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Sustained privatisation resolves political risk, bolsters development

Enrico C. Perotti

A bit of history
The rapid evolution of capital markets in developing countries has emerged as a major event in recent financial history. Portfolio flows to emerging countries rose tenfold from 1989 to 1995 (IFC 1997) and kept rising until the recent crises in Asia (1997) and Russia (1998). Local stock markets also grew considerably in size. The aggregate market capitalisation of the countries classified by the IFC as emerging markets rose from $488 billion in 1988 to $2,225 billion in 1996. Trading on these stock markets rose in similar magnitude, growing from $411 billion to $1,586 billion in that period (IFC 1997).

These remarkable developments followed the crisis period in the ‘80s, when foreign debt and sizeable government deficits undermined confidence in these economies. A critical policy change in many of these countries has been the establishment of large privatisation programmes. The known benefits of privatisation include a reduction in public debt, improved incentives and efficiency, and better access to capital. Sales to the private sector resulted in an inflow of foreign capital and technological transfers (Sader 1995), and increased integration of local firms in international trade patterns.

The earliest extensive privatisation plans were launched in the early eighties in Chile and the UK. These programmes, deemed successful, were mimicked by many developing and industrialised countries. Candoy-Sekse (1988) recorded a total of 696 privatisation transactions from 1980 to 1987 – 456 of which took place in developing countries. The importance of sales in developing countries thereafter increased significantly. Privatisation revenues climbed from $2.6 billion in 1988 to $25.4 billion in 1996, amounting to $154.5 billion over the whole period (World Bank 1997, 1998).

Missing pieces
While the privatisation process in developing countries has been studied extensively, little attention has been given to its impact on the development of the local equity markets. Unquestionably, a major impulse has come from financial integration (Stulz 1999); direct evidence now suggests that the onset of financial liberalisation directly promotes market development (Henry 2000). Yet, what are the underlying causes of the increasing confidence that led foreign investors to invest in emerging stock markets—a process that took place over a certain time span, rather than all at once?

Many emerging countries carried out privatisation sales through public offerings on the local stock exchange, leading to significant increases in market capitalisation. However, this direct effect of privatisation (total sales revenue of $154.5 billion in 1988-1996) represents only a small fraction of the increase in market capitalisation over that period. In addition, many privatisation transactions were not carried out through public share issues, and some of them took place in countries not classified by the IFC as emerging markets. Thus, although privati-
successful privatisation results in a strengthening of property rights and institutional reliability, which broadens the appeal and confidence in equity investment.
The relevance of political risk for privatisation that we have documented is consistent with results reported by Jones et al. (1998). They show that the share allocation and sale price in IPOs from privatisations are sensitive to political considerations. Our result that political risk resolves gradually is also consistent with the puzzling findings that privatisation IPOs appear to outperform matched control groups (Meggison et al. 1998). Perotti and Huibers (1998) attribute this result to the greater sensitivity of these stocks to political risk. They confirm that this effect vanishes after the IPO, as political risk gradually declines.

Credibility in the real world
We first concentrate on how political risk has developed over the different stages of the privatisation programmes of 22 emerging economies from Latin America, Asia and the Middle East, which have privatised extensively over a number of years after 1987. (We exclude former communist countries, for which privatisation has had an obvious direct effect on market development). We use several proxies for our notion of political risk, and assess their importance for stock market development by regressing changes in stock market development proxies such as market capitalisation, traded value and excess returns to changes in political risk.

The results are quite strong: changes in political risk have a strong effect on local stock market development and excess returns in emerging economies, suggesting that political risk is a priced factor. We find that many emerging countries gradually reduced their political risks during the course of sustained privatisation. Privatisation often starts at a time of declining credibility. Thereafter, perceived political uncertainty is resolved only upon actual implementation of privatisation, as opposed to its announcement. In fact, most risk resolution seems to take place as privatisation proceeds to its later stage. This suggests that a sustained privatisation policy represents a major political test that gradually resolves uncertainty over the political commitment to a market-oriented policy.

Changes in political risk are strongly associated with growth in stock market capitalisation, traded value and excess returns. The economic impact of changes in political risk on stock market development appears to be sizeable. Taken together, these results suggest that the resolution of political risk through sustained privatisation has been an important factor in the recent emergence of the stock markets of developing countries.

Market segmentation
Bekaert (1995) provides evidence that higher levels of political risk are related to higher degrees of market segmentation. Erb, Harvey and Viskanta (1996a) show that in both developing and developed countries, the lower the level of political risk, the lower are the required stock returns. De Santis and Imrohoroglu (1997) report that emerging financial markets exhibit a higher conditional probability of large price changes than do developed stock markets. There may be a role for political risk in explaining this difference in magnitude, as policy changes tend to have a large systemic effect. We can conclude that political risk is a priced factor for which investors are rewarded, and that it strongly affects the local cost of equity.

Our results also have implications for the analysis of market segmentation, of which political risk is viewed as one of the main causes. If emerging capital markets are believed to have grown largely as a result of decreasing segmentation, it is important to explain what has driven investors to progressively integrate these markets.
Conclusions

We conclude that the resolution of political risk resulting from successful privatisation has been an important impetus for the rapid growth of stock markets in emerging economies. We do not, however, argue that privatisation has been always successful. In two countries in our sample the sale programme was stopped, and deregulation partially reversed, leading to a sharp reassessment of political risk and a plummeting of domestic capital markets. Finally, consider the lessons learned from the extreme case of Russia: insider privatisation per se does not ensure the foundations of a market economy – particularly when sales are done without any true change to the structure of the legal environment.

Insider privatisation per se does not ensure the foundations of a market economy—particularly when sales are done without any true change to the structure of the legal environment.

The result that political risk has strong implications for stock market development is an important finding for growth in emerging economies. There is a growing literature that suggests that the development of financial markets supports economic growth. Levine and Zervos (1998) find that stock market variables such as market capitalisation over GDP, traded value over GDP, and various measures of asset mis-pricing help predict subsequent economic growth.
Jeroen van den Bergh

Abstract

In spite of the obvious physical dimension of economic production and consumption, economics has essentially ignored flows and stocks of materials and substances. Environmental economics has recently paid increased attention to material flows, which is not surprising given that its core problems – pollution and resource scarcity – can be directly related to material flows through the economy. Various economic theories and methods are now being refined and applied to improve our understanding of possible de-linking between economic growth and various types of environmental pressure.
It seems that economic growth helps to solve or to export mainly local, health-related problems, and ignores problems distant in space or time, such as global warming.

Methods for analysis

The notion “material-product chain” (M-P chain) provides a general starting point to analyse the factors behind material flows. It denotes a system or network of linked flows of at least one material and one product that connect activities or phases in a production chain-such as resource extraction, manufacturing, consumption, refuse collection, reuse, and dumping or incineration of waste. Traditional equilibrium analysis can be applied to such an M-P chain by adding economic elements such as resource allocation, production- and cost functions, markets, demand relationships, and prices (see Kandelaars and van den Bergh 1996). The modelling of material flows in M-P chain models requires incorporation of mass balance conditions, which alter substitution relationships between production inputs. Dynamic aspects, like materials accumulating in durable products, can lead to a capital approach with multiple vintages of products with varied material composition.

To gain insight into the empirical relationship between material flows and economic structure, one can use decomposition techniques. In structural I/O decomposition analysis (Rose and Casler 1996), which is based on methods that have not yet been fully explored, two input-output tables of different years are compared in order to decompose certain indicators of material use or intensity. Our research has therefore a methodological component, in which different decomposition techniques (multiplicative, additive, absolute, intensity, etc.) and various indices are examined. On the basis of these approaches it is possible to decompose changes into more than 20 or 30 factors, thus identifying various subtle substitution and technological change mechanisms that influence material flows. This information can subsequently be used to fill predictive or policy-oriented models.

In order to arrive at a precise and informative model of physical interactions between the environment and the economy, we should make a distinction between direct substitution or “replacement”, and indirect substitution or “saving.”

Substitution

The relationship between values, substitution, production factors and thermodynamics in production functions is a somewhat neglected topic in environmental and ecological economics. There is confusion in the use of the term “substitution”, which is often undefined, subject to cryptic use, and too aggregated to arrive at a precise and informative model of physical interactions between the environment and the economy. A distinction between direct substitution or “replacement”, and indirect substitution or “saving” seems useful (van den Bergh 1999). “Direct substitution” refers to changes within a category of production factors that fulfil the same, or a similar, function in the production process. Think of it as “replacement” of one type of production factor by another having the same function – such as machines by labour, or one material by another. “Indirect substitution” refers to a process involving multiple categories of production factors, which fulfil different – and often complementary – functions in the production process. Think of this as “saving” on the use of materials, which can result from working more accurately and less wastefully.

The present day. Ayres and van den Bergh (2000) have proposed a direction for a new growth theory based on three modifications of the conventional theory. The first modification is multiple “growth engines”; the second is a production function that distinguishes between resource use, technical efficiency and value creation. The last modification has to do with accounting for the impact of the cost of production through demand on growth. The resulting model is capable of generating various types of structural change over time.
“Industrial ecology” and “factor 4”

A new field of multidisciplinary study, known as “Industrial Ecology,” has recently come to the fore (Socolow et al. 1994). The approach is based on the analogy between metabolic processes of living organisms and natural cycles of substances and the transformation of substances and energy in the economy. At a macro level it emphasises physical relations between economic activities. This has given rise to the idea of designing industrial ecosystems that imitate natural ecosystems, thus focussing on the recycling of materials and co-operation among various types of firms. A well-known example is the Kalundborg complex in Denmark.

At a micro level, improvements in the “eco-efficiency” of processes, products, organisation and logistics of production processes are examined. The “factor 4” approach is perhaps the best known example of this approach (see von Weizsäcker et al. 1997). It refers to a simultaneous doubling of welfare and halving of material and energy use. However positive this may sound, there is a risk that concrete “eco-efficiency” suggestions on a micro level may give rise to overly optimistic assessments of net savings of energy and material use at the macro level. The reason is that various behavioural effects, as well as “rebound” effects (indirect and macro effects through changing prices and incomes, and interactive markets) can partly undo the direct “eco-efficiency” improvement. Only the integration of “industrial ecology” with economic models will pave the way for a complete study of all indirect effects (Bouman et al. 2000). This could contribute to a new type of economics that pays more attention to the physical dimensions of economic reality.

The Factor 4 approach, referring to a simultaneous doubling of welfare and halving of material and energy usage, carries with it the risk of overly optimistic assessments.
Experimenting with Economics

An interview with Joep Sonnemans

Psychology and economics – the relationship between these two disciplines buoys the interest of Joep Sonnemans, assistant professor at the University of Amsterdam (UvA). Sonnemans, who obtained his doctorate degree in psychology, is now doing experimental research at CREED\(^1\) at the UvA. He spends most of his research time combining and contrasting psychological and economic issues.

You’re a social psychologist; why did you decide to join CREED and do economic experiments?

After I finished my Ph.D. on emotions at UvA’s psychology department, I decided I wanted to do something different than psychology. I was already interested in economic issues and experimental economics. It just happened that when I was looking around for a job, CREED was looking for a psychologist for experimental economics. Experimental economics was actually just starting off in the Netherlands at that time.

If you compare the situation now with the situation when you first started, can you say that experimental economics has become popular in a short time?

When I started, there was quite a risk that economic journals would not accept experimental papers because the editors either didn’t believe in experiments or thought that economics was not an experimental science. All economic journals now accept experimental papers if they are within their field. Even though some people still maintain that experimental economics is not scientific, the field has now been accepted by most economists. That’s quite a change in ten years.

What is the relation between experiments and reality?

In a way, experiments are reality. Our subjects earn according to the decisions they make; so every decision is a real economic decision. A good experiment fulfills all assumptions of the theory, so if the theory does not work there, there is no reason to believe it will work in real life. You can reject

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\(^1\) CREED refers to the Center for Research in Experimental Economics and Political Decisionmaking.
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a theory in the lab, or at least say which theories do better than others, but you can never say that a theory is the right one. You can only say that you cannot reject the possibility that it is the right theory. You can falsify but not verify, as in all empirical sciences.

What are the strengths of experimental economics, relative to, for example, observations of reality?

You have complete control over the essential parts of the situation – for example, over the amount of information the subjects have. You do not have as much noise as you would have in real life. Moreover, you can change one aspect of a treatment, keeping the others constant. In real life you cannot do that. In real life replications are also often impossible, whereas experiments can easily be replicated.

One of the problems that may exist in experimental economics concerns “framing”. How people react may depend on how the issue or question was framed.

That’s a potential problem in all social sciences. In almost all experiments we use a frame that is as neutral as possible. For example, we don’t say that you are an employer and another person is a worker, but we say that you are “player one”, etc. In a Prisoner’s Dilemma, rather than saying that you co-operate or defect, we say that you employ “strategy one” or “strategy two”.

Nevertheless, behaviour may depend a lot on how a problem is presented to the subject. In the majority of cases, though, you want to compare behaviour in different treatments. In a bargaining experiment, for example, you change the outside options and see how the outcomes change. The frame stays the same. If someone else does the experiment and frames the situation differently, he or she may find other percentages, but it is unlikely that it leads to other differences between treatments. Basically, you’re interested in change, not in absolute numbers.

Is there an effective feedback mechanism from experimental research to economic theory?

Strong feedback has been there from the beginning. The first economists who started doing experiments were game theorists. They saw that some of the sophisticated reasoning in game theory was unlikely to be found in normal humans. For example, backward induction is a subtle matter (it took some time before game theorists developed the concept), and one cannot expect that everybody will use this. Game theorists liked to use game theory as a tool to describe strategic elements of a situation, but saw that game theory could not be used to predict behaviour. Many game theorists have become interested in how people learn, and were actually the first to recognise the strengths of experimental economics – and there certainly was a feedback to theory.

The nice thing about economic theory is that it is unified because the assumptions are the same. If you let these assumptions go, you need new theories – about bounded rationality, for example. The problem is that behaviour can be context-dependent, so that you may need different theories for each situation. Many theorists don’t like that, and are therefore hesitating to include bounded rationality in their theories. But it may be necessary in the end. People may act differently in situations that are considered to be equivalent by neo-classical theories. If no single theory can explain all, you need more theories, and that’s the place that experimental economics can play a role. It can test what kinds of assumptions are reasonable.

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About the relations between psychology and economics: Is it true that psychologists tend to be less strict than economists in experimental standards such as no use of deception and the use of financial incentives?

I think that the differences in methodology are overstated. Especially in the beginning, experimental economists wanted to show that they were different from psychologists. They stressed their differences with social psychologists in their use of no deception and their use of financial incentives. The argument is that if you deceive a subject in your experiment, then he or she will not believe you the next time. You use financial
I’m not aware of any phenomena that was first studied by experimental psychologists that was not found again when it was done “properly,” with incentives and without deception, by experimental economists. Nowadays, social psychologists are using more financial incentives, because they know that economists may criticise them otherwise.

If a psychologist wants to use deception, then he plans the experiment in September, when there are fresh students.

Alvin Roth sees experimental economics developing toward out-of-equilibrium dynamics. What is your view on the future of experimental economics?

Most economic theories assume that everything is in equilibrium. If it is not, it will go towards equilibrium, and there is learning involved here. Alvin Roth has done a lot of research on learning; he believes it is the most important field in experimental economics. I agree in part with him, but what I don’t like about most learning experiments is that they’re unrelated to specific economic theories. The danger is that experimental economics then becomes a field apart from the rest of economics. It would be a pity if that happened.

What I hope is that experiments become a research tool for all economists. That, depending on the situation, of course, every economist at least considers approaching the problem through experiments. This may take some time, because researchers need to build up some experience with economic experiments. The younger researchers are the ones most interested in experiments. I find that in very different fields Ph.D. students ask themselves the question, “does my subject need experiments?” I find it a promising development.

What I hope is that...

depending on the situation, of course, every economist at least considers approaching the problem through experiments.

Economists tend to have very broad interests – also, for example, in evolutionary biology – which is nice. On the other hand, psychologists generally have no interest at all in economics.

What I like a lot is working with economists without a background in experimental research. For example, I work together with Randolph Sloof and Hessel Oosterbeek. I bring in the experimental expertise, and we all have our own things to contribute. That works very well. I also work with Cars Hommes on expectation formation and markets. It is very interesting. Prices on financial markets are more or less shaped by the beliefs of the participants. If you have different kinds of investors, you can get very complicated dynamics. You have to make assumptions about how the feedbacks from beliefs into markets work, and you need experiments to find this out. That is what we do.
improving empirical models of auctions

Efficiency is usually not an issue in single-unit auctions. In (symmetric) private value auctions, equilibrium bids increase in bidders’ values; hence, the object is awarded to the bidder who values the commodity most. In common value auctions, any allocation is (trivially) efficient. The objects for sale in most auctions, however, display both private and common value characteristics. In such auctions, a bidder with a moderate private value and an optimistic estimate of the common value may outbid a rival with a superior private value and a pessimistic estimate of the common value. Inefficiencies are to be expected – even in equilibrium. From a stylised strategic analysis of equilibrium bidding behaviour in auctions with both private and common value components, it appears that more uncertainty about the common value results in higher efficiency and higher profits for the winning bidder. Moreover, information provided by the auctioneer decreases uncertainty, which improves efficiency and increases the seller’s revenue. These positive effects of public information disclosure are stronger the more precise the information is. Thus, perhaps unexpectedly, when governments sell public utilities (for example, UMTS frequencies for Telecom companies) by auction, they are well advised to reveal as much as possible of their own information about the commodity for sale. Efficiency and revenues are also higher when more bidders enter the auction. Since our model nests both the private and common value cases, it may lead to an improved specification of empirical models of auctions.

Does the internet promote or diminish economic efficiency?

Hotly debated in the media, as well as among economists and practitioners, are the implications of the rapid growth of Internet use for economic performance. While some agree that the use of Internet will promote economic efficiency and will reduce commodity prices, others provide empirical evidence supporting the opposite view. The two factors on which the more optimistic perspective rests seem to be that Internet will reduce consumers’ search costs and increase competition through market globalisation. We study a market for a commodity that could very well resemble an on-line market, and argue that both of the opposite perspectives mentioned above may be correct. The first view appears to be associated with an environment in which consumer incentives to search for lower prices are large, while the second holds true when buyers search too little. Three elements underlie buyers’ search incentives: (i) how large search costs are relative to the value of the good, (ii) how important buyers’ relative ignorance is and (iii) how many firms are present in the market. The relative importance of these three elements is crucial, in that it leads to distinct market allocations – each offering theoretical support for the above-mentioned views.

Keeping older workers on the payroll

Hotly debated in the media, as well as among economists and practitioners, are the implications of the rapid growth of Internet use for economic performance. While some agree that the use of Internet will promote economic efficiency and will reduce commodity prices, others provide empirical evidence supporting the opposite view. The two factors on which the more optimistic perspective rests seem to be that Internet will reduce consumers’ search costs and increase competition through market globalisation. We study a market for a commodity that could very well resemble an on-line market, and argue that both of the opposite perspectives mentioned above may be correct. The first view appears to be associated with an environment in which consumer incentives to search for lower prices are large, while the second holds true when buyers search too little. Three elements underlie buyers’ search incentives: (i) how large search costs are relative to the value of the good, (ii) how important buyers’ relative ignorance is and (iii) how many firms are present in the market. The relative importance of these three elements is crucial, in that it leads to distinct market allocations – each offering theoretical support for the above-mentioned views.

The unemployement insurance (UI) system in the Netherlands does not allow for experience rating (‘premium differentiation’) at the level of the individual firm. Consequently, a firm that fires a worker is not directly confronted with the costs of financing the UI benefits that the worker will receive. Under discussion recently has been the possibility of introducing experience rating in order to curtail the inflow of elderly workers into the UI scheme. This paper quantifies the effects on (the steady state level of) labour demand of the introduction of experience rating in the Netherlands. For this purpose, we have adapted Bentolilla and Bertola’s (1990) model by introducing two types of workers – the ‘young’ and the ‘old’ (50+) – who have different wages, hiring and firing costs, and quit rates. The model allows for both business cycle uncertainty and linear adjustment costs (hiring and firing costs). Due to the existence of adjustment costs, labour demand will not change if the marginal revenue product of labour lies between a lower and an upper bound. These bounds depend on the hiring and firing cost level and the wage rate (among other things). Changes in the bounds, due to the introduction of experience rating, will change the firm’s hiring and firing strategy and, consequently, the firm’s labour demand. Experience rating is modelled by an increase in firing costs, associated with a decrease in the wage rates (due to a decrease in UI premiums). Although the increase in firing costs has a negative effect on both firing and hiring, the stronger effect seems to be on firing. The simulations have operated under the assumption that half of the UI benefits will be charged to the individual firm. This scheme leads to a substantial increase in firing costs. According to the simulations, an increase in firing costs results in an average growth in the demand for younger workers of 0.5%. Labour demand for older workers increases by 2%. The effect is stronger for older workers because firing costs change more, due to the introduction of experience rating. The second effect of experience rating is a wage decrease. Obviously, this leads to an increase in

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labour demand. The total effect of experience rating on labour demand is 5.3% (6.9%) for younger (older) workers. Since the model addresses only the demand side of the labour market, the analysis presented above is partial: an increase in firing costs may lead to a higher insider power of the workers in a firm, as the probability of being fired has decreased. This may lead to higher wages, which then exert downward pressure on employment. A sensitivity analysis suggests the following: by taking into account insider power, the number of younger (older) workers increases by 3.2% (5.3%).

Mobile and connected — planning a dispersed telecom service*

Telecommunications seems to be among the leading industries of the contemporary economy. Several services in the telecom field have recently shot forward, with wireless communications among them. In contrast to this rapid growth, the capacity of service providers remains severely restricted, causing interruption or loss of calls. Due to the limited number of frequencies available, the service provider divides the area into cells, thereby constructing a wireless network in which each frequency can be reused over different parts. The initial assignment of frequencies to certain cells of the network is carefully planned to optimise average performance. But while this assignment remains fixed, the dynamics of call requests may vary strongly-for example, due to subscriber movement. It appears that optimal frequency assignment would be dynamic, requiring the prediction of future call behaviour.

The paper investigates the dynamics of calls over the network, given subscriber dynamics. It concludes that the distribution of calls over the network follows a simple form of Poisson point process. The paper further asserts that call length influences this distribution in a limited way. Both simplicity of call distribution and its insensitivity to call length appear to be valuable properties in this perfectly dynamic environment. As such, this characterisation seems to be a suitable tool for use in further research.

Aljaz Ule and Richard Boucherie (UvA), "On the distribution of calls in a wireless network driven by fluid traffic" TI 00-052/4

The minimum wage paradox

Coen Teulings (EUR, TI)

Most empirical research shows that the disemployment effects of an increase in minimum wages are modest (Card and Krueger, 1995). At the same time, recent research has shown that the minimum wage has a substantial impact on the wage distribution (Teulings, 1998; Lee, 1999). These two facts can only be made consistent when the elasticities of substitution between types of labour are low – so that a small disemployment effect has a large effect on relative wages. Standard empirical studies do not find such low elasticities. These standard studies are flawed, however. They aggregate types of labour in a small number of classes. Workers within each class are considered to be perfect substitutes. In contrast, if we allow the substitution process to work more smoothly, where the substitutability between two worker types declines gradually with the difference in their skill level, then we can account for this paradox. The empirical results for the US, using this smooth substitution process, show large spillovers of an increase in the minimum wage to wage levels slightly above the minimum: a 10% increase in the minimum raises these wages by 6-9%. These spillovers range from equal wage levels to those twice the minimum wage. The strength of this mechanism is such that the 40% decrease in the minimum wage in the US during 1980s can explain almost all of the rise in wage inequality in the lower half of the distribution, consistent with the findings of Lee (1999).

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WTO and the failure of Seattle

Michiel Keyzer (VU)

Late in 1999, the World Trade Organization (WTO) held its Third Ministerial Conference in Seattle. Although the conference was supposed to set the agenda for a new round of multilateral trade negotiations, the participants failed to reach agreement. The paper discusses the causes of the failure, reviews the most contentious issues and assesses the consequences for the WTO’s future. Among the main reasons for the conference’s failure, the paper mentions unfortunate timing, inadequate consultation procedures in dealing with the increased number of participants and the complexity of the negotiations. In addition, many participants
were and are still involved in parallel negotiations on regional alliances that conflict in part with the proposed WTO agenda. Contentious issues went beyond the usual quarrels about reduction of agricultural protectionism in the EU and Japan and the further liberalisation of the service sectors. Also on the table were questions of how to deal with the emergence of consumer concerns (labelling), vertical integration of firms, and increased market power of multinationals due to concentration. It is argued that in this changing environment, the WTO will have to define more clearly the various roles it might assume. It could, for example, be an advisor on international competition code and rules for labelling. It could act as a convener for round table meetings that also involve the critics of the WTO-system, thereby helping to bridge the gap between developed and developing world. The WTO could also serve as an initiator of new legislation – especially in the field of an improved and expanded settlement of disputes with better enforcement mechanisms. But the actual political power will presumably remain with its members, and elevation to the position of super-cop of international trade is most unlikely.

M.A. Keyzer

Evolutionary game theory

This thesis focuses on how the boundedly rational behaviour of individual economic agents effects the (large) population of agents as a whole. It gives insight into the aggregation problem that lies at the basis of providing micro foundations for macroeconomic models. The core question: will the population be led to a Nash equilibrium, and which of several Nash equilibria will most probably be observed in the long run? The main insight is thus the way in which economic systems may evolve toward certain equilibria. The applied methods lie in the field of evolutionary game theory; rather than forming rational expectations, agents act according to certain rules-of-thumb. The players compete with one another, which yields evolutionary selection on both the level of actions played and behavioural rules applied. In addition to selection, an important role is played by the administration of occasional errors by the players: the “mutations”. These prevent the system from becoming stuck indefinitely in certain states.

M.A. Keyzer
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Managing risk

For many financial institutions – including banks, pension funds, and insurance companies – the ability to meet their financial obligations is of crucial importance. Their assets should eventually be sufficient to cover liabilities. At the same time, most financial institutions also want to minimize the costs of funding the liabilities by investing a part of their wealth in risky assets, like stocks. Hence the high relevance of asset liability management, which looks for optimal investment strategies and financing policies, while making a trade-off between the risk of not meeting the liabilities and the cost of funding.

In reality, many financial institutions operate in a changing environment. Therefore, optimal dynamic investment strategies and financing policies are of particular interest. Using a financial economic model and a dynamic programming model, one can show that an optimal investment portfolio should consist of three funds: the riskless asset, the market portfolio (consisting of risky assets), and a hedge portfolio (consisting of the riskless asset, the market portfolio (consisting of risky assets), and a hedge portfolio for the inflation rate (and any other major factor that affects the liabilities). Stochastic programming seems to be an interesting technique for studying optimal dynamic investment strategies under additional market imperfections, such as transaction costs and trading restrictions. However, due to high sensitivity to the quality of input, it requires much care in scenario generation. The thesis studies an option hedging problem, as an example of applying this method. Here, the goal is to find the optimal trading strategy of a firm that sold an option on a stock. It turns out that in comparison with traditional methods, such as delta hedging and delta-vega hedging, the stochastic programming method can considerably reduce hedging errors and transaction costs.

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