagram at <https://odo.lv/ftp/COFRIS>.

<sup>3</sup> In contrast with services that may be not agreed upon, e.g., provided as a gift or a rescue

<sup>4</sup> In capitalism to own production, an agent must own the resources used in production – the raw materials and labor-power, cf. [27].

counterpart resources. It means that together with resource transfers and recognition, the value transfers and measurements of (cost and revenue) as mentioned cf. in [29] happen. Economic Exchanges must have economic substance, i.e., change the resources and/or value of the parties. Economic exchanges need to pursue balanced reciprocity and account for uncertainty in valuation [28].

Economics studies individual choices in relation to the efficient allocation of scarce resources [27]. In the light of the property rights theory, we find economic resources and their control as the most important concept that has not been included in OntoFINE and other UFO subontologies. Previously UFO provided research on resources analyzing ArchiMate constructs [15] and software development [20]. Afterward, only episodic mentions occurred, e.g., where resources were declared as objects an agent needs to achieve his/her goal, and the further analysis was postponed [23]. Similarly, several other ontologies such as UFO-S [17] and UFO-L [18] occurred without introducing economic resources or property rights. Money that participates in the actions depicted by these ontologies is not a service but an economic resource. The analysis of money in OntoFINE ROME could start with being grounded in the economic resource concept. The OntoFINE ROME includes the *control* concept, but in limited form for money objects.

**Figure 2:** OntoUML diagram of Resource Rights and Control

<sup>5</sup> rights that correspond to an obligation of another party, also called *in personam* rights in contrast with *in rem* rights

financial reporting, which is planned for a future paper and is preliminary developed in our previous work [7-11]. However, to attain the attention of OntoFINE developers and for discussion, we continue with some background and a preliminary fragment of economic resource and relator concept depiction in OntoUML.

The thought that economic resources are scarce and are valued personal and property rights were raised in the late 19<sup>th</sup> century by John Commons which led to the concept of a bundle of rights between economic agents over objects or actions further developed by Hohfeld, Coase, and many others. This concept is now increasingly represented by *sharing economy* whereby owners provide short-term use rights while keeping the remaining property rights bundle.

Per Stanford Encyclopedia of Philosophy: “Rights are (1) entitlements (not) to perform certain actions, or (not) to be in certain states; and/or (2) entitlements that others (not) perform certain actions or (not) be in certain states”<sup>6</sup>.

Resources thus are not physical objects nor services but property rights of a holder to perform over objects or contractual rights of a creditor to receive objects or services of a specified type from a debtor (see Fig.2). *Economic Resources* may have the *receipt disposition* to produce economic benefits by using the resources, possibly in combination with other resources, in the allowed activities. Benefits are obtained either by fulfillment of the obligations by debtors, by producing (improving) resources, or by selling to the debtors. Another way of obtaining benefits is by manifestation of the *settlement disposition* of obligations to the creditors.

To produce, an economic agent needs not only rights but also the control of economic resources. The author of Theory of accounting measurement [21], Yuji Ijiri defines an economic exchange as an action whereby an entity<sup>7</sup> forgoes [or obtains obligation to forgo] control over some economic resources in order to obtain [or to forgo obligation to forgo] control over other economic resources, with a goal of increasing the monetary resources under the enterprise's control.

*Control* over resources, including committed and receivable resources, here means discretionary power to utilize or dispose of the resources that are under the positive (i.e., are rights) or under the negative control (resp. obligations) of the entity. An entity is defined as an identifiable unit empowered to control resources, and finally, resources are defined as scarce objects having a utility that the entity intends to place under its control. Scarcity and utility of resources are measured at a historical and present monetary value of respectively past and expected resource participation in an exchange.

Related concepts of assets (liabilities and equity) are resources (resp., obligations) under positive (resp., negative) control recognized by the enterprise. An enterprise controls an economic resource if it has the present ability to direct the use of the economic resource (*resource control*) and obtain the economic benefits that may flow from it (*benefit control*). Control includes the present ability to prevent other parties from directing the use of the economic resource and from obtaining the economic benefits that may flow from it [4]. Control, in this case, is determined per standards' regulated recognition and measurement criteria, and Control generally excludes conditional commitments and executory contracts as resources. For example, patents and trademarks can be assets, but skilled workforce (and the training that has created those skills) not [2, standard IAS 38].

Similarly, as for trust, an agent controls resources if for his *intentions* the resource usage and the agent have capabilities to use it in her activities and obtain the economic benefits from the process that he believes in grounded in previous experience – *dispositional beliefs*.

In short, the accounting and financial domain interprets economic resources as property rights or contractual rights that have the potential to produce economic benefits – resources and services of greater than historical value – generally via production and exchanges. Control includes rights but also considers the functionality of underlying resources, the enterprise's capabilities, its legal conditions of resource usage (e.g., sanctions or tax allowances), risks, goals, and plans.

We agree with OntoFINE that value, trust, and risk are not inherent in some object but in social relationships and experience. In an economic context, all these are characteristics or preconditions of economic resource control. To control something (a property object) or someone (a contractual debtor) in an economic system an agent as a holder (or even creditor) must have the corresponding contractual or property rights. Let us take the ontological commitments for, e.g., Trust from the OntoFINE ROT

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<sup>6</sup> <https://plato.stanford.edu/entries/rights/rights>

<sup>7</sup> We will refer to reporting entity as an economic agent or enterprise in this paper

[1] as an example and find the similarities and differences (depicted in bold) with Economic Resource Control for a deeper understanding of the Economic Resource concept (see Table 1). At this stage we mainly show that there are patterns of regularity that are common to these two phenomena, leaving a further analysis of how the two are related for future work.

**Table 1**

Comparison of ontological commitments for Trust and Economic Resource Control

Trust [1, page 7]	Economic Resource Control
Trust/Control is relative to a goal.	
An agent, the trustor, trusts: <ul style="list-style-type: none"> <li>- someone or</li> <li>- something, the trustee,</li> </ul> only relative to a goal, for the achievement of which she counts upon the trustee.	An <b>economic</b> agent, the controller, controls: <ul style="list-style-type: none"> <li>- someone (<b>based on contractual right or law</b>) or</li> <li>- something (<b>based on property right</b>) - the controllee,</li> </ul> only relative to a goal, for the achievement of which she counts upon the controllee <b>and the economic benefits of controllee's behavior</b> .
Trust/Control is a complex mental state	
of a trustor regarding a trustee and her behavior.	of a controller regarding a controllee and her behavior <b>and the economic benefits of the behavior</b> .
Trust/Control is composed of:	
(i) a trustor's intention, whose propositional content is a goal of the trustor;	(i) a controller's intention, whose propositional content is a goal of the controller;
(ii) the belief that the trustee has the capability to perform the desired action or exhibit the desired behavior; and	(ii-a) the belief that the controllee has the capability to perform the desired action or exhibit the desired behavior;
	<b>(ii-a) controller's rights to control the desired action or behavior and the resulting economic benefits, and exclude other agents from controlling;</b>
	<b>(ii-b) controller's belief in the capability to control the controllee;</b>
	<b>(ii-d) the belief that action or behavior will produce economic benefits to the controller; and</b>
(iii) the belief that the trustee's vulnerabilities will not prevent her from performing the desired action or exhibiting the desired behavior.	(iii) the belief that the controllee's vulnerabilities will not prevent her from performing the desired action or exhibiting the desired behavior <b>and producing economic benefits</b> .
When the role of trustee is played by an agent, trust is also composed of the trustor's belief that the trustee has the intention to exhibit the desired behavior.	When the economic resource is to be received by the debtor, control is also composed of the creditor's belief that the debtor has the <b>obligation</b> and intention to exhibit the desired behavior.
The trustor/controller is necessarily an "intentional entity".	
The trustor is a cognitive agent, an agent endowed with goals and beliefs.	The controller is an economic agent, an agent of <b>bounded rationality endowed with economic goals and preferences</b> .
The trustee/controllee is not necessarily a cognitive system.	
The trustee is an entity capable of having a (hopefully positive) impact on the goal of the trustor by the outcome of its behavior. A trustee may be a person, an animal, a car, a vaccine, etc.	The controllee is an entity capable of having a (potentially positive) impact on a goal of the controller by the <b>economic benefits</b> of its behavior. A controllee may be a person, an animal, a car, a vaccine, etc.
Trust/Control is context-dependent.	
The trustor may trust the trustee for a given goal in a given context, but not do so for the same goal in a different context.	Control is context-dependent. The controller may control controllee for a given goal in a given context, but not do so for the same goal in a different context.
Institution-based trust depends on the social system trustee.	
Institution-based trust depends on the social system trustee.	Economic Resources <b>depict rights to produce economic benefits in an economic system context by a generic agent. Assets are Economic Resources under the control of a particular agent.</b>
it implies risk	
By trusting, the trustor accepts to become vulnerable to the trustee in terms of potential failure of the expected behavior and result, as the	By obtaining control, the controller accepts to become vulnerable to the controllee in terms of potential failure of the expected behavior and result, as the controllee may not exhibit the expected behavior, or it may not have the desired <b>economic benefits</b> .

trustee may not exhibit the expected behavior, or it may not have the desired result.	
Trust/Control can be quantified	
Trust can be quantified	Economic resources are quantified <b>and</b> <b>valuated</b>

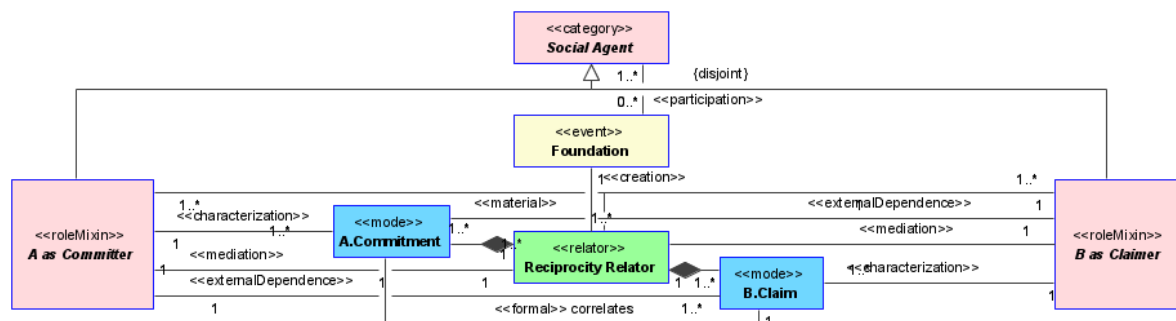
#### 4. Social, Reciprocity, and Economic Relators for Economic System

To sketch a conceptualization of the economic system we need to regard the *relator* concept of the UFO. In UFO *Extrinsic Aspects* are reified relationships. A distinction is made between *formal* relations holding between two or more entities “directly without any further intervening individual” [12: 236], and *material* relations, which require the existence of an intervening individual – a specific construct, called a relator. A *Relator* mediates the mutual relationships of two or more concrete individuals. Extrinsic aspects can also be reified one-sided relationships.

The UFO-C is an ontology of social entities (both endurants and events) where the main distinctions are between agents and non-agentive objects [16]. An agent is a substantial that creates actions, perceives events, and to which we can ascribe mental states (intentional modes). Agents can be physical (e.g., a person) or social (e.g., an organization). A human agent is a type of physical agent. An object, on the other hand, is a substantial unable to perceive events or to have intentional modes. Objects can also be further categorized into physical (e.g., a book, a car) and social objects (e.g., money, language).

Intentional modes can be social modes or mental modes. Intentions (or internal commitments) are mental modes that represent an internal commitment of the agent to act towards that will. They cause the agent to perform actions. The propositional content of an intention is a goal.

Besides internal commitments (intentions), there are also social commitments. A social commitment is a commitment of an agent (a committer) towards another agent (a claimer). As an externally dependent mode, a social commitment inheres in the committer and is externally dependent on the claimer. The social commitments necessarily cause the creation of an internal commitment in the committer. Also, associated with this internal commitment, a social claim of the claimer towards the committer is created. Commitments and claims always form a pair that refers to unique propositional content, and a social relator is an example of a relator composed of associated commitments/claims, see Fig.3. A closed commitment is a commitment that is based on an Action Universal (Plan). The closed commitment is *fulfilled* by the agent only if the agent *satisfies* the commitment goal by executing an action which is an instance of the plan. The social relator concept has been further employed in developing a legal relator in UFO-L [18] that associates different kinds of correlative obligations/rights of two agents.



**Figure 3:** OntoUML diagram of UFO Social Relator. Adapted from [17]

Finally, actions are intentional events, i.e., they have the specific purpose of satisfying some intention (e.g., a business process, a communicative act). As events, actions can be atomic or complex.

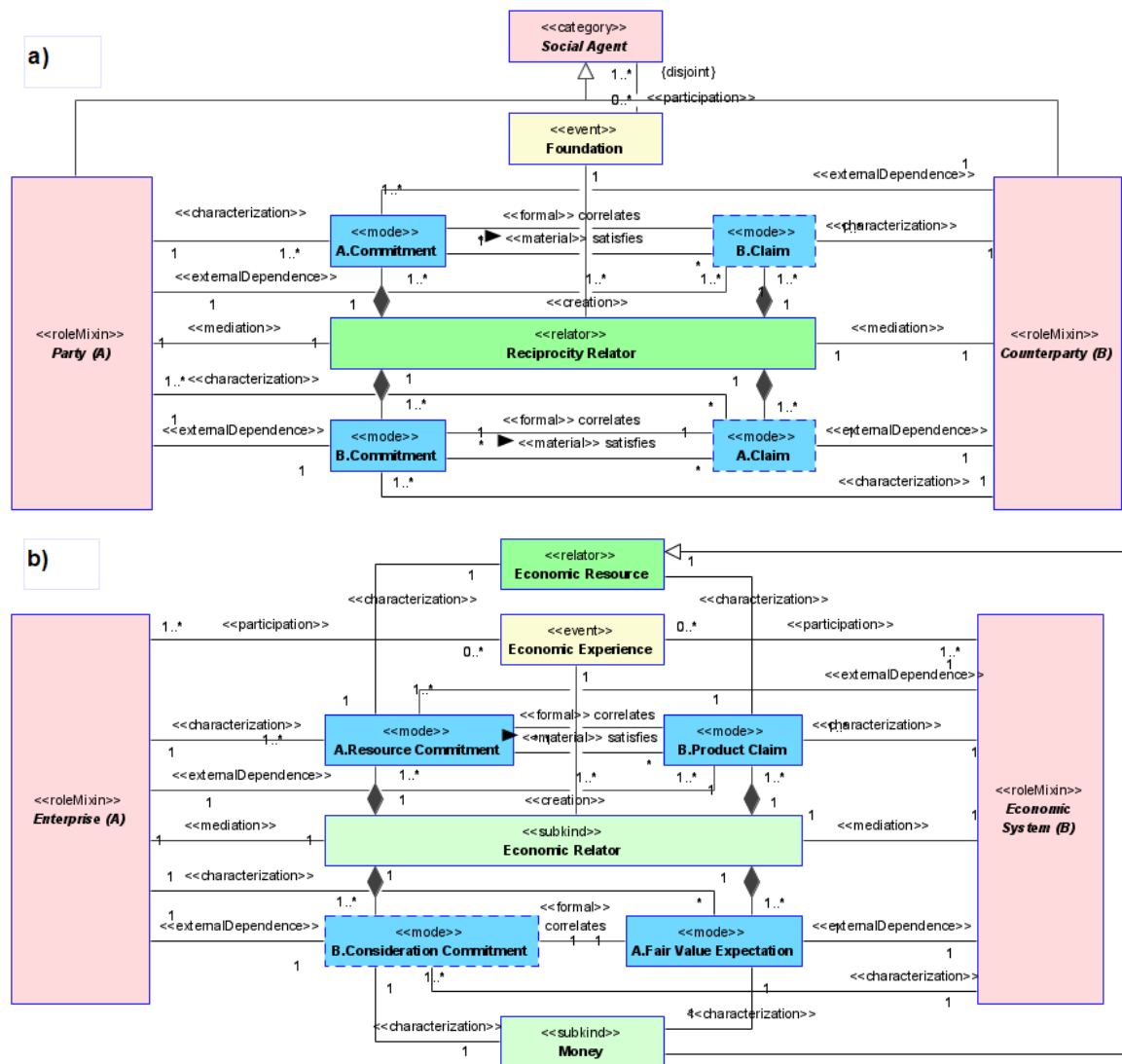
Applying the social concepts of UFO-C for economical phenomena we find that in a financial environment *Economic Commitments* of resource transfers and service provisions are established with the goal of satisfying *Economic Claims* for resource receiving and affecting [25]. Economic commitments are consensual, complex, and closed. They are time interval referring (aka appointments) and can be correlative, conditional, and reciprocal. *Correlative* (and equivalent) means that one party's commitment and its fulfillment is a counterparty's claim and its fulfillment and vice versa. *Consensual* means that the commitment and the claim and their fulfillment are agreed upon and immutable upon a new agreement, among parties.

Most relator examples in UFO literature, such as marriage or employment, as well as service agreements, are modeling relations of deontic relations, particularly *reciprocity*. As Castelfranchi notices in [26]: "one should consider that normally in cooperation, in social exchange, in contracts, in organizations social commitments are reciprocal".

An exchange plan or contract is a reciprocity relator in requiring the exchange of performance of each party in consideration of the other.

A valued performance obligation of a party is a reciprocity relator in requiring accrual of consideration value from the counterparty in exchange for transferring resources (assuming obligations) and providing services.

An offering and a valued economic resource are reciprocity relators (but subject to greater uncertainty) mediating an enterprise's potential but constructive right to receive economic benefits of a fair value from some economic system (market, target community) member in exchange for transferring resources.



**Figure 4:** A verified OntoUML diagram of (a) Reciprocity Relator and (b) Economic Relator.



For modeling exchange contracts, economic resources, and obligations, we first introduce a pattern of reciprocal commitments and reciprocal claims and their formation and execution lifecycle [7]. A reciprocity relator, which is an agreement between two parties comprising commitments of each party in consideration of the other, has been used before in UFO literature for modeling service offerings and agreements [17]. Our pattern generalizes its use and introduces several additional concepts, see Fig.4 (a). We avoid including correlative positions when the relationship is formal, thus reciprocity relator can be specified by reciprocal commitments without specifying correlative claims or vice versa (positions that can be omitted are depicted as a dashed line of a border in Fig.4). The correlative relationship is *formal* in the independent view for simple transfers or accruals (or even can be reduced to the value aspect of the relator), OR *material* for transfers that include service provision (and depict production). We specify resources required and affected in specifying and fulfilling economic commitments:

The *Reciprocity Relator* pattern is depicted in Fig.4(a). It involves two economic agents – a *Party* and a *Counterparty*. The Reciprocity relator thus contains a minimum of two Commitment/Claim pairs. The fulfillment and settlement include performances of the parties. *Performance* in the context of reciprocity is not simply “doing” as stated in ATE [cf. 19], but an agreed resource transfer and service provision for the benefit of the other party, in exchange for consideration. As noted in [6]: “Economic behavior requires two elements. First, the outcome of behavior can be measured by money. Second, the behavior is for the purpose of return or conducive to return.”

Enterprises use Resources to produce and sell Products and Services for Fair Value within an Economic System. The disposition of this core economic process is depicted by *Economic Resource* and *Relator* (a subkind of Reciprocity Relator). See Fig.4(b). As defined earlier Resources are Rights that allow an enterprise to produce and exchange within the Economic System to obtain Economic Benefits increasing the enterprise’s value. At the same time, these rights controlled by the enterprise are intentions and conditional commitments to use resources for producing and supplying products satisfying market demand in exchange for consideration in the amount of Fair Value.

## 5. Conclusions

Developing a core of OntoFINE can bring substantial benefits for reference ontology creation. However, a careful selection of core subontologies and synchronizing with other UFO ontologies and tools is needed. An important core element should be the *Economic Resource* and related concepts. Its inclusion, subject to further discussions could be beneficial for the understanding of this rather complex and general phenomenon.

Financial Reporting (Concepts and Standards) can be an important validator of OntoFINE. However, it does not include some concepts (such as opportunity cost) or maintains a different understanding. These differences have to be made clear if the OntoFINE includes Finance.

To arrive at a useful and commonly understood ontology network its subdomains and primarily the core subdomain candidates need to be discussed in competitive research. Ontological commitment lists, exemplified in Table 1 as well as element relationship matrixes could be a helpful methodological tool. The due process could include principles similar to those of standard-setting<sup>8</sup>.

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